1985

Illinois Turfgrass Research Report

Department of Horticulture and
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University of Illinois at Urbana-Champaign

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Forward

This report presents the results for 1985 for turfgrass research projects conducted in Illinois. Contributors to the report include scientists from the Departments of Horticulture and Plant Pathology and the Office of Agricultural Entomology 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.

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, Editor

David Wehner, Associate Editor

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

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.

TABLE OF CONTENTS

Page

USDA NATIONAL KENTUCKY BLUEGRASS TRIAL

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

INTRODUCTION

Kentucky bluegrass (Poa pratensis) is the primary turfgrass used for home lawns in most of Illinois. The many available cultivars of Kentucky bluegrass differ considerably in characteristics such as quality, color, density, texture, stress tolerance, resistance to disease and insect infestation. The turf program at the University of Illinois is one of 35 participants in a nationwide Kentucky bluegrass evaluation trial. This evaluation examined the long term performance of 84 Kentucky bluegrass cultivars under a variety of environmental conditions and cultural programs. At the Urbana research facility a trial has been established on a silt loam soil. A duplicate trial was established on a pure sand soil at our Kilbourne facility. This trial was completed during the 1984 growing season.

MATERIALS AND METHODS

The Urbana evaluation was established 15 September 1980. Plot size is 5 x 6 feet and each cultivar is replicated 3 times. Prior to establishment, the area was fertilized with 1 lb N/1000 sq ft (12-12-12). After seeding, plots were covered with Soil Guard, a synthetic spray mulch, and irrigated as needed. In 1981 the area received a total of 4 lb N/1000 sq ft (12-12-12) and in 1982 the area was fertilized with a total of 3 lb N/1000 sq ft (18-5-9). During the 1983 and 1984 growing season the area was treated with 4 lb N/1000 sq ft (18-5-9). During 1985 the evaluation was fertilized with 2 lbs N/1000 sq ft. No preemergence crabgrass control herbicide was used in 1983 through 1985. The area was irrigated as needed to prevent wilt.

In 1983 half of each 6 x 5 foot plot was treated with the growth retardant amidochlor (Limit) at a rate of 2.0 lb ai/A. In 1984 and 1985 the same half of each plot was treated with 2.5 lb ai/A of amidochlor. This was to determine any differences in response to the growth regulator among the cultivars. The turf was allowed to grow for 2 weeks without mowing. Turfgrass height and seedhead production were evaluated. The results of this investigation are listed in the report "Kentucky Bluegrass Response to the Application of Limit, a Plant Growth Retardant", page

RESULTS

During 1983 turfgrass quality was fair to good with quality the highest during June and September. Although the plots were irrigated, quality declined during July and August because of heat and drought stress. Several cultivars that did not recover from the stress are Lovegreen, Charlotte, Dormie, and S-21. Cool weather pythium affected the early spring performance of many varieties. Varieties exhibiting the greatest susceptibility to pythium were Piedmont, Wabash, K3-162, S. D. Common, Kenblue and Monopoly. Dollar spot disease was a problem in late July. The cultivars A20-6A, A20-6, Escort, Harmony, Charlotte, Nugget, and Dormie showed the most injury from this disease.

Turfgrass cultivars differed widely in their performance throughout the 1984 growing season. In general, turfgrass quality was fair to excellent with quality the highest during April and June. Good quality was maintained throughout the summer. There were no major disease problems during 1984.

In 1985 quality was evaluated on 2 dates only (Table 1). In general, turfgrass quality was fair to good with some deterioration from April to July.

This 1980 Urbana evaluation was replaced with a new Kentucky bluegrass evaluation established in the fall of 1985 at Urbana. The 72 cultivars included in this evaluation can be found in Table 2.

Table 1. The evaluation of Kentucky bluegrass cultivars during the 1985 growing season.[1]

Cultivar	Quality[2]		Cultivar	Quality[2]	
	4/23	7/15		4/23	7/15
I-13	9.0a	7.3ab	Trenton	7.7a-c	5.0d-i
Mystic	7.7a-c	7.7a	K3-162	6.0c-h	6.3a-e
H-7	8.0ab	7.0a-c	Mosa	6.0c-h	6.3a-e
Monopoly	8.0ab	6.7a-d	Plush	6.0c-h	6.3a-e
Eclipse	7.0b-e	7.7a	Sydsport	6.7b-f	5.7b-g
PSU-173	7.3a-d	7.3ab	A-34	6.7b-f	5.7b-g
A20-6A	7.7a-c	6.7a-d	239	7.0b-e	5.0d-i
SH-2	7.3a-d	7.0a-c	Cello	7.0b-e	5.0d-i
A20-6	7.7a-c	6.7a-d	Vantage	6.3b-g	5.7b-g
WW AG 480	8.0ab	6.3a-e	K1-152	6.7b-f	5.3c-h
PSU-150	7.0b-e	7.3ab	Ram-1	6.7b-f	5.3c-h
CEB VB 3965	7.0b-e	7.0a-c	Argyle	5.7d-i	6.0a-f
Enmundie	7.0b-e	7.0a-c	Columbia	7.3a-d	4.3f-j
K3-179	7.0b-e	7.0a-c	NJ 735	7.3a-d	4.3f-j
Wabash	7.0b-e	6.7a-d	Rugby	7.3a-d	4.3f-j
Adelphi	7.0b-e	6.7a-d	Merion	6.0c-h	5.7b-g
Birka	7.3a-d	6.3a-e	Shasta	7.0b-e	4.7e-j
Bono	7.0b-e	6.0a-f	Parade	6.0c-h	5.3c-h
Glade	6.0c-h	7.0a-c	Barblue	7.0b-e	4.3f-j
Escort	7.7a-c	5.3c-h	Holiday	6.7b-f	4.7e-j
Piedmont	6.7b-f	6.3a-e	Cheri	6.3b-g	5.0d-i
Geronimo	7.0b-e	6.0a-f	America	5.0f-j	6.3a-e
WW AG 478	5.3e-i	7.7a	Bonnieblue	7.0b-e	4.3f-j
A20	7.0b-e	5.7b-g	Nugget	4.7g-j	6.7a-d
Vanessa	6.0c-h	6.7a-d	Midnight	6.3b-g	5.0d-i
WW AG 463	7.3a-d	5.3c-h	Victa	5.0f-j	6.3a-e
Mona	7.0b-e	5.7b-g	K3-178	7.0b-e	4.0g-j
PSU-190	6.7b-f	6.0a-f	Aspen	5.7d-i	5.3c-h
Admiral	6.7b-f	6.0a-f	Banff	6.3b-g	4.3f-j
225	6.7b-f	6.0a-f	Bristol	6.3b-g	4.3f-j
Majestic	6.0c-h	4.7e-j	N535	5.7d-i	4.3f-j
Kimono	6.0c-h	4.3f-j	BA-61-91	5.0f-j	5.0d-i
Merit	4.3h-j	6.0a-f	Kenblue	5.0f-j	5.0d-i
SV-01617	5.7d-i	4.7e-j	Enoble	5.3e-i	4.7e-j
MER PP 300	4.3h-j	5.7b-g	MLM-18011	5.7d-i	4.3f-j

(continued)

Table 1. The evaluation of Kentucky bluegrass cultivars during the 1985 growing season (continued).[1]

Cultivar	Quality[2] 4/23	Quality[2] 7/15	Cultivar	Quality[2] 4/23	Quality[2] 7/15
Fylking	5.7d-i	4.0g-j	Touchdown	6.0c-h	3.3ij
Bayside	5.3e-i	4.3f-j	Charlotte	5.0f-j	4.3f-j
Harmony	4.3h-j	5.3c-h	Lovegreen	5.0f-j	4.0g-j
Baron	5.0f-j	4.7e-j	243	4.3h-j	4.7e-j
Dormie	4.7g-j	4.7e-j	S-21	4.3h-j	4.3f-j
S.D. Common	4.0ij	4.3f-j	Welcome	3.3j	4.3f-j
Apart	4.0ij	3.7h-j	MER PP 43	4.0ij	3.0j
$LSD_{0.05}$	1.7	1.8		1.7	1.8

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

Table 2. The 1985 national Kentucky bluegrass cultivar evaluation.

Cultivar	Sponsor	Cultivar	Sponsor
Classic	Peterson Seed Company	Parade	Van Der Have Oregon
Monopoly	Peterson Seed Company	Asset	Van Der Have Oregon
Barzan	Mount Emily Seeds	HV 97	Pure-Seed Testing
Gnome	Turf Merchants, Inc.	Lofts 1757	Loft's Seed, Inc.
Tendos	Turf Merchants, Inc.	Cheri	Jacklin Seed Co.
P-104	Loft's Seed Inc.	Eclipse	Turf Cultivar Assoc.
Ram-1	Jacklin & Loft's Seed	Liberty	Garfield-Williamson
Compact	Tib Szego Associates	Destiny	Jonathan Green & Son
Joy	Green Seed Company	Dawn	LESCO, Inc.
Sydsport	E. F. Burlingham	Merion	-----
Haga	E. F. Burlingham	Nassau	Jacklin & Loft's Seed
Georgetown	Loft's Seed, Inc.	Amazon	Jacklin Seed Co.
Somerset	Loft's Seed, Inc.	239	Jacklin & Loft's Seed
Mystic	Loft's Seed, Inc.	Wabash	Jacklin Seed Co.
Baron	Loft's Seed, Inc.	Julia	Jacklin Seed Co.
Able I	Warren's Turf Nursery	Ikone	L. C. Nungessor
A-34	Warren's Turf Nursery	Glade	Jacklin Seed Co.
Merit	Full Circle, Inc.	Huntsville	Jacklin Seed Co.
BAR VB 577	Barenbrug Holland	F-1872	Jacklin Seed Co.
Annika	Production Services	Aquila	Northrup King Co.
Conni	Production Services	K1-152	Northrup King Co.
Kenblue	------	Harmony	Rothwell Seeds
Bristol	O. M. Scott & Sons	Welcome	Rothwell Seeds
Victa	O. M. Scott & Sons	Aspen	Northrup King Co.
Ba 70-139	O. M. Scott & Sons	Rugby	Northrup King Co.
Ba 70-242	O. M. Scott & Sons	Trenton	Northrup King Co.
Ba 72-441	O. M. Scott & Sons	K3-178	Northrup King Co.
Ba 72-492	O. M. Scott & Sons	Midnight	Turf-Seed, Inc.
Ba 72-500	O. M. Scott & Sons	Challenger	Turf-Seed, Inc.
Ba 73-626	O. M. Scott & Sons	Blacksburg	Turf-Seed, Inc.
BAR VB 534	Barenbrug Holland	PST-CB1	Pure-Seed Testing
Cynthia	Van Der Have Oregon	South Dakota Cert.	------
NE 80-88	Univ. of Nebraska	WW Ag 468	E. F. Burlingham
America	Pickseed West	WW Ag 491	E. F. Burlingham
Ba 69-82	O. M. Scott & Sons	WW Ag 495	E. F. Burlingham
Ba 73-540	O. M. Scott & Sons	WW Ag 496	E. F. Burlingham

USDA NATIONAL PERENNIAL RYEGRASS CULTIVAR EVALUATION AT URBANA

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

INTRODUCTION

In the past, perennial ryegrass has been included in seed mixtures as a temporary lawn or nursegrass. In Illinois, deterioration of the turf during the summer months has prevented perennial ryegrass from becoming an important permanent turfgrass. Improved varieties with better color, density, mowing quality, and disease resistance have challenged the traditional image of perennial ryegrass. The turf program at the University of Illinois is participating in a USDA national perennial ryegrass test. 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 8 September 1982, includes 50 perennial ryegrass cultivars, some that are experimental and others that are commercially available (Table 1). Plots measure 5 x 6 feet and each cultivar is replicated 3 times. All plots are mowed at 2.0 inches. During the 1983 and 1984 growing seasons the turf received 4 lb N/1000 sq ft/year (18-5-9) and during 1985 the turf was fertilized with 2 lb N/1000 sq ft. The ryegrass is irrigated as needed to prevent wilt.

RESULTS

In 1983, early spring density evaluations reflected turf resistance to cool weather pythium and injury from winter stress. Density, for most cultivars, was generally poor to fair with Gator, Blazer, NK 80389, Fiesta, and Manhattan/Blazer being the most dense. Cultivars performed the best in spring and fall with the highest quality observed in November. Although the plots were irrigated, several cultivars performed very poorly during drought stressed August. They include Elka, Cupido, Pippin and Linn.

In early spring of 1984 snow mold was a problem for the perennial ryegrass turf. Many cultivars, including Acclaim, Crown, Cupido, Regal, Fiesta, Linn,and the experimental varieties IA 728, 2EE, HE168, NK 79307, and HE178 were especially hard hit by the disease. Perennial ryegrass quality was highest during May, June and September. As in 1983, turfgrass quality deteriorated during the month of August.

In 1985 red thread was a problem in late July. Cultivars with an average red thread rating lower than 4.0 (indicating high susceptibility) were HR1, Fiesta, M 382, Yorktown, Ranger, Elka, NK 80389, Pippin, Premier, Dasher, and Omega (Table 1). Perennial ryegrass quality was lowest during July and

August. In general overall quality ratings for the 1985 growing season were lower than 1984.

Table 1. Evaluation of perennial ryegrass cultivars during the 1985 growing season.[1]

Cultivar	All Dates[2]	Quality[3] 4/19	5/23	7/10	8/30	9/26	Red Thread[4] 7/23
Manhattan II/Blazer	5.9a	6.7ab	6.0a-c	4.3a-d	5.0a	7.7ab	4.3d-i
IA 728	5.8ab	6.3a-c	6.0a-c	5.3a	4.7ab	6.7b-e	5.7a-e
SWRC-1	5.7a-c	6.0a-d	5.7b-d	5.0ab	4.3a-c	7.3a-c	4.3d-i
HR-1	5.7a-c	6.7ab	5.3c-e	4.3a-d	4.3a-c	7.7ab	3.7f-j
Gator	5.6a-d	7.0a	6.3ab	4.0b-e	3.7c-e	7.0a-d	4.0e-j
GT II	5.6a-d	6.3a-c	6.3ab	4.3a-d	3.7c-e	7.3a-c	4.7c-h
Fiesta	5.6a-d	6.7ab	5.7b-d	3.7c-f	5.0a	7.0a-d	3.7f-j
282	5.5a-d	6.3a-c	5.7b-d	4.3a-d	4.3a-c	7.0a-d	5.0b-g
Palmer	5.5a-d	5.7b-e	6.0a-c	4.3a-d	4.3a-c	7.3a-c	4.7c-h
M 382	5.5a-d	5.7b-e	5.7b-d	3.7c-f	4.7ab	8.0a	3.7f-j
Fiesta/Manhattan II	5.5ad	5.7b-e	5.3c-e	4.7a-c	5.0a	7.0a-d	4.0e-j
Pennant	5.5a-d	6.0a-d	5.7b-d	4.3a-d	4.7ab	7.0a-d	5.0b-g
Acclaim	5.5a-e	6.3a-c	5.3c-e	4.3a-d	4.7ab	6.7b-e	5.3a-f
Prelude	5.4a-f	7.0a	5.3c-e	4.3a-d	4.0b-d	6.3c-e	5.7a-e
BT I	5.7a-f	6.3a-c	6.7a	4.0b-e	3.3de	6.7b-e	4.7c-h
HE178	5.3b-g	5.3c-e	5.7b-d	4.0b-e	4.7ab	7.0a-d	4.3d-i
Premier	5.3b-g	6.3a-c	5.0d-f	4.0b-e	4.7ab	6.7b-e	3.7f-j
LP 210	5.3b-g	6.0a-d	6.0a-c	4.3a-d	3.7c-e	6.7b-e	5.3a-f
Prelude/Blazer	5.3b-g	5.7b-e	5.7b-d	4.0b-e	4.3a-c	7.0a-d	4.3d-i
LP 792	5.3b-g	5.0de	5.3c-e	4.3a-d	4.3a-c	7.3a-c	4.0e-j
Blazer	5.3b-g	6.3a-c	5.7b-d	4.0b-e	3.3de	7.0a-d	4.0e-j
Manhattan	5.3b-g	6.0a-d	5.7b-d	4.0b-e	4.0b-d	6.7b-e	4.0e-j
Diplomat	5.3b-g	6.0a-d	6.0a-c	4.0b-e	3.3de	7.0a-d	4.7c-h
HE 168	5.2c-h	5.3c-e	5.7b-d	4.3a-d	3.7c-e	7.0a-d	5.0b-g
LP 702	5.2c-h	5.7b-e	5.7b-d	4.3a-d	3.3de	7.0a-d	4.7c-h
Dasher	5.2c-h	6.0a-d	5.3c-e	4.0b-e	4.0b-d	6.7b-e	3.0h-j
Derby	5.2c-h	6.0a-d	5.5.0d-f	4.7a-c	4.0b-d	6.3c-e	4.7c-h
Yorktown	5.2c-h	5.7b-e	5.7b-d	3.7c-f	3.7c-e	7.3a-c	3.3g-j
WWE 19	5.2c-h	6.3a-c	6.0a-c	4.3a-d	3.3de	6.0d-f	5.7a-e
2 ED	5.2c-h	6.0a-d	5.3c-e	4.0b-e	4.0b-d	6.7b-e	5.7a-e
2EE	5.2c-h	6.0a-d	5.0d-f	4.3a-d	4.0b-d	6.7b-e	6.7ab
Omega	5.2c-h	6.0a-d	5.7b-d	4.0b-e	3.7c-e	6.7b-e	3.7f-j
Delray	5.2c-h	5.3c-e	5.0d-f	4.7a-c	4.7ab	6.3c-e	6.7ab
Manhattan II	5.1c-h	5.7b-e	5.3c-e	3.7c-f	4.0b-d	7.0a-d	4.3d-i
LP 736	5.1c-h	5.7b-e	5.3c-e	3.3d-f	4.3a-c	7.0a-d	4.3d-i

(continued)

Table 1. Evaluation of perennial ryegrass cultivars during the 1985 growing season (continued).[1]

Cultivar	All Dates[2]	Quality[3] 4/19	5/23	7/10	8/30	9/26	Red Thread[4] 7/23
Regal	5.1c-h	5.7b-e	4.3fg	4.7a-c	4.7ab	6.3c-e	6.0a-d
Cupido	5.1d-h	5.7b-e	5.7b-d	4.3a-d	3.3de	6.3c-e	4.3d-i
Crown	5.1d-h	5.3c-e	5.3c-e	4.0b-e	4.3a-c	6.3c-e	4.7c-h
Pennfine	5.1d-h	5.7b-e	5.0d-f	4.3a-d	4.0b-d	6.3c-e	6.3a-c
Cigil	5.1d-h	5.7b-e	5.7b-d	4.0b-e	3.7c-e	6.3c-e	4.3d-i
Ranger	5.1d-h	6.3a-c	6.3ab	3.3d-f	3.0ef	6.3c-e	3.3g-j
Barry	4.9e-h	6.3a-c	4.7e-g	3.7c-f	3.3de	6.7b-e	5.0b-g
Cockade	4.9e-h	5.3c-e	5.7b-d	4.0b-e	3.0ef	6.7b-e	4.3d-i
NK 79307	4.9e-h	5.0de	5.0d-f	5.0ab	4.7ab	5.0f	7.0a
Elka	4.9f-i	5.3c-e	5.3c-e	2.7fg	4.0b-d	7.0a-d	2.3j
NK 80389	4.8g-i	5.0de	5.3c-e	3.0e-g	3.7c-e	7.0a-d	2.7ij
NK 79309	4.7hi	5.0de	4.3fg	4.0b-e	4.3a-c	5.7ef	6.3a-c
Citation	4.3ij	5.3c-e	4.0g	3.7c-f	3.7c-e	5.0f	6.3a-c
Pippin	3.9j	4.7e	5.3c-e	3.3d-f	2.3f	3.7g	2.7ij
Linn	1.9k	3.0f	2.0h	2.0g	1.0g	1.7h	4.3d-i
$LSD_{0.05}$	0.6	1.0	0.9	1.1	1.0	1.1	2.0

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

[2]Values represent the mean of 15 scores obtained from 3 replications and 5 evaluation dates.

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

[4]Disease evaluations are made on a 1-9 scale where 9 = no visible evidence of disease and 1 = complete necrosis.

USDA NATIONAL FINE FESCUE CULTIVAR EVALUATION

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

INTRODUCTION

Fine fescue is a term generally used to refer to several fine leaf turfgrasses of the Festuca genus. Fine fescues include red or creeping fescue (Festuca rubra), chewings fescue (Festuca rubra var. commutata), sheeps fescue (Festuca ovina), and hard fescue (Festuca ovina var. duriuscula). Red fescue performs well as a turfgrass under shade and has a stoloniferous habit. Chewings, sheeps, and hard fescue grow well in sunny dry areas as low maintenance turfs. These fescues have a bunch type growth habit. New cultivars have been developed to improve the adaptability and quality of the fineleaf fescues. The University of Illinois turf program is participating in the USDA national fineleaf fescue test. This test evaluates the performance of 47 cultivars of creeping red, chewings, sheep, and hard fescue in central Illinois (Table 1). Identical tests have been established at other universities nationwide to examine the cultivars under a broad range of climates and cultural programs.

MATERIALS AND METHODS

The Urbana trial, established 27 September 1983, includes 47 fineleaf fescue cultivars, some that are experimental and others that are commercially available. Plots measure 5 x 6 feet and each cultivar is replicated 3 times. Plots were seeded at 3.6 lb seed per 1000 sq ft (50 grams seed/30 sq ft). Prior to seeding the area was fertilized with 1 lb N/1000 sq ft (18-9-5). The seeded area was covered with a straw mulch that was removed when the seedlings emerged. In 1984 the area was fertilized with 18-5-9 at 4 lb N/1000 sq ft and in 1985 the area received 2 lb N/1000 sq ft. In 1984 the turf was treated several times with a fungicide to control leaf spot and irrigated as needed to prevent wilt. It should be noted that the evaluation site is in full sun. This might effect the performance of the creeping red fescue cultivars which are better adapted to light or medium shade.

RESULTS

In 1984 fineleaf fescue quality was highest in May and steadily declined over the growing season. Helminthosporium leaf spot appeared in late June and remained a problem throughout the summer although the area was treated with fungicides. Cultivars less effected by the disease were Epsom, Aurora, Enjoy and the experimental varieties FRI-FRT-83-1, BAR FO 81-225, and 4LS.

During 1985 quality was highest in April and July. Throughout the season, the chewings fescues, Longfellow and 4FL consistently exhibited good quality with the exception of August quality.

Over the years the plots will be further evaluated for quality, disease resistance, density, cold tolerance and drought tolerance.

Table 1. USDA fineleaf fescue cultivars.

Chewings fescue		
Atlanta	Epsom	Magenta
Banner	HF 9-3	Mary
Beauty	Highlight	Shadow
Center	Ivalo	Tamara
CF-2	Jamestown	Tatjana
Checker	Koket	Waldorf
Enjoy	Longfellow	Wilma
4FL		
Creeping red fescue		
Boreal	Flyer	Ruby
Ceres	Lovisa	Wintergreen
Commodore	Pennlawn	430
Ensylva	Pernille	
Estica	Robot	
Hard fescue		
Aurora	Reliant	ST-2
BAR Fo 81-225	Scaldis	Valda
Biljart	Spartan	Waldina
Sheeps fescue		
4LS		
Unknown fescue species		
FRI-Frt 83-1		
entry no. 47		

Table 2. Evaluation of fine fescue cultivars during the 1985 growing season.[1]

Cultivar	All Dates[2]	Quality[3] 4/18	5/23	7/10	8/30	9/26
Longfellow	6.5a	7.7a	6.3a	7.0a	4.7ab	7.0a
4FL	6.1ab	7.0a-c	5.7ab	7.0a	5.3a	5.7ab
Enjoy	5.5bc	6.3a-e	5.7ab	6.7ab	4.7ab	4.3b-e
Pernille	5.3b-d	7.0a-c	5.7ab	6.0a-d	3.0d-g	4.7b-d
Tamara	5.3b-d	6.7a-d	5.3a-c	6.3a-c	3.0d-g	5.0bc
Mary	5.1c-e	6.7a-d	5.3a-c	5.7a-e	4.0b-d	4.0c-f
CF-2	5.1c-e	6.0b-f	5.3a-c	6.0a-d	4.3a-c	4.0c-f
HF 9-3	4.9c-f	6.3a-e	6.3a	5.7a-e	3.3c-f	2.7f-i
Shadow	4.9c-f	6.0b-f	4.3c-f	5.7a-e	3.7b-e	4.7b-d
Koket	4.7c-g	6.3a-e	4.7b-e	5.0c-g	3.3c-f	4.3b-e
Aurora	4.7c-g	5.3d-h	5.0b-d	5.7a-e	4.3a-c	3.3d-h
Waldorf	4.7c-g	5.7c-g	5.0b-d	5.7a-e	3.3c-f	4.0c-f
Banner	4.5d-h	5.7c-g	4.3c-f	4.7d-h	3.0d-g	4.7b-d
Center	4.5d-h	5.7c-g	4.3c-f	5.0c-g	3.7b-e	3.7c-g
Biljart	4.4d-i	6.3a-e	4.3c-f	4.3e-i	4.0b-d	3.0e-h
Reliant	4.3e-j	5.3d-h	4.7b-e	5.0c-g	3.7b-e	3.0e-h
Ceres	4.3e-j	5.7c-g	4.0d-g	4.0f-j	3.7b-e	4.3b-e
FRI-FRT 83-1	4.3e-j	7.3ab	5.7ab	4.7d-h	1.7hi	2.3g-i
BAR FO 81-225	4.3e-j	6.3a-e	4.3c-f	4.0f-j	4.0b-d	3.0e-h
Spartan	4.2f-j	5.3d-h	4.7b-e	4.7d-h	3.7b-e	2.7f-i
Atlanta	4.2f-j	5.0e-h	3.3f-h	4.7d-h	3.7b-e	4.3b-e
Epsom	4.2f-j	5.7c-g	5.3a-c	5.3b-f	2.3f-i	2.3g-i
Magenta	4.1f-k	5.3d-h	4.3c-f	4.7d-h	3.3c-f	3.0e-h
Boreal	4.1f-k	6.0b-f	4.7b-e	4.3e-i	2.7e-h	3.0e-h
4LS	4.1f-l	4.0h	4.0d-g	4.7d-h	4.0b-d	3.7c-g
Jamestown	4.1f-l	6.0b-f	4.3c-f	5.0c-g	2.3f-i	2.7f-i
Estica	4.0f-m	6.0b-f	4.3c-f	5.0c-g	2.0g-i	2.7f-i
Beauty	4.0f-m	5.0e-h	4.3c-f	5.0c-g	3.0d-g	2.7f-i
Flyer	3.9g-n	5.7c-g	3.7e-h	5.0c-g	2.0g-i	3.3d-h
Unknown	3.9g-n	6.3a-e	3.3f-h	3.7g-j	2.7e-h	3.3d-h
Ensylva	3.9g-n	6.0b-f	4.7b-e	4.3e-i	2.3f-i	2.0hi
Robot	3.7h-n	4.7f-h	3.3f-h	3.3h-j	3.0d-g	4.3b-e
430	3.7h-n	6.0b-f	4.0d-g	4.0f-j	1.3i	3.0e-h
Ruby	3.7h-n	5.0e-h	3.3f-h	3.3h-j	2.7e-h	4.0c-f
Waldina	3.6h-n	5.0e-h	3.3f-h	3.3h-j	3.7b-e	2.7f-i

(continued)

Table 2. Evaluation of fine fescue cultivars during the 1985 growing season (continued).[1]

Cultivar	All Dates[2]	Quality[3] 4/18	5/23	7/10	8/30	9/26
ST-2	3.5i-n	4.7f-h	4.0d-g	2.7j	3.0d-g	3.3d-h
Valda	3.5i-n	4.7f-h	3.7e-h	3.3h-j	3.0d-g	3.0e-h
Checker	3.5j-o	5.3d-h	3.7e-h	4.0f-j	2.0g-i	2.3g-i
Wilma	3.5j-o	4.3gh	4.0d-g	3.0ij	3.0d-g	3.0e-h
Commodore	3.5j-o	4.7f-h	2.7h	3.0ij	3.3c-f	3.7c-g
Scaldis	3.5j-o	4.7f-h	3.0g-h	3.0ij	3.7b-e	3.0e-h
Highlight	3.3k-o	4.7f-h	3.3f-h	3.0ij	2.7e-h	2.7f-i
Lovisa	3.2l-o	4.0h	3.3f-h	4.0f-j	2.3f-i	2.3g-i
Tatjana	3.1no	4.7f-h	3.7e-h	3.7g-j	1.7hi	2.0hi
Ivalo	3.0no	5.3d-h	3.0gh	3.0ij	2.0g-i	2.0hi
Pennlawn	3.1no	5.0e-h	3.0gh	3.3h-j	2.0g-i	2.0hi
Wintergreen	2.6o	4.3gh	3.0gh	2.7j	1.7hi	1.3i
$LSD_{0.05}$	0.9	1.3	1.2	1.3	1.1	1.4

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

[2]Values represent the mean of 15 scores obtained from 3 replications and 5 evaluation dates.

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

TALL FESCUE CULTIVAR EVALUATION UNDER TWO MAINTENANCE LEVELS

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

INTRODUCTION

In Illinois, tall fescue (Festuca arundinacea) is primarily used on low maintenance sites like roadways and playgrounds. Tall fescue has excellent heat, drought and wear tolerance but a coarse texture prevents its use in areas where a high quality turf is needed and a bunch type growth habit prevents its use in mixtures with other turf species. Improved "turf" type tall fescue cultivars with finer texture and improved cold tolerance have recently been introduced.

MATERIALS AND METHODS

In order to examine the performance of these "turf" type tall fescue cultivars, an evaluation trial was established in Urbana, 20 September 1982. The trial contains 21 "turf type" tall fescue cultivars (experimental and commercially available), one "forage type" (K-31), five tall fescue-Kentucky bluegrass mixes, two tall fescue-perennial ryegrass mixes and one tall fescue blend. Plot size is 5 x 6 feet and each cultivar is replicated three times. The trial is duplicated in order to evaluate the cultivars at two levels of cultural maintenance. Under maintenance level I, the turf is not irrigated. During 1983 and 1984, it was fertilized only once in the fall with 1 lb N/1000 sq ft (18-5-9). Under maintenance level II, the turf is irrigated. During 1983 and 1984 it was fertilized four times per year with 1 lb N/1000 sq ft (18-5-9). During 1985 turf under maintenance level I received no nitrogen fertilization and turf under maintenance level II received 2 lb N/1000 sq ft. All turf is maintained at a 2.5 inch height of cut.

RESULTS

In 1984, despite high temperatures and droughty conditions, tall fescue performance was good for those cultivars maintained without irrigation. The exceptions to this were the tall fescue-perennial ryegrass mixes. Quality was highest during May and June and deteriorated slightly in late summer. Plots maintained with irrigation and high fertilization exhibited excellent quality throughout the summer, although there was a slight decline in performance in late August.

In 1985 growing conditions for tall fescue were excellent. Turf quality under both maintenance levels was good to superior throughout the year (Table 1 and Table 2). The quality of tall fescue grown under maintenance level I was lowest in July (Table 1). The quality of tall fescue grown under the high maintenance level fluctuated very little from month to month throughout the season (Table 2).

Table 1. Evaluation of tall fescue cultivars during the 1985 growing season, maintained with no irrigation and low fertilization.[1]

Cultivar	All Dates[2]	Quality[3] 4/22	5/14	7/11	8/23	9/25
5 M4-82	8.1a	7.3a-c	7.3ab	8.0a	9.0a	9.0a
Jaguar	7.7b	7.3a-c	7.7a	7.3ab	7.7bc	8.3ab
Olympic	7.5bc	7.7ab	7.7a	7.0bc	7.7bc	7.7b-d
Rebel/Bonnieblue 90/10	7.5bc	7.7ab	7.0bc	7.0bc	7.7bc	8.0bc
Olympic + 5% PST 483	7.5bc	7.7ab	7.7a	7.0bc	7.3b-d	7.7b-d
Rebel	7.5bc	7.3a-c	7.0bc	7.0bc	8.0b	8.0bc
Falcon	7.4b-d	7.3a-c	7.0bc	7.0bc	8.0b	7.7b-d
Mustang	7.3b-e	6.7cd	7.3ab	7.0bc	7.7bc	8.0bc
Rebel/Baron 90/10	7.3b-e	7.0b-d	7.0bc	7.0bc	7.7bc	8.0bc
Rebel/Newport 90/10	7.3b-e	7.3a-c	7.0bc	7.3ab	7.3b-d	7.7b-d
K 82142	7.3b-f	7.0b-d	7.0bc	7.3ab	7.3b-d	7.7b-d
K 79628	7.3b-f	7.0b-d	7.0bc	7.3ab	7.7bc	7.3c-e
SYN GA	7.3b-f	7.0b-d	7.0bc	6.7b-d	7.3b-d	8.3ab
52 H	7.3b-f	7.3a-c	7.0bc	7.0bc	7.0c-e	8.0bc
ISI BK 2	7.2c-g	8.0a	7.0bc	6.7b-d	6.7d-f	7.7b-d
Houndog	7.2c-g	6.7cd	7.0bc	7.0bc	7.3b-d	8.0bc
52 W	7.2c-g	7.3a-c	7.7a	6.0d-f	6.7d-f	8.3ab
Marathon	7.1c-g	7.3a-c	7.0bc	7.0bc	7.0c-e	7.3c-e
Olympic + 10% PST 483	7.1c-g	7.3a-c	6.7cd	7.0bc	6.7d-f	8.0bc
Rebel/Fiesta 50/50	7.1c-g	8.0a	7.0bc	5.7ef	7.0c-e	8.0bc
Clemfine	7.0d-g	7.0b-d	7.0bc	6.7b-d	7.0c-e	7.3c-e
Galway	6.9e-g	6.7cd	6.7cd	7.0bc	7.0c-e	7.3c-e
Barcel	6.9e-g	7.3a-c	7.3ab	6.7b-d	6.7d-f	6.7e-g
Brookston	6.9e-g	7.0b-d	7.0bc	7.0bc	6.7d-f	7.0d-f
Clemfine/Olympic 50/50	6.9e-g	6.7cd	6.3de	7.0bc	7.7bc	7.0d-f
TF 805	6.9fg	7.3a-c	7.0bc	6.7b-d	6.3e-g	7.0d-f
Rebel/Blazer 50/50	6.8gh	7.0b-d	7.0bc	5.3f	7.0c-e	7.7b-d
K-31	6.4hi	6.3d	6.3de	6.7b-d	6.0f-h	6.7e-g
BEL SYN 22	6.3i	6.7cd	6.0e	6.7b-d	5.7gh	6.3fg
NK 81452	6.2i	6.3d	7.0bc	6.3c-e	5.3h	6.0g
$LSD_{0.05}$	0.4	0.9	0.6	0.7	1.0	0.8

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

[2]Values represent the mean of 15 scores obtained from 3 replications and 5 evaluation dates.

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

Table 2. Evaluation of tall fescue cultivars during the 1985 growing season, maintained with irrigation and high fertilization.[1]

Culitvar	All Dates[2]	Quality[3] 4/22	5/14	7/11	8/23	9/25
Jaguar	8.9a	9.0a	8.7a	9.0a	9.0a	9.0a
5 M4-82	8.9a	9.0a	8.7a	8.7a	9.0a	9.0a
Olympic + 10% PST 483	8.8ab	9.0a	8.7a	8.3ab	9.0a	9.0a
Rebel	8.7a-c	9.0a	8.0a-c	9.0a	9.0a	8.3a-c
Rebel/Newport 90/10	8.7a-c	9.0a	8.0a-c	9.0a	9.0a	8.3a-c
52 H	8.7a-c	9.0a	7.7b-d	9.0a	8.7ab	9.0a
Rebel/Baron 90/10	8.6a-c	8.7a	8.7a	8.7a	8.7ab	8.3a-c
52 W	8.5a-c	8.3ab	8.3ab	8.7a	9.0a	8.3a-c
Olympic + 5% PST 483	8.5a-c	8.7a	8.0a-c	8.7a	9.0a	8.3a-c
Rebel/Bonnieblue 90/10	8.5a-c	9.0a	8.3ab	8.3ab	9.0a	8.0a-d
Olympic	8.5a-c	8.3ab	8.0a-c	8.3ab	9.0a	8.7ab
Falcon	8.3bc	8.7a	8.0a-c	8.7a	8.7ab	7.7b-e
Mustang	8.3cd	9.0a	7.7b-d	8.3ab	8.3a-c	8.0a-d
SYN GA	8.3cd	9.0a	8.0a-c	7.7bc	8.3a-c	8.3a-c
K 82142	7.8de	9.0a	7.3cd	7.3cd	7.3de	8.0a-d
Houndog	7.8de	8.3ab	7.3cd	7.7bc	8.0b-d	7.7b-e
Clemfine/Olympic 50/50	7.8de	8.3ab	7.7b-d	7.7bc	8.0b-d	7.3c-f
TF805	7.8de	8.7a	7.7b-d	7.3cd	8.0b-d	7.3c-f
Marathon	7.7ef	7.7b	7.7b-d	7.3cd	8.0b-d	7.7b-e
Clemfine	7.6e-g	8.3ab	7.0de	7.7bc	7.7c-e	7.3c-f
Brookston	7.6e-g	8.3ab	7.0de	7.0cd	8.3a-c	7.3c-f
Rebel/Fiesta 50/50	7.5e-h	8.7a	6.3ef	7.7bc	7.3de	7.7b-e
ISI BK 2	7.5e-h	8.3ab	7.0de	7.0cd	7.7c-e	7.7b-e
K 79628	7.5e-h	8.3ab	7.3cd	7.3cd	7.7c-e	7.0d-f
NK 81452	7.5e-i	7.7b	7.3cd	7.3cd	7.3de	7.7b-e
BEL SYN 22	7.3f-i	7.7b	7.0de	6.7d	7.7c-e	7.3c-f
Barcel	7.2f-i	8.3ab	7.0de	7.0cd	7.0e	6.7ef
Rebel/Blazer 50/50	7.1g-i	8.3ab	6.0f	7.0cd	7.0e	7.3c-f
Galway	7.1hi	7.7b	7.3cd	7.0cd	7.0e	6.3f
K-31	7.0i	7.7b	7.0de	7.0cd	7.0e	6.3f
$LSD_{0.05}$	0.5	0.8	0.7	0.9	0.8	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]Values represent the mean of 15 scores obtained from 3 replications and 5 evaluation dates.

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

BENTGRASS BLENDS FOR PUTTING GREEN TURF

J. E. Haley and D. J. Wehner

INTRODUCTION

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

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

MATERIALS AND METHODS

All possible two-way blends of the cultivars Penncross, Penneagle, Seaside, and Emerald were established at the Ornamental Horticulture Research Center in Urbana on 21 August 1981. Each blend and the four individual components were established in 6 x 10 ft plots with three replications. The turf is maintained at a 0.25 inch height of cut and irrigated as necessary to prevent wilt. During the 1985 growing season the turf was fertilized with 3.5 lb N/1000 sq ft and was on a preventative fungicide program. The area was lightly topdressed 4 times during the growing season with a 8-1-1 sand - soil - peat mixture.

RESULTS

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

During 1985 the best quality was observed with Penneagle and all blends containing Penneagle (Table 1). 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.

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

Table 1. The evaluation of creeping bentgrass cultivars and blends for the 1985 growing season.[1]

Cultivar/Blend	All Dates[2]	Quality[3] 4/18	5/15	6/10	7/26	8/23	9/24	11/06
Penneagle	8.2a	8.0a	7.0a	8.0a	9.0a	8.7a	9.0a	8.0a
Penncross/Penneagle	7.7ab	7.3ab	6.0bc	7.7ab	8.3a-c	8.3ab	8.7a	7.7ab
Penneagle/Emerald	8.0a	7.0bc	6.7ab	8.0a	9.0a	9.0a	9.0a	7.3a-c
Penneagle/Seaside	7.9a	7.0bc	6.7ab	7.7ab	8.7ab	8.3ab	9.0a	7.7ab
Penncross	7.2bc	7.0bc	6.0bc	7.0bc	8.0bc	7.3bc	7.7b	7.3a-c
Penncross/Emerald	6.8c	6.3cd	5.7c	6.7cd	8.0bc	7.0cd	7.3bc	6.3cd
Penncross/Seaside	6.7c	6.3cd	5.3c	6.7cd	7.7cd	6.3c-e	7.7b	6.7b-d
Emerald	6.0d	6.0de	4.0d	6.0de	7.0de	6.0de	7.0bc	6.3cd
Seaside/Emerald	5.7de	5.7de	3.7d	5.7e	6.7e	5.3e	6.7cd	6.0d
Seaside	5.4e	5.3e	3.7d	5.7e	6.3e	5.3e	6.0d	5.7d
$LSD_{0.05}$	0.6	0.9	0.9	0.7	0.7	1.0	0.7	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]Values represent the mean of 21 scores obtained from 3 replications and 7 evaluation dates.

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

FAIRWAY BENTGRASS MANAGEMENT STUDY

D. J. Wehner and J. E. Haley

INTRODUCTION

Creeping bentgrass has not been widely utilized for golf course fairways because of its aggressive nature and requirement for high levels of maintenance. However, annual bluegrass, which is a predominant component of many golf course fairways and is susceptible to heat and drought injury, can also require high levels of maintenance to produce quality turf. The purpose of this research is to evaluate the creeping bentgrass cultivars Prominent, Penncross, Penneagle, Seaside, Emerald, and Highland colonial bentgrass under varying levels of fairway management.

MATERIALS AND METHODS

The large blocks of each cultivar which were established in 1981 have been split so that half the area is receiving a preventative fungicide program while the other half receives no fungicide. Perpendicular to the fungicide strips are cultivation treatments consisting of vertical mowing, core cultivation, or no cultivation. These treatments are applied in June. The plots are monitored for turfgrass quality, thatch buildup, and disease severity. Plots are mowed at 5/8" and given 3 lbs N/1000 sq ft/yr as 18-5-9. All cultivars and treatments are replicated four times.

RESULTS

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

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

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

Because of the severity of the crabgrass infestation in 1984, these plots were treated with bensulide in spring of 1985. Crabgrass did not become a problem even in the plots that received cultivation. Differences in the amount of annual bluegrass infestation started to appear during 1985 (Table1). The percent annual bluegrass in the various cultivars reflects the trends in quality and density that have been seen the previous years. The cultivars with poorer quality and density had the highest percentage of annual bluegrass. The cultivars Penncross and Penneagle received the highest quality ratings in 1985 followed by Prominent and Seaside with Highland and Emerald receiving the lowest ratings (Table 1).

Table 1. The evaluation of creeping bentgrass maintained as a fairway turf.[1]

Treatment	Quality[2] 4/17	5/22	6/10	7/26	8/26	9/25	Percent Annual Bluegrass[3] 4/16
Fungicide	5.6	6.2	6.7	5.8	5.9	6.5	12.6
No Fungicide	4.7	5.7	6.6	5.8	5.6	5.8	4.8
$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	NS
Prominent	5.3bc	6.0b	6.9bc	5.9ab	6.0a	6.2a	7.2bc
Seaside	5.5ab	6.3b	6.6c	6.2ab	5.7a	6.1ab	0.6c
Penncross	5.8a	7.3a	7.6a	6.4a	5.8a	6.2a	0.4c
Penneagle	4.4d	6.3b	7.3ab	6.3a	6.5a	7.1a	0.5c
Highland	4.8cd	4.6d	5.5d	4.6c	4.8b	5.1b	23.5a
Emerald	5.1bc	5.2c	5.9d	5.2bc	5.7a	6.2a	19.8ab
$LSD_{0.05}$	0.5	0.6	0.6	1.0	0.9	1.0	13.7
Core Cultivation	5.2a	6.0	6.7	5.9a	5.8a	6.3	7.7
Vertical Mowing	5.3a	6.0	6.6	5.8a	5.8a	6.1	10.0
No Cultivation	5.0b	5.8	6.6	5.5b	5.5b	6.0	8.2
$LSD_{0.05}$	0.2	NS	NS	0.3	0.3	NS	NS

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

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

[3]Percent annual bluegrass represents the area of each plot covered by annual bluegrass plants.

TALL FESCUE SEEDING RATE EXPT.

H. L. Portz

INTRODUCTION

Tall fescue has been a major turfgrass species in the transition zone for lawn and athletic areas. Seeding rates have been much increased over the 12 to 16 lbs/A used for pasture seedings; from 5 to 6 lbs/1000 sq ft of 'Ky-31' tall fescue are recommended. With the newer fine-leaved tall fescue cultivars, even higher rates of 10 to 12 lbs/1000 sq ft are suggested to obtain a dense turf. These which seeding rates may be good for a quick cover and a low cut, high maintenance lawn but are questionable for a low maintenance, drought resistant, minimum management turf. Previous research has indicated that Ky-31 and several newer cultivars (see 1984 Illinois Turfgrass Research Report p. 25-27) were more drought tolerant at 3 lbs then at a 5 lbs/1000 sq ft seeding rate.

This experiment has been initiated to determine what seeding rates for Ky-31 and a tall fescue blend should be best for high and for low maintenance turf.

MATERIALS AND METHODS

This trial was initiated in September, 1985 at the Horticulture Research Center (HRC) at SIU-Carbondale. Ky-31 alone and tall fescue cultivars; 'Falcon', 'Adventure', and 'Mustang', were blended and seeded at 3, 6, 9 and 12 lbs/1000 sq ft. Two levels of maintenance will be imposed; low maintenance with 2 1/2 in cutting height, no irrigation and 3 lbs of N/1000 sq ft per year vs high maintenance with 1 1/4 in cutting height, irrigation and 6 lbs of N/1000 sq ft per year. Seedling counts and stand ratings were taken in fall, 1985. Stand counts, density, turf quality and other parameters will be investigated in 1986 and future years.

RESULTS

Initial results indicate a greater number of seedlings and better stand ratings for the higher seeding rates 9 and 12 lbs/1000 sq ft in the fall of 1985 (Table 1). There was little difference between Ky-31 and the tall fescue blend of Falcon, Adventure, and Mustang. The two maintenance levels will be imposed in 1986.

Table 1. Initial seedling establishment and stand rating for tall fescue cultivars at four seeding rates at HRC.

Cultivars	Seeding Rate per 1000 sq ft	Seedlings per 625 sq cm	Stand Rating[1]		
	lb.	13 Oct	13 Oct	18 Oct	1 Nov
Ky-31	3	456	3.1	4.9	5.8
Ky-31	6	744	5.0	6.1	6.5
Ky-31	9	880	5.9	6.8	6.8
Ky-31	12	1039	6.8	7.1	7.0
Blend[2]	3	491	2.8	5.0	5.8
Blend	6	720	3.7	6.2	6.2
Blend	9	759	6.0	7.0	7.4
Blend	12	1136	7.1	7.6	7.5

[1]Stand rating 1 = poor stand, 9 = excellent stand

[2]Blend of 1/3 Falcon, 1/3 Adventure, 1/3 Mustang tall fescue

ZOYSIAGRASS (Zoysia japonica Steud.) SEED PRODUCTION AND TREATMENT EXPERIMENTS

H. L. Portz, J. Preece and Dagmar Geisler-Taylor

A. ENHANCING SEED GERMINATION OF ZOYSIAGRASS

INTRODUCTION

Previous research in South Korea, at SIU-Carbondale, and at USDA-Beltsville has clearly shown the enhancement of germination of zoysiagrass seed using base scarification, primarily potassium hydroxide (KOH). Sodium hydroxide (NaOH = lye), however, is more available and less expensive than KOH and is the chemical used for commercial treatment in Korea. The purpose of this experiment was to determine the appropriate concentration and soaking time for best germination using two differently-aged seed lots that were hand harvested in Korea.

MATERIAL AND METHODS

Two lots of 'Korean Common' seed, one harvested in 1979 and another in 1984, were selected for treatment with NaOH. Both lots of unscarified seed were stored in a refrigerator at + or - 5 degrees C until treated. There were four NaOH-water concentration's; 0, 15, 25, and 35% w/v and four soaking times; 15, 25, 35, and 45 minutes. Germination temperatures were a 20/25 degree C and 30/35 degree C dark/light 12-hour regime. There were 25 seeds per petri dish and four replications.

RESULTS

At a temperature of 30/35 degree C NaOH concentrations of 25 and 35% for 35 and 45 minutes resulted in germination from 77 to 84.5% in 7 days (Table 1). After 14 days, germination was from 77.5 to 85.5% with the same treatments. There were no differences between the 1979 and 1984 seed lots. At a temperature of 20/25 degrees C there was much lower germination even after 21 days. Also, there was a highly significant difference between seed lots with the old seed (1979) germinating 27.7% as compared to only 7.7% for the new seed (1984) (Table 2).

Alternaria mold developed at low temperature, especially on the newer seed harvested in 1984 and appeared to inhibit germination (Table 3). This was despite careful aseptic conditions including a mercuric chloride disinfestation. Since this appeared primarily on scarified seed and all possible surface contamination was eliminated, the mold was internal and probably developed during seed production in Korea. This condition is being further investigated at SIU-C and by Dr. Hank Wilkinson at the University of Illinois-Urbana/Champaign campus.

B. PRODUCTION AND GERMINATION OF ZOYSIAGRASS SEED FROM DIFFERENT SOURCES

INTRODUCTION

Seed can be produced in the United States by nearly all cultivars and selections of zoysiagrass. Immediately following harvest, fresh seed can be treated with KOH or NaOH and will germinate from 75 to 95% depending on the cultivar. To date seeds harvested from vegetatively propagated 'Meyer', 'Midwest', 'USDA 52-22(24)', and 'Korean Common' have been sown in field plots. These cultivars were also grown as individual seedlings in pots in the greenhouse. Considerable phenotypic variability is expressed, especially among Meyer seedlings. In field plots, Midwest and 52-22(24) showed the most rust and Korean Common being the only cultivar that had both good rust resistance and uniform and vigorous establishment characteristics (Table 4). Plant growth regulators (PGR's) have been tested to retard leaf growth so head exertion is maximum thus allowing convenient harvest.

MATERIALS AND METHODS

Seeds were harvested from several seeded zoysiagrass plots for two generations. Embark and Cutless were applied to Korean Common zoysiagrass after the last mowing just as seed heads began to appear. Seeds were "cleaned" by placing them in a water bath with a surfactant; only seeds heavy enough to sink were used for the germination tests. Seeds were treated with a NaOH-water solution (conc. of 30% for 30 min.), disinfested with Chlorox and then germinated at a constant 32 or 23 degree C under light. There were 25 seeds per petri dish and four replications.

RESULTS

Both Embark and Cutless retarded leaf growth and allowed good seed head exertion and seed production of Korean Common zoysiagrass. Germination of seed harvested after these two PGR treatments and then NaOH-scarified germinated to 95 and 99% in 14 days at 32 degrees C (Table 5). Midwest F_1 and Midwest F_2 also germinated well with Midwest F_1 germinating 92%. Meyer F_2 seed germinated 63% and Korean Common harvested in 1979 only germinated 54%. The Midwest F_2 seed had a surprising 75% germination even when unscarified (H_2O only). Germination at 23 degrees C was only slightly lower than at 32 degrees C and again, Midwest F_1 seed without scarification germinated very well (Table 6). Heavy incidence of mold was noted on the seed from the Embark and Cutless-treated zoysiagrass especially when germinated at 23 degrees C and untreated except with water (Table 7). NaOH-treated seed had a significantly lower incidence of mold, a reverse from an earlier experiment where the NaOH-treated seed had the most mold.

Further research is needed to determine where the mold is located and why such a high incidence in the seed produced on PGR-treated zoysiagrass. The very good germination of Midwest F_1 seed without scarification is another phenomenon to be investigated.

Table 1. Germination of NaOH-treated Korean Common zoysiagrass seed at 30/35 C.

NaOH Conc. (%)		Scarification Duration (min) 15	25	35	45	Ave.
				7 days		
35		67.0	73.5	77.5	84.5	75.6A*
25		68.5	69.0	77.0	81.5	74.0A
15		49.0	72.5	72.5	69.0	65.7B
0		9.0	5.0	5.5	6.5	6.5C
	Average	48.4B	55.0AB	58.1A	60.4A	
				14 days		
35		73.5	77.5	78.0	85.0	78.5A
25		72.5	71.5	77.5	82.0	75.9AB
15		58.5	74.5	76.0	72.0	70.2B
0		35.0	32.5	34.0	27.0	32.1C
	Average	59.9A	64.0A	66.4A	66.5A	

*Mean separation within columns and within rows according to Sheffe's Method of Contrasts.

Table 2. Germination of NaOH-treated Korean Common zoysiagrass seed at 20/25 C in 21 days.

NaOH Conc. (%)	Scarification Duration (min.) 15	25	35	45
		Old Seed (1979) 27.7**		
35	30	33	35	46
25	30	37	53	52
15	28	35	47	17
0	0	0	0	1
		New Seed (1984) 7.7		
35	2	5	15	30
25	8	12	14	9
15	3	4	16	6
0	0	0	0	0

**Significant according to F test, 1% level.

Table 3. Incidence of Alternaria mold in 21 days in two seed lots of Korean Common zoysiagrass germinating at 20/25 C.

NaOH Conc. (%)	Scarification Duration (min) 15	25	35	45
			Old (1979)	
35	2*	1	1	1
25	1	1.5	1	1
15	1.25	1.25	1	1
0	1	1	1	1
			New (1984)	
35	3	2	1.75	1.5
25	2	2	1.5	1.75
15	2.25	2	1.75	1.5
0	1	1	1.0	1.5

*1 = no mold, 2 = <50%, 3=>50%

Table 4. Zoysiagrass establishment with freshly harvested and treated seed. Seed harvested 18 June; planted July, 1982, SIU-C.

Zoysiagrass Seed Parent	1982 % Ground Cover 13 Aug	1982 % Ground Cover 10 Sept	1982 % Rust[1] 14 Sept	1983 Quality[2] 6 July
Meyer	40.8	72.5	4.0	3.9
Midwest	59.2	84.6	6.8	6.4
USDA 52-22(24)	56.3	68.8	9.0	5.0
Korean 1980 seed from Korea	62.5	87.9	4.1	7.9

[1]Rust rating 1 = no rust; 9 = all plants and almost all leaves infected

[2]Quality (cover, uniformity and general appearance) 1 = v. poor; 9 = excellent

Table 5. Germination of zoysiagrass seed from different sources and years at 32 C.

Seed Treatment	Seed Designation	Produced Location	Produced Year	% Germination at DAT* 4	7	14	21
NaOH	Korean/Embark	C'dale	1985	24	93	95	95
(30% w/v)	Korean/Cutless	C'dale	1985	32	94	99	99
(30 min.)	Korean	Korea	1979	38	51	54	54
	Korean	Korea	1984	32	74	75	76
	Midwest F_1	C'dale	1982	81	92	92	92
	Midwest F_2	C'dale	1985	43	93	93	93
	Meyer F_2	C'dale	1984	30	61	63	63
$LSD_{0.05}$				13	10	12	14
H_2O	Korean/Embark	C'dale	1985	0	3	25	28
	Korean/Cutless	C'dale	1985	0	4	19	22
	Korean	Korea	1979	0	0	8	17
	Korean	Korea	1984	0	4	9	12
	Midwest F_1	C'dale	1982	10	33	61	75
	Midwest F_2	C'dale	1985	0	13	28	29
$LSD_{0.05}$				13	10	12	14

Table 6. Germination of zoysiagrass seed from different sources and years at 23 C.

Seed Treatment	Seed Designation	Produced Location	Produced Year	% Germination at DAT* 4	7	14	21
NaOH	Korean/Embark	C'dale	1985	0	50	87	87
(30% w/v)	Korean/Cutless	C'dale	1985	0	59	95	95
(30 min)	Korean	Korea	1979	5	59	63	63
	Korean	Korea	1984	3	79	81	81
	Midwest F_1	C'dale	1982	42	90	93	93
	Midwest F_2	C'dale	1985	4	62	88	88
$LSD_{0.05}$				10	22	14	17
H_2O	Korean/Embark	C'dale	1985	0	0	20	27
	Korean/Cutless	C'dale	1985	0	0	13	18
	Korean	Korea	1979	0	0	13	23
	Korean	Korea	1984	0	0	12	23
	Midwest F_1	C'dale	1982	0	16	52	76
	Midwest F_2	C'dale	1985	0	2	35	39
$LSD_{0.05}$				NS	NS	14	17

*DAT refers to Days after Treatment.

Table 7. Incidence of mold on germinating zoysiagrass seed at 23 C.[1]

Seed Treatment	Seed Designation	Produced Location	Produced Year	Disease Rating at DAT*[2] 4	7	11	14
NaOH	Korean/Embark	C'dale	1985	1.00	1.25	1.25	1.25
(30% w/v)	Korean/Cutless	C'dale	1985	1.00	1.25	1.25	1.25
(30 min.)	Korean	Korea	1979	1.00	1.50	1.50	1.50
	Korean	Korea	1984	1.00	1.00	1.25	1.25
	Midwest F_1	C'dale	1982	1.00	1.25	1.50	1.75
	Midwest F_2	C'dale	1985	1.25	1.50	1.50	1.50
$LSD_{0.05}$				NS	NS	NS	NS
H_2O	Korean/Embark	C'dale	1985	1.75	2.25	2.50	3.00
	Korean/Cutless	C'dale	1985	1.25	1.75	2.00	2.50
	Korean	Korea	1979	1.00	1.00	1.00	1.50
	Korean	Korea	1984	1.00	1.25	1.75	2.00
	Midwest F_1	C'dale	1982	1.00	1.50	2.00	2.00
	Midwest F_2	C'dale	1985	1.25	1.50	2.00	2.25
$LSD_{0.05}$				0.53	0.72	0.62	0.67

*DAT refers to Days after Treatment.

[1]All seed treated with ammonia bleach (Chlorox)

[2]1 = no mold, 2 = <50%, 3 = >50% of seed infected

EFFECT OF VARIOUS COVERS ON SEED GERMINATION OF ZOYSIAGRASS

M. J. Dozier and H. L. Portz

INTRODUCTION

Zoysiagrass (Zoysia japonica Steud.) is a warm season turfgrass which is well adapted to the transition zone. It has exhibited excellent qualities for high maintenance turf areas. Previous establishment of zoysiagrass has been by various vegetative propagation methods. These methods are expensive and the turf is slow to fill in. Research indicates that KOH or NaOH - scarified seeds followed by a light treatment germinate up to 80 percent in seven days. In the transition zone, seeding is not done until early June due to the high temperature requirement necessary for good germination. If adequate moisture is not provided during this establishment phase, the resulting turf stand is often very poor . The purpose of this study was to test the use of clear polyethylene and other covers for providing warmer temperatures and conserving moisture in early spring to obtain early and maximum seedling establishment.

MATERIALS AND METHODS

In 1984 and 1985, Southern Illinois University at Carbondale conducted research at Jackson Country Club, Murphysboro, IL. The experimental area on a golf course fairway was glyphosated in mid-April. A split-plot experiment was set up utilizing four covers as main plots with scarified (S) and scarified and light-treated (SL) seed as subplots. Main plots were 2m x 4m and subplots were 2m x 2m. Approximately 14 days after a glyphosate application, (S) and (SL) 'Korean Common' zoysiagrass seed was dropseeded at 1 lb/1000 sq ft. The area was verticut two times in different directions. All plots were sprayed with siduron at 6 lb ai/A. Coverings were secured with wire staples and thin metal rods. Seedling counts were taken and temperature and moisture levels were monitored under the various covers. The covers were a 4 mil clear polyethylene, 10 mil polyethylene, tobacco netting and no cover in 1984 and 4 mil clear polyethylene, white polyurethane, spunbonded polyester, and no cover in 1985.

RESULTS

In 1984 and 1985 (SL) seed germinated quicker than (S) seed but did not significantly increase seedling counts after several weeks. In 1984, seedling counts were significantly higher under the 4 mil clear polyethylene, and the 10 mil clear polyethylene. In 1985, temperature readings were substantially higher under the clear polyethylene compared to no cover. White polyurethane did not effectively increase temperature and allowed severe weed infestation. The spunbonded polyester was less effective than the clear polyethylene in increasing temperature (Fig. 1). At 6 weeks after establishment, seedlings under the clear polyethylene cover showed

Table 1. Seedling establishment at 6 weeks under various covers, seeded 26 April, 1985.

Cover	Seed Treatment	Seedlings 625 cm^{-2}
Clear polyethylene	S & SL*	169.0
White polyurethane	S & SL	100.0
Spunbonded polyester	S & SL	81.4
No cover	S & SL	70.1
$LSD_{0.05}$		32.2

Table 2. Percent zoysiagrass stand at 10 weeks from establishment seeded 26 April 1985.

Cover	Seed Treatment	Zoysiagrass Stand (%)
Clear polyethylene	S & SL*	80.0
White polyurethane	S & SL	60.8
Spunbonded polyester	S & SL	64.2
No Cover	S & SL	50.8
$LSD_{0.05}$		17.2

*Combined means of scarified and scarified and light-treated seed.

significantly higher counts compared to all other treatments at the 0.05 level (Table 1). As noted in Table 2, there was a significantly higher percent turfgrass stand under the clear polyethylene than with no cover. The clear polyethylene increased zoysiagrass stand by 30% and the spunbonded polyester material by 14% over the control. White polyurethane did not significantly increase percent stand over the control.

Based on this research, the Jackson Country Club implemented this procedure in 1985 on nine golf course fairways representing 12 acres. The 90 foot-wide fairways were outlined with a 12 inch-wide sod strip. The sod was used to secure the outside edges of 28-32 foot-wide polyethylene covers. Volunteers assisted in laying and taping the overlapping covers. The clear polyethylene covers were removed after 2 weeks. An 80% zoysiagrass stand was obtained in 10 weeks on most of the area. Poor germination occurred in a few areas due to heavily matted vegetation. The covers also prevented seed movement and soil erosion during heavy rains in early May.

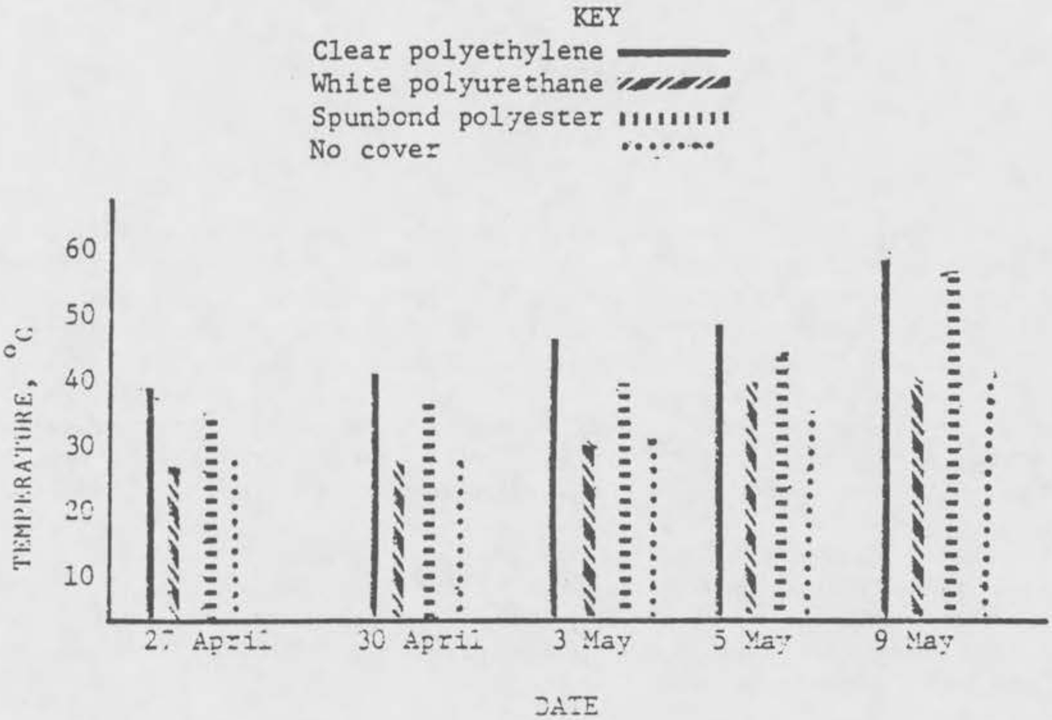


Fig. 1. Maximum temperatures under various covers-1985.

WEAR TOLERANCE EVALUATION OF A TALL FESCUE AND ZOYSIAGRASS SEED MIXTURE FOR ATHLETIC TURF

V. R. Patterozzi and H. L. Portz

INTRODUCTION

Athletic turf are subjected to extreme wear, under varying weather conditions and activities. The most common combination of warm and cool season grasses is bermudagrass and overseeded ryegrass. This combination however, has not proven very successful in this area of the transition zone. Winterkill of the bermudagrass and droughty conditions leading to ryegrass degradation have encouraged a review of other turfgrass choices. Two prominent turfgrass choices in this area are tall fescue (*Festuca arundinacea*) and zoysiagrass (*Zoysia japonica*), both being very wear tolerant and drought resistant with tall fescue also retaining good fall color.

Recent research at SIU-Carbondale and USDA-Beltsville has shown excellent stand density resulting from tall fescue and zoysiagrass seeding mixtures. The purpose of this study is to evaluate and measure the wear tolerance of a seeded tall fescue and zoysiagrass football field under both actual player wear and simulated wear.

MATERIAL AND METHODS

In order to evaluate the performance of these two species, a local high school football game field was renovated. The field was treated with glyphosate (Roundup) in late April 1985. In early May the field was tilled, crowned, disked, fertilized with 16 lb /1000 sq ft of 6-24-24 and harrowed to provide an adequate seedbed, good drainage and proper fertility. Zoysiagrass was then seeded at 1/3 lb /1000 sq ft, using a Brillion seeder over the entire field. Four tall fescue cultivars, 'Mustang', 'Rebel', Falcon', and 'Ky-31' were each seeded, using a Scott's drop seeder, at two rates, 1 1/2 lb and 2 lb/1000 sq ft. Plot size was 15' x 160' for each seeding rate, replicated three times and randomized. Final zoysiagrass seeding was at 2/3 lb/1000 sq ft over the entire field, using the Brillion seeder which also aided in firming the tall fescue into the soil. Siduron (Tupersan) was then applied at 6 lb ai/A. Irrigation, fertilization and weed control were applied as needed throughout the summer and fall.

RESULTS

A good initial stand of tall fescue was noted and rated (percent ground cover) at four weeks (Table 1). Seedling counts were taken at eight weeks (Table 1).

Wear tolerance ratings and stand density counts were made after the last football game and indicated a reduction in stand density, especially

Table 1. Percent cover and stand of tall fescue cultivars and zoysiagrass seeded May 8,9 at the Carbondale Community High School football field.

Tall Fescue Cultivar	Seeding Rate lb 1000 ft^{-2}	Seeding Rate g m^{-2}	% Cover 4 weeks	Average number Plant/tiller 8 weeks
Ky-31	1.5	7.5	33	1074
Ky-31	2.0	10.0	33	1280
Rebel	1.5	7.5	21	1028
Rebel	2.0	10.0	26	1332
Mustang	1.5	7.5	23	1666
Mustang	2.0	10.0	26	1258
Falcon	1.5	7.5	21	1112
Falcon	2.0	10.0	26	956
Zoysiagrass	1.0	5.0	no rating	123

Table 2. Visual rating of player wear for four tall fescue cultivars and zoysiagrass seeded on a football field after games.

Cultivars and Species	Visual Rating of Wear[1]
Ky-31	3.5a*
Falcon	2.8b
Rebel	2.8b
Mustang	2.6b
Zoysiagrass	2.5b

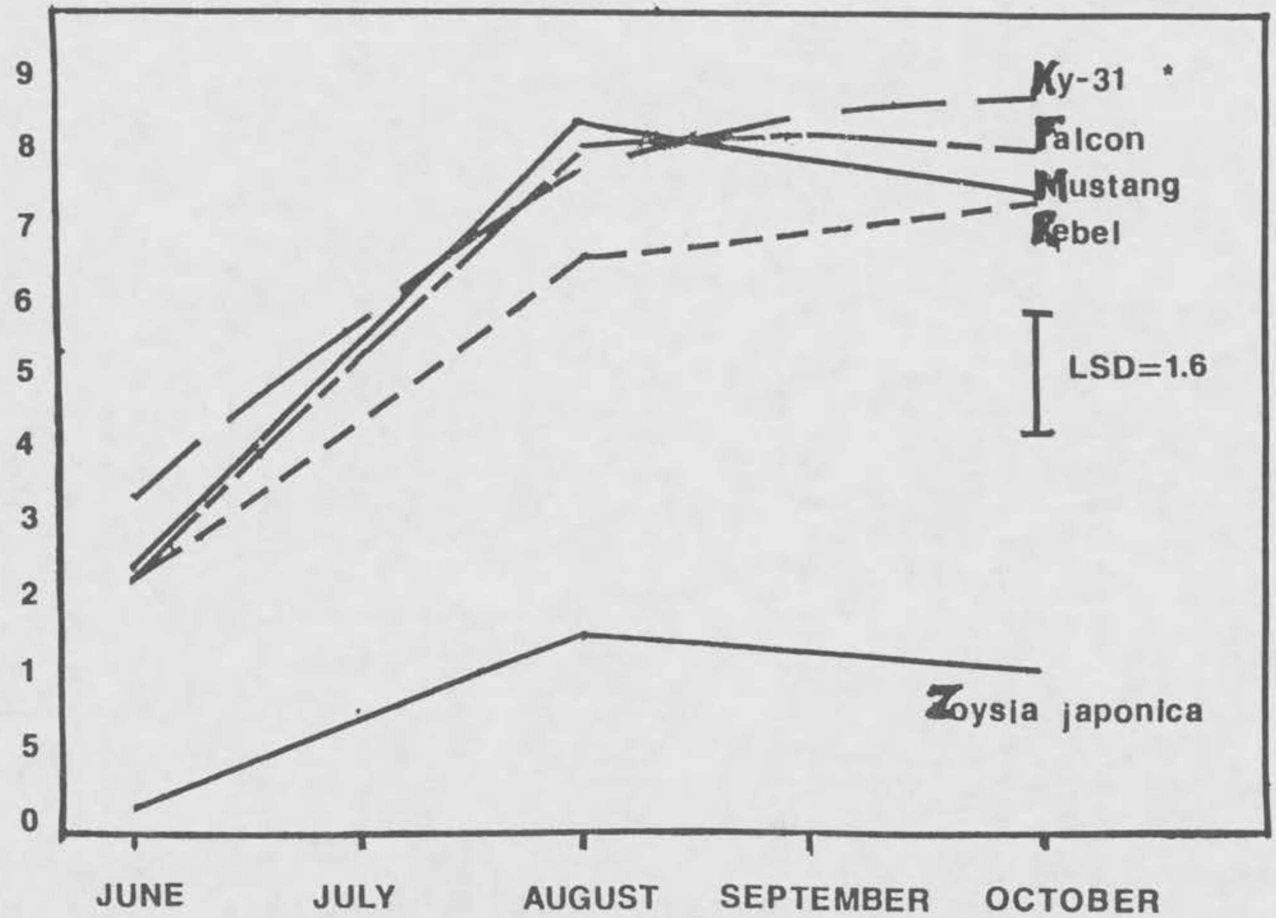
[1]Visual ratings based on 1 = leaf injury and bare soil and 5 = no injury.

*Values with the same letter are not significantly different at the 5% level, using LSD Test. LSD = 0.42.

between the 30 yard lines and with in the hash-marks where stand counts and wear ratings were taken. Figure 1 indicates stand density of the four tall fescue cultivars and zoysiagrass from June through October. By mid-August, Mustang had the greatest stand density, but dropped significantly through October. This was due primarily to replicate location, thus the low 'player wear' rating, as compared to Ky-31 as shown in Table 2. The field, overall, maintained good color up to late October. This study will be continued thru the 1986 football season with additional artificial wear being initiated.

FIGURE 1.

STAND DENSITY of FOUR TALL FESCUE CULTIVARS and ZOYSIAGRASS SEEDED ON A FOOTBALL FIELD



*means tested at 5 % level using LSD.

STUDIES ON ANNUAL BLUEGRASS HEAT TOLERANCE

D. L. Martin and D. J. Wehner

INTRODUCTION

The decline in color and quality of annual bluegrass (Poa annua L.) turfs during the hot, dry summer months is a serious problem on many golf courses in the midwest. In 1983-1985 research was conducted on the high temperature response of annual bluegrass. The specific objectives of this work were: i) to examine the variability in heat tolerance among populations of annual bluegrass from various locations in Illinois, ii) to determine if the heat tolerance of field grown annual bluegrass could be predicted using environmental data from the site and iii) to examine the effect of the soil moisture regime on annual bluegrass heat tolerance. This research was conducted as a contribution toward the long range goal of having a greater ability to predict and influence turfgrass heat tolerance.

Experiment I: Heat Tolerance of Selections of Annual Bluegrass From Various Locations in Illinois.

MATERIALS AND METHODS

Samples of annual bluegrass were collected from 14 locations in Illinois (Figure 1). A single tiller of annual bluegrass was used to generate a population of annual bluegrass to represent each collection site in heat tolerance testing. Ten tillers were selected from an annual bluegrass turf at the Horticulture Research Center at Urbana, Illinois to give rise to populations for use in evaluating heat tolerance within a single collection site. All tillers were multiplied in a greenhouse under conditions of regular watering, fertilization (.125 lb N per 1000 sq ft week), and clipping (1 inch).

After adequate quantities of plant material had been produced, the selections of annual bluegrass were taken to the Horticulture Field Laboratory where plants were subjected to high temperature stress in a temperature controlled water bath for 30 minutes. The treatment temperatures used were in the range 104-118 F inclusive. Sydsport Kentucky bluegrass was included for comparative purposes. The annual bluegrass plants were then allowed to recover for 2 weeks in the greenhouse before all surviving and newly generated tissue was dried and weighed. The weights of treated plants expressed as a percentage of the weight of nontreated control plants provided a relative heat tolerance index for each selection. The heat tolerance index scale ranged from 0 to 100. The higher the index number, the greater the heat tolerance of the plants. A total of 4 screenings were conducted; one screening to examine variability in heat tolerance within the Urbana populations, and 3 screenings to examine variability among populations from various regions within the state.

RESULTS AND DISCUSSION

No significant differences in heat tolerance were found among the annual bluegrass selections from Urbana; suggesting that variability in heat tolerance among populations of annual bluegrass from within a site with relatively uniform topography, such as the Urbana site, is rather small. Several differences in heat tolerance were found among the annual bluegrass selections from different locations, with the selection from Danville being significantly more heat tolerant than the selection from Highland Park in all three screenings (table 1). Regression analysis was performed on the heat tolerance indices to determine if the relative heat tolerance of the selections could be predicted on the basis of the geographical location of the site of collection or upon long term temperature data from the site of collection. No relationship was found between the heat tolerance index and either of these parameters. Table 2 shows the heat tolerance indices as well as the long term mean temperature for July and latitude of 13 of the sites of annual bluegrass collection.

Experiment II: Predicting Annual Bluegrass Heat Tolerance.

MATERIALS AND METHODS

The monostand of annual bluegrass used in this study was established at the Horticulture Research Station at Urbana, Illinois in the fall of 1983. The stand was mowed at a 1 inch height of cut 2-3 times per week and fertilized with approximately 4 lb of N per 1000 sq ft year. Tensiometers were installed at the 2 in depth so that irrigation could be properly timed.

Four sample plugs of turf were taken from the sampling area approximately every other week over the 1984 and 1985 growing seasons. Plants were evaluated for heat tolerance as discussed under experiment I. The heat tolerance indices of plants treated at 104-113 F were averaged for each sampling date, and the means analyzed using regression analysis involving on site parameters such as air and soil temperatures, rainfall plus irrigation, and soil matrix potentials from the tensiometers.

RESULTS AND DISCUSSION

The best equation found for predicting the heat tolerance indices was a quadratic equation that used the mean maximum daily air temperature occurring during the two days prior to sampling and the mean combined daily rainfall and irrigation from the second through the fourth days prior to sampling. This equation was able to account for 78% ($R2=0.78$) of the variation in heat tolerance indices occurring over the two growing seasons. The actual and predicted indices as well as the prediction equation are shown in table 3 and figures 2 and 3. Further research will be necessary to determine the accuracy of the equation generated during the two years of this work.

Experiment III: Effect of Soil Moisture on Annual Bluegrass Heat Tolerance.

MATERIALS AND METHODS

This study was conducted on a portion of the annual bluegrass stand discussed in experiment II. Two watering treatments were replicated 3 times as a 3.3 x 6.6 ft plot in a randomized complete block design. Black iron plate was driven into the soil to form the boundaries of each plot. The plate, driven into the soil to a depth of 6 inches, prevented movement of water between the plots being maintained under the different treatments. The first treatment, designated the "wet treatment", maintained the turf under very moist soil conditions; whereas the second treatment, designated the "dry treatment", maintained the turf under more moderate to dry conditions. Turf maintained under the wet treatment received .4 inches of irrigation water (by hand) approximately every other day, in addition to the amount of irrigation received by the general area on which the plots were situated. The wet treatment was not administered on dates when ambient rainfall exceeded .4 inches or on dates when irrigation of the general area exceeded .4 inches. The plots maintained under the dry treatment received ambient rainfall in addition to irrigation in the quantity delivered to the general area. In each plot tensiometers were installed at the 2 in depth to monitor the soil matrix potential. The study began on May 19, 1985.

The annual bluegrass maintained under the two watering treatments were screened for heat tolerance on a total of ten sampling dates. A single sample plug was taken from each plot on all sampling dates, and screened for heat tolerance as previously discussed. Five of the sampling dates were conducted when the soil under the wet treated plots was more moist than that under the dry treated plots, while the remaining five sampling dates were conducted when the soil under both sets of plots was saturated at the 2 inch depth.

Quality ratings were taken on the turf on 9 dates during the study. In addition, the depth of the live white root system under each plot was measured. Eight inch long soil cores were taken from each of the sample plots on 4 sampling dates, and from the general area on 10 dates. The cores were soaked overnight in water to remove all soil and dead root system prior to root length measurements.

RESULTS AND DISCUSSION

Statistical analysis of the heat tolerance indices obtained from the annual bluegrass under the two watering treatments revealed that no statistically significant effect on heat tolerance occurred due to the differences in watering treatments. The heat tolerance indices of annual bluegrass under the dry treatment were however, greater than those under the wet treatment on 9 of the 10 sampling dates. Mean heat tolerance indices from turf treated at 109-113 F are shown in figures 4 and 5.

Quality of annual bluegrass turf maintained under both treatments declined during the hot, dry portion of the growing season and increased late in the growing season. Annual bluegrass under the wet treatment usually demonstrated more satisfactory quality than that grown under the dry treatment. Differences in quality appeared to be due primarily to increased drought injury of turf maintained under reduced moisture. Quality ratings are shown in figure 6.

No statistical differences in the depth of the root system were present between the annual bluegrass maintained under the two watering treatments. The maximum depth of the annual bluegrass root system from the general area is shown in figure 7. The maximum depth of the root system declined as temperatures increased, with an increase in rooting depth associated with a decline in soil temperature later in the growing season. A strong negative correlation (R = -0.83) was found between the maximum depth of the root system and the mean maximum daily soil temperature (4 inch depth) of the period 2 weeks prior to core sampling.

On several dates during the warmest portion of the growing season, annual bluegrass plants showed severe wilting, even though tensiometer readings showed the soil to be saturated at the 2 in depth and greater. The root system during this time of the season was confined to the upper inch of soil where soil moisture was insufficient to meet transpirational needs. The findings of this study illustrate the need for insuring that adequate soil moisture is present for annual bluegrass to meet transpirational needs during the warmest portion of the growing season when the root system is at its shallowest.

Table 1. Mean heat tolerance indices of Sydsport Kentucky bluegrass and several annual bluegrass selections evaluated in experiment I.[1]

Selection	Mean heat tolerance index[2]		
Screening:	A	B	C
Centralia	59.4 bc	55.3 b-e	----
Danville	75.9 ab	60.0 bc	60.5 a
Decatur	64.2 b	44.5 ef	----
East Lansing	64.0 b	48.7 c-f	----
East Moline	54.9 bc	50.1 b-f	----
Harrisburg	60.9 bc	49.4 b-f	----
Highland Park	38.4 c	44.7 d-f	34.7 b
Kankakee	75.5 ab	51.0 b-f	----
Olympia Fields	69.5 b	49.6 b-f	----
Peoria	56.9 bc	57.1 b-d	----
Pickneyville	77.5 ab	44.3 ef	----
Rockford	----	55.9 b-e	----
St. Charles	----	61.5 b	----
Springfield	71.1 ab	40.9 f	----
Sydsport	94.1 a	74.8 a	57.5 a
Urbana	72.7 ab	52.3 b-f	63.5 a

[1]Heat tolerance indices are the plant recovery weights expressed as a percentage of the mean of the weights of two controls. Means in the same column with the same letter are not significantly different at the 5% level as determined by Fisher's Least Significant Difference Test.

[2]Values represent the mean of 4 replications. Means in screenings a, b and c are the mean heat tolerance indices of plants treated at 104 and 108, 108 and 109, and 106-111 F respectively.

Table 3. Comparison of actual and predicted heat tolerance indices (HTI) for the 1984 and 1985 growing seasons. Predicted indices were generated using a quadratic equation with predictor variables of air temperature and rainfall.[a]

Date	Maximum daily air temperature (C)	Daily rainfall (mm)	Actual heat tolerance index[b]	Predicted heat tolerance index	Difference between indices
05-04-84	19.44	1.87	25.93	34.01	-8.08
05-18-84	20.83	0.90	36.67	39.12	-2.45
06-01-84	17.50	1.78	16.04	19.93	-3.89
06-14-84	31.67	0.00	70.16	79.65	-9.49
07-01-84	27.22	8.13	55.95	71.74	-15.79
07-15-84	30.56	5.95	64.82	79.50	-14.68
07-29-84	24.17	14.31	50.10	45.16	4.94
08-12-84	31.39	10.00	68.28	67.96	0.32
08-23-84	28.06	8.67	67.92	71.66	-3.74
09-07-84	22.22	1.27	62.26	48.71	13.55
09-21-84	25.28	0.00	54.60	59.66	-5.06
10-04-84	18.61	0.00	25.04	19.74	5.30
05-09-85	22.78	5.67	64.73	60.47	4.26
05-23-85	25.00	4.67	77.38	68.35	9.03
06-06-85	25.00	0.33	52.12	59.53	-7.41
06-09-85	26.11	3.75	70.56	71.31	-0.75
06-18-85	26.11	7.25	53.58	70.94	-17.36
06-27-85	30.56	3.33	103.24	81.31	21.93
07-21-85	29.17	8.83	80.52	72.19	8.33
08-05-85	28.61	1.17	73.58	75.03	-1.45
08-21-85	25.56	4.50	84.65	70.11	14.54
09-04-85	30.56	2.33	85.96	80.87	5.09
09-10-85	33.33	8.33	75.72	72.85	2.87

Prediction equation:
HTI = -194.71 + 15.60 * Air temperature(A) + 9.85 * Rainfall(B) - .22 * A * A -.25 * A * B - .31 * B * B R^2=0.78 p=0.0001

[a]Predicted heat tolerance indices were calculated from the equation fitted to the 1984 and 1985 indices. Air temperature was the mean maximum daily air temperatures from the two days prior to heat tolerance sampling. Rainfall was the mean daily rainfall occurring on the second through the fourth day prior to heat tolerance evaluation.

[b]Actual heat tolerance indices were the mean of the recovery weights of annual bluegrass heated at 104 through 113 C, expressed as a percentage of the weight of nontreated controls.

Table 2. Mean heat tolerance indices, temperature, and geographical data for 13 sites of annual bluegrass collection.

Selection	Mean heat tolerance index[a]	Mean temp (F) for July[b]	Latitude[c]	
			Min	Sec
Centralia	57.4	-----	--	--
Danville	67.9	75.09	40	06
Decatur	54.3	76.50	39	50
East Lansing[d]	56.3	70.81	42	47
East Moline	52.5	74.50	41	27
Harrisburg	55.1	78.80	37	45
Highland Park[e]	41.5	71.91	42	21
Kankakee[f]	63.3	75.20	41	08
Olympia Fields[g]	59.5	73.51	41	30
Peoria	57.0	75.09	40	40
Pickneyville	60.9	-----	--	--
Springfield	56.0	76.10	39	51
Urbana	62.5	75.31	40	06

[a]Heat tolerance indices were calculated by averaging the mean indices from heat tolerance screenings A and B. Indices from St. Charles and Rockford do not appear in this table as they were not evaluated in screening A.

[b]Unless otherwise shown, latitudes and long term mean temperatures for July are from Anonymous (1980). Climatological Data-Illinois. U.S. Environmental Data Service. Volume 58.

[c]Latitude is that of the site where weather data was collected, not necessarily equal to the true latitude of the collection site for the selection.

[d]Long term mean for July is that of Lansing, Michigan. Mean was obtained from Anonymous (1981). Weather of U.S. Cities. Volume 1. Gale Research Company. Detroit, Michigan.

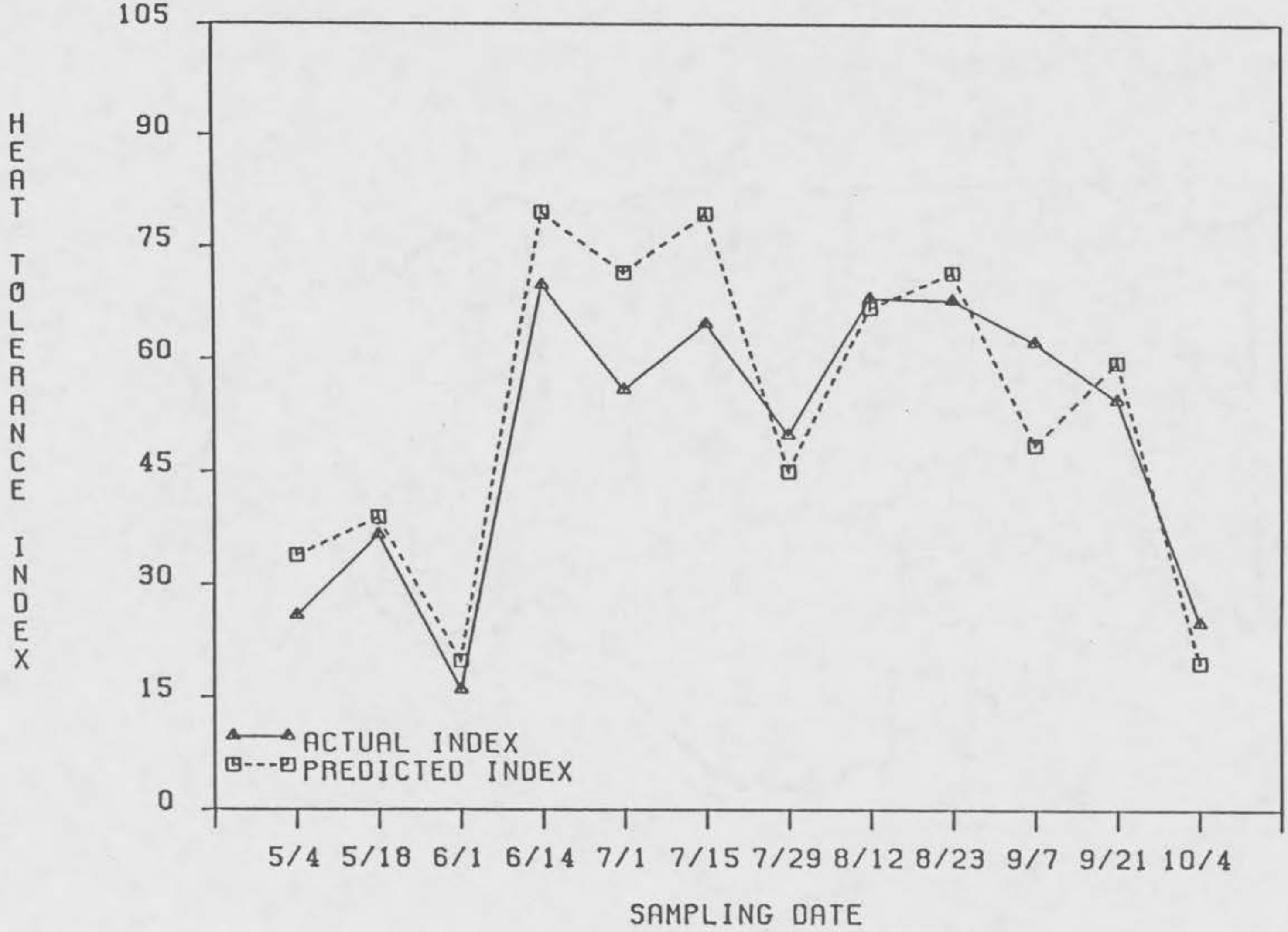
[e]Long term mean for July is that of Waukegan, Illinois.

[f]Long term mean for July was obtained from Anonymous (1972). Climatological Data-Illinois. U.S. Environmental Data Service. Volume 73.

[g]Long term mean for July is that of Park Forest, Illinois. Mean was calculated from data obtained in Anonymous (1952 -1980). Climatological Data-Illinois. U.S. Environmental Data Service. Volumes 57-85.

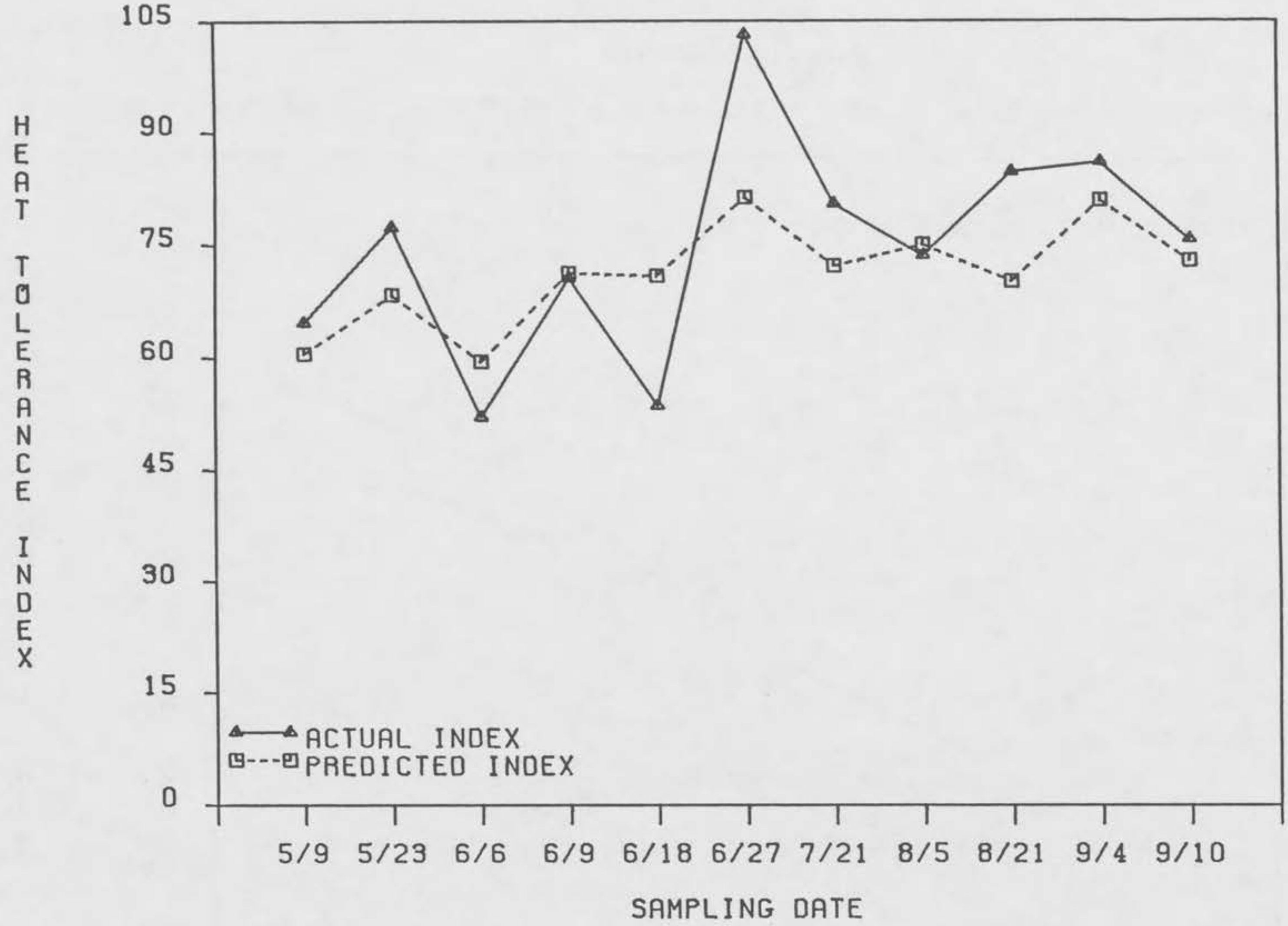
Figure 1. Locations of annual bluegrass collection sites in Illinois.

Figure 2. Actual and predicted heat tolerance indices for the 1984 growing season. Predicted indices were calculated from an equation generated from analysis of heat tolerance indices obtained over the 1984 and 1985 growing seasons.[1]



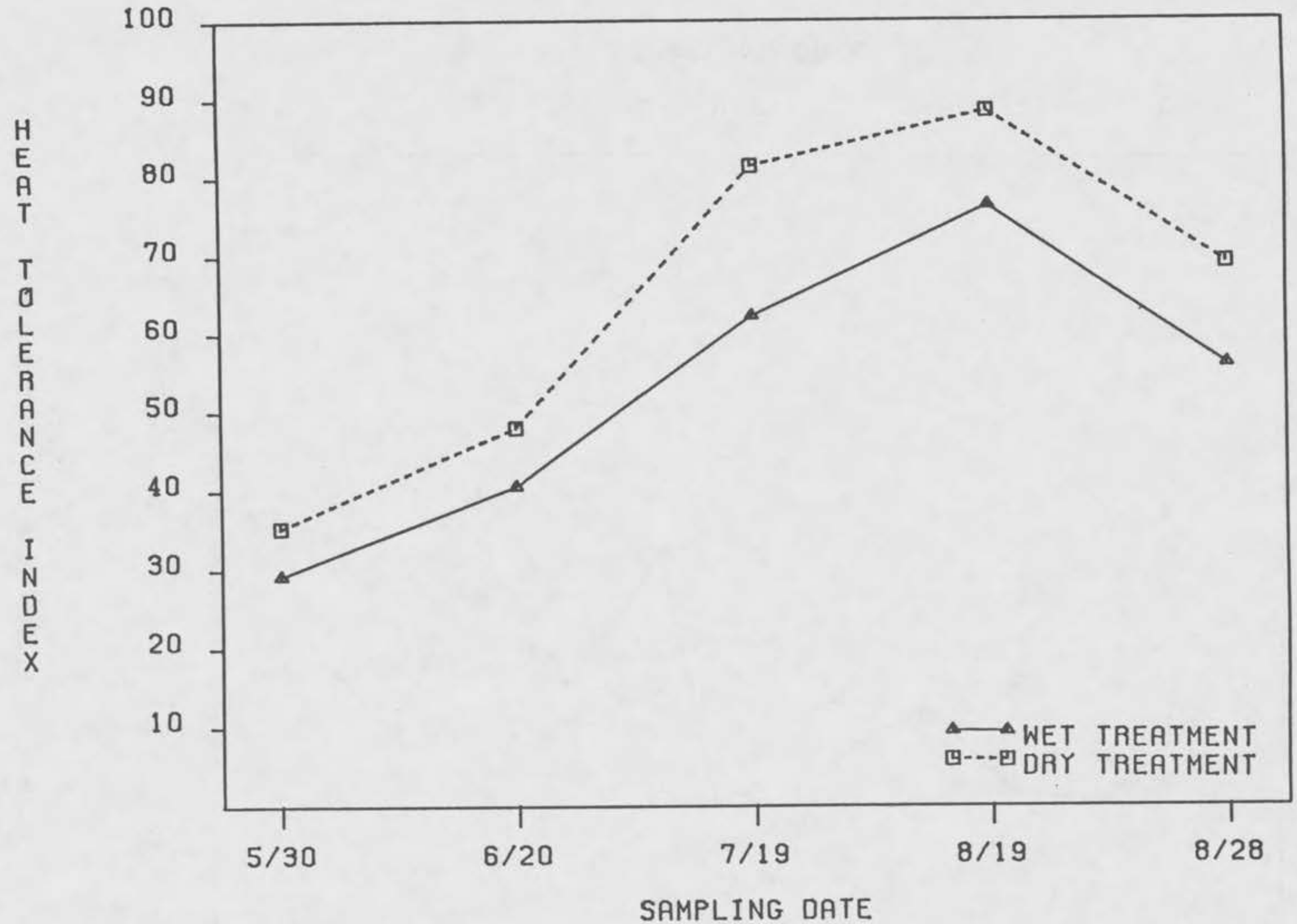
[1]Actual indices represent the mean of 4 samples treated in the temperature range 104 - 113 F.

Figure 3. Actual and predicted heat tolerance indices for the 1985 growing season. Predicted indices were calculated from an equation generated from analysis of heat tolerance indices obtained over the 1984 and 1985 growing seasons.[1]



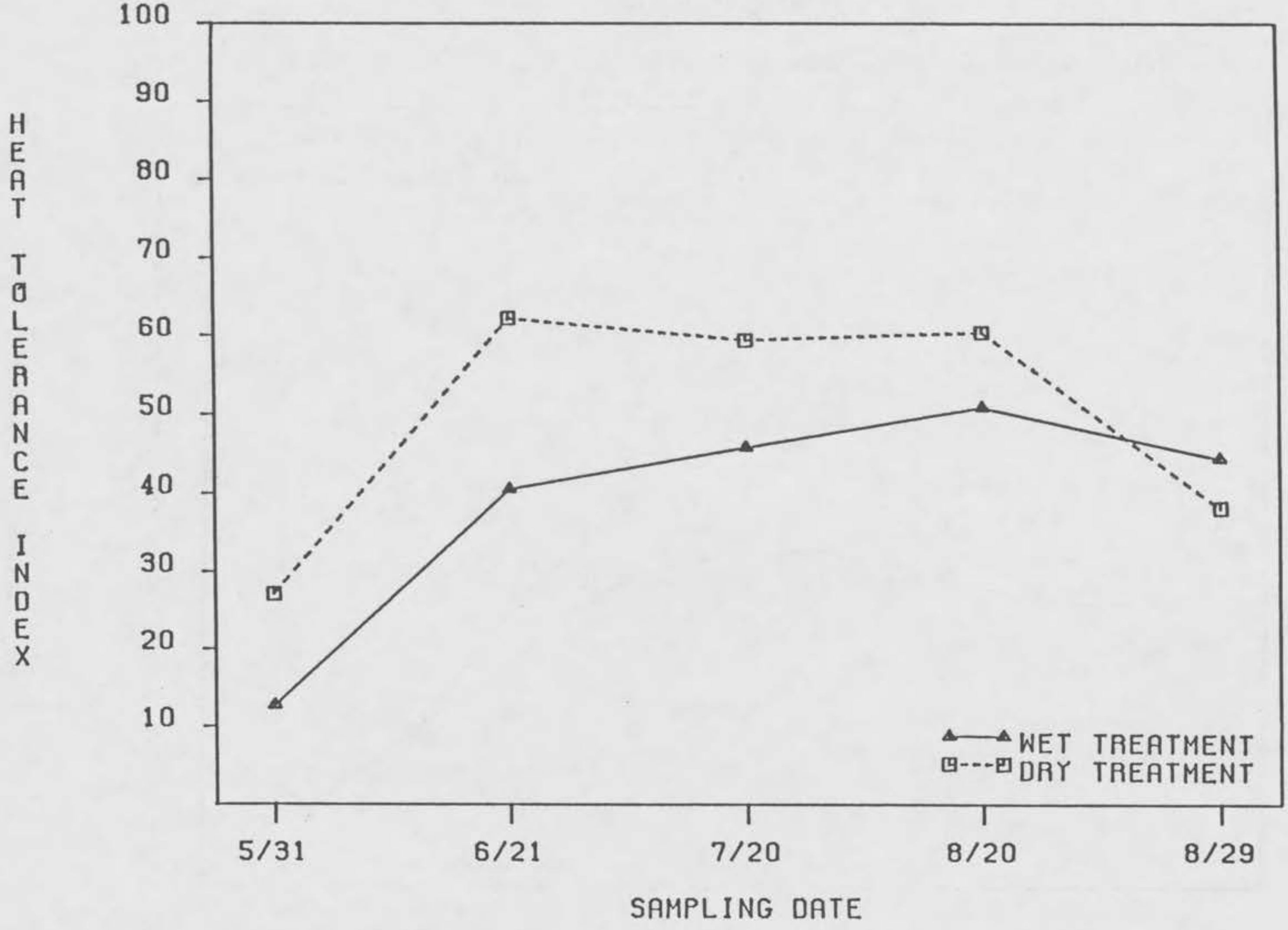
[1]Actual indices represent the mean of 4 samples treated in the temperature range 104 - 113 F.

Figure 4. Mean heat tolerance indices of annual bluegrass on 5 sampling dates when soil under dry treated plots was dryer than that under wet treated plots at the 2 inch depth.[1]



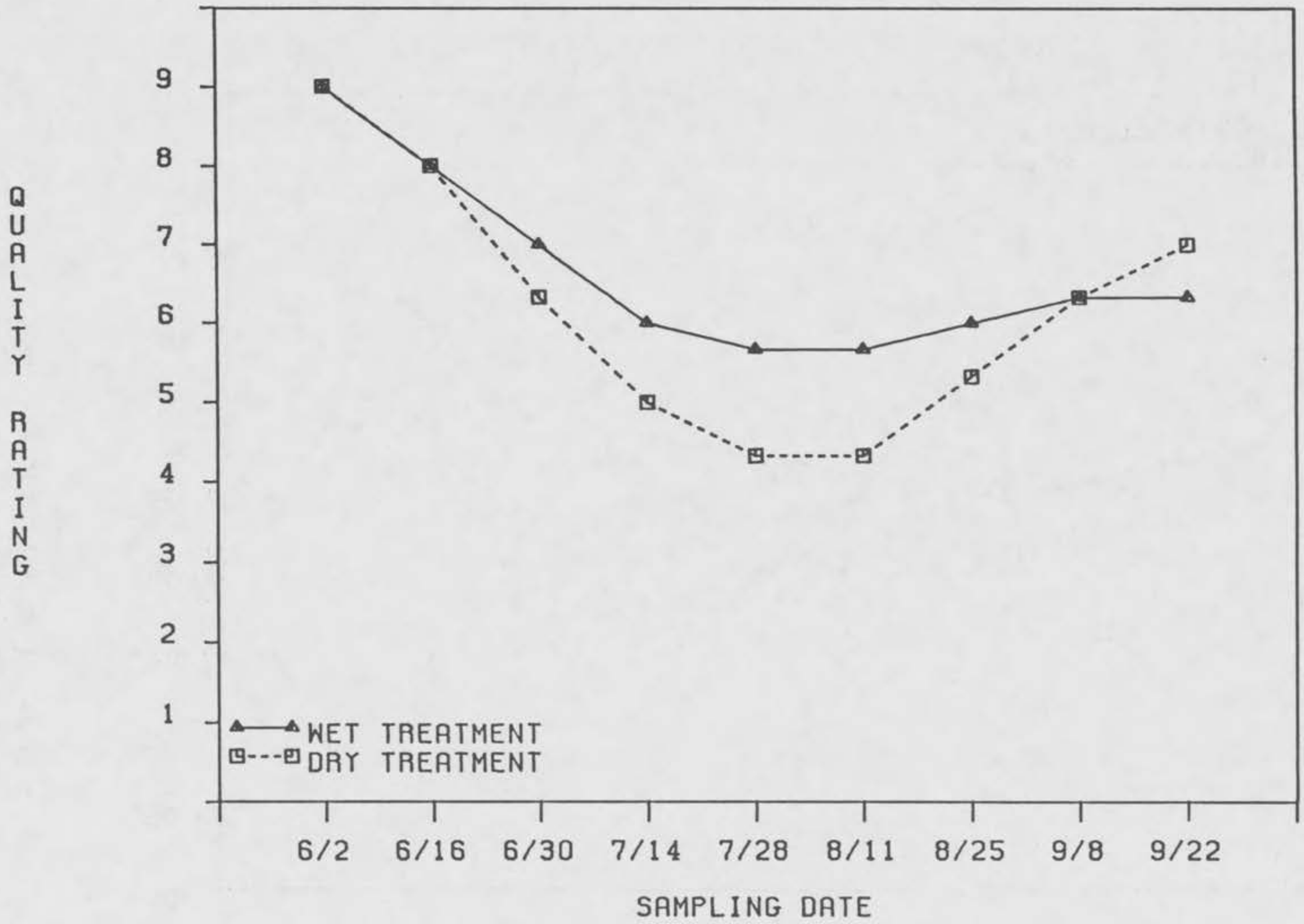
[1]All values represent the mean of 3 replications. Means are those of plants treated at 109 - 113 F.

Figure 5. Mean heat tolerance indices of annual bluegrass on 5 sampling dates when soil under both wet and dry treated plots was saturated at 2 inch depth.[1]



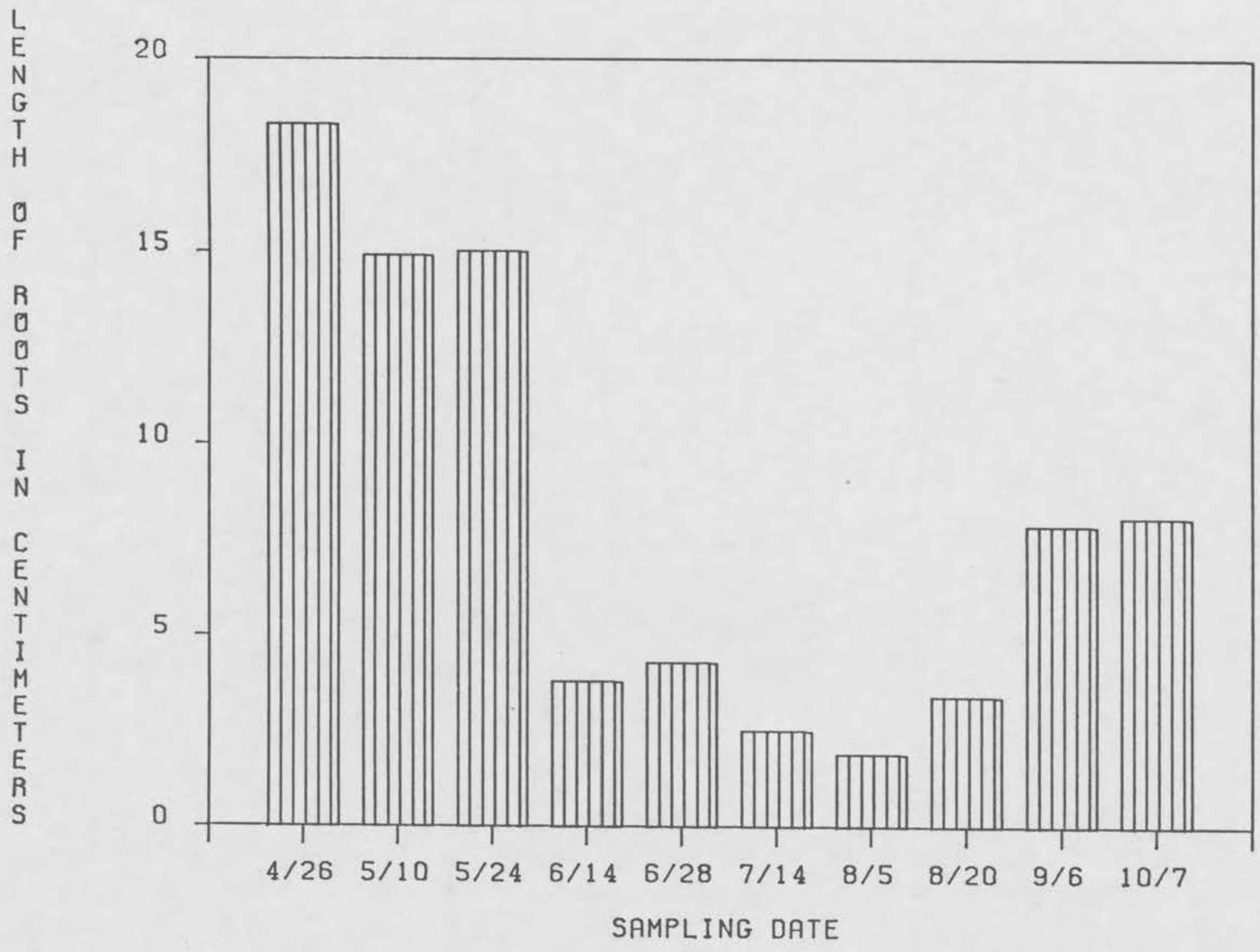
[1]All values represent the mean of 3 replications. Means are those of plants treated at 109 - 113 F.

Figure 6. Mean quality ratings of annual bluegrass on 9 dates in 1985.[1]



[1]All values represent the mean of 3 replications.

Figure 7. Maximum depth of the annual bluegrass root system on ten sampling dates in 1985.[1]



[1]All vaules represent the mean of 3 samples.

PREEMERGENCE CONTROL OF CRABGRASS

D. J. Wehner and J. E. Haley

INTRODUCTION

Preemergence herbicides for control of crabgrass have been available to turfgrass managers for many years. Periodically, new herbicides are developed that need to be evaluated for crabgrass control in comparison to the existing materials. The purpose of this research was to evaluate the experimental herbicides SN 594 and Orbencarb and the recently released Pre M herbicide for crabgrass control.

MATERIALS AND METHODS

The herbicides evaluated in this research were orbencarb (PBI Gordon), SN 594 (Nor-Am), Pre M (pendimethalin, LESCO), Dacthal (DCPA, SDS Biotech), Betasan (bensulide, Stauffer), Balan (benefin, Elanco), and Team (benefin + trifluralin, Elanco). The rates and dates of application are presented in Tables 1 and 2. The orbencarb treatments were applied to an area adjacent to the main study at a later date because the herbicide was received late. Treatments were applied with a small plot sprayer in a volume of 40 gallons of water per acre. The percent crabgrass in the plots was rated several times after the application of the sprays. The turf was Kentucky bluegrass; plot size was 3 x 10 feet with 3 replications of each treatment. An untreated check plot was included with each replication. The plots were irrigated on a regular basis to insure excellent crabgrass germination.

RESULTS AND DISCUSSION

Because of ideal weather conditions and supplemental irrigation, there was tremendous crabgrass pressure on our test area as evidenced by the large percentage of crabgrass in the check plots (Table 1). The weather conditions were also ideal for the breakdown of the herbicides. This is evident by the lower level of crabgrass control found in 1985 from some of the standard herbicides than had been found in previous years.

All herbicides except orbencarb and SN 594 at the 1.0, 2.0, and 4.0 lb ai/A rate provided good control of crabgrass through the 15 July rating date (Tables 1 and 2). The percentage of crabgrass in the plots increased after this date due to the growth and development of the crabgrass present on 15 July. The ratings taken on August 21 indicate that there were few statistically significant differences in percent crabgrass in plots treated with Pre M, Dacthal, Betasan, Balan and Team.

Table 1. The evaluation of herbicides for preemergence control of crabgrass in a Kentucky bluegrass turf applied April 20, 1985.[1]

Material	Rate lb ai/A	% Cover of Plot with Crabgrass[2] 7/02	7/15	8/21
Betasan (4EC)	7.5	0.7d	2.3de	23.3cd
Balan (2.5G)	2.0	1.0d	4.0c-e	30.0c
Balan	2 + 2*	0.0d	1.3e	10.0d
Team (2G)	2.0	0.0d	1.0e	16.7cd
Dacthal (75WP)	10.5	0.3d	1.3e	18.3cd
SN 594 (7 lb/Gal)	1.0	13.3b	21.7b	83.3a
SN 594	2.0	5.7c	10.3cd	56.7b
SN 594	4.0	6.0c	12.0c	60.0b
SN 594	6.0	0.7d	4.3c-e	33.3c
Pre M 60% DG	1.5	0.3d	2.7de	23.3cd
Pre M 60% DG	3.0	0.0d	0.7e	8.3d
Pre M 10% DG[3]	1.5	0.7d	1.3de	20.0cd
Pre M 10% DG[3]	3.0	1.7d	1.7e	10.3d
Check	---	30.0a	46.7a	96.7a
$LSD_{0.05}$		3.7	8.1	18.5

[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 cover of plot with crabgrass represents the area of the treated plot covered by crabgrass plants.

[3]Pre M 10% DG formulation on urea carrier. This treatment was applied May 3, 1985.

*The second application was made 10 days following the first application.

Table 2. The evaluation of herbicides for preemergence control of crabgrass in a Kentucky bluegrass turf applied May 3, 1985.[1]

Material	Rate lb ai/A	% Cover of Plot with Crabgrass[2] 7/02	7/15	8/21
Betasan (4EC)	7.5	2.3bc	7.0bc	36.7
Orbencarb	4.0	8.3b	21.7b	41.7
Orbencarb	8.0	5.7b	13.7bc	58.3
Orbencarb	12.0	3.7bc	11.7bc	61.7
Check	-	23.3a	50.0a	53.3
$LSD_{0.05}$		7.0	17.1	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]Percent cover of plot with crabgrass represents the area of the treated plot covered by crabgrass plants.

EVALUATION OF PRODIAMINE FOR PREEMERGENCE CONTROL OF CRABGRASS AND WINTER ANNUALS

J. E. Haley and T. W. Fermanian

INTRODUCTION

A herbicide currently being evaluated at the University of Illinois as a preemergence crabgrass and winter annuals control is Prodiamine (Velsicol). Very little is known about the effect Prodiamine has on turfgrass, especially the effect over several growing seasons. A trial was established 6 November 1984 to evaluate the potential phytotoxicity of Prodiamine applied over the long term and to examine its ability to control winter annuals and crabgrass.

MATERIALS AND METHODS

This evaluation consists of treatments of Prodiamine at 0.25, 0.38, 0.50, 0.75 and 2.0 lb ai/A and Dacthal at 5.25, 10.5 and 21.0 lb ai/A. Dacthal at the 1/2, 1 and 2 times recommended label rates is included as an industry standard for preemergence weed control. Herbicides were applied to one set of plots in the fall (6 November 1984 and 3 October 1985) and to another set of plots in the spring (20 April 1985). An untreated control is included in each fall and spring application for all replications. Materials were applied using a CO_2 propelled backpack sprayer in a spray volume of 40 gallons of water per acre to 3 x 10 feet plots of common Kentucky bluegrass.

RESULTS

In 1985 crabgrass control was excellent with all spring applications of Dacthal and with all spring and fall applications of Prodiamine (Table 1). Late in the season crabgrass germination was observed in plots with spring applied Dacthal at 5.25 lb ai/A, spring applied Prodiamine at 0.25, 0.38 and 0.5 lb ai/A and fall applied Prodiamine at 0.25, 0.38, 0.5 and 0.75 lb ai/A. Minor to moderate turfgrass injury was found on plots treated with prodiamine, especially with the fall applied rate of 2.0 lb ai/A. This injury did not last long. A two foot section of each plot was scalped (mowed down to bare soil) 23 July 1985. No difference in turfgrass regrowth was observed among treatments.

Table 1. The evaluation of prodiamine for control of crabgrass in a Kentucky bluegrass turf.[1]

Material	Rate lb ai/A	Application Time[2]	% Crabgrass[3] 7/02	7/15	8/21	Phytotoxicity[4] 5/30
Dacthal	5.25	Spring	0.0d	10.3d	35.0de	9.0a
Dacthal	5.25	Fall	10.3b	35.0b	80.0bc	9.0a
Dacthal	10.0	Spring	0.0d	0.3d	2.3g	8.7a
Dacthal	10.0	Fall	7.0bc	26.7bc	61.7c	8.7a
Dacthal	21.0	Spring	0.0d	0.0d	0.7g	9.0a
Dacthal	21.0	Fall	0.0d	0.7d	15.0gf	9.0a
Prodiamine	0.25	Spring	0.3cd	3.7d	26.7d-f	8.7a
Prodiamine	0.25	Fall	1.0cd	13.3cd	61.7c	8.3ab
Prodiamine	0.38	Spring	0.3cd	2.3d	15.0fg	8.7a
Prodiamine	0.38	Fall	0.7cd	4.0d	40.0d	8.7a
Prodiamine	0.5	Spring	0.3cd	2.3d	15.0fg	8.3ab
Prodiamine	0.5	Fall	0.3cd	1.0d	36.7de	8.3ab
Prodiamine	0.75	Spring	0.0d	0.3d	0.7g	7.7b
Prodiamine	0.75	Fall	0.0d	1.0d	18.3e-g	8.3ab
Prodiamine	2.0	Spring	0.0d	0.0d	0.0g	8.3ab
Prodiamine	2.0	Fall	0.0d	0.0d	0.3g	6.3c
Check	---	Spring	31.7a	73.3a	93.3ab	9.0a
Check	---	Fall	30.0a	70.0a	100.0a	9.0a
$LSD_{0.05}$			6.9	14.5	18.6	0.9

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

[2]Fall applications were made 6 November 1984 and 3 October 1985. Spring application was made 20 April 1985.

[3]Percent crabgrass represents the area of the treated plot covered by crabgrass plants.

[4]Phytotoxicity evaluations are made on a 1-9 scale where 9 = no visible phytotoxic effects and 1 = complete necrosis.

EFFECTS OF SOIL TEMPERATURE AND MOISTURE ON THE RATE OF DECOMPOSITION OF THE PREEMERGENCE HERBICIDE DCPA.

J. Choi and T. W. Fermanian

INTRODUCTION

The control of summer annual weed species is regarded as one of the more important procedures in modern turfgrass maintenance. The use of preemergence herbicides including DCPA (Dacthal) has been known to be very effective for short term control of this group of weeds. Sometimes, however, turf managers have experienced poor control or early loss of control of target weeds. A study was developed to build a model of preemergence herbicide fate in turf.

DCPA was selected as an example to investigate the effects of major environmental factors such as soil temperature, soil moisture and soil texture on the degradation rate of this herbicide. Microbial degradation is known to be a major route responsible for the loss of DCPA in soil. Because the activity of microorganisms are greatly affected by soil temperature, moisture availability, soil structure, soil pH and other factors, it was necessary to investigate their effects on the degradation of DCPA.

Six different soil temperatures (10, 15, 20, 25, 30, 35 C) and three moisture levels were used in an initial experiment. Field studies followed to find the threshold concentration of DCPA for crabgrass control.

MATERIALS AND METHOD

Treatments were prepared by evenly mixing soil with DCPA (Technical grade, 98.6%) at the rate of 33.6 microgram/g dry soil (equivalent to 10.5 lb ai/A incorporated to a depth of 2.5 cm). The treated soils were placed in erlenmyer flasks and plugged with cotton to minimize evaporation but not impede the respiration of microorganisms.

Constant temperature chambers were built using styrofoam boxes with heating cable installed under hardware cloth racks. The boxes were kept in a refrigerated room (4 C). The desired temperature was maintained by electronic temperature controller using a thermocouple as a sensor. Moisture levels were obtained by adding a predetermined weight of water to the soil. The wettest treatment was near saturation, and the medium and dry levels had 50% and 25% (by weight) of the wettest treatment.

In a second experiment soil and sand were passed through a 1.7 mm sieve before sterilization by an autoclave for 40 min. Soil, sand and soil/sand mixture (50:50 by weight) were used as three different textures of soil. Microorganisms were introduced by adding same amount of nonsterilized (air-dried) soil to the each soil type (about 5% of total weight).

Soil samples (10 g) were removed weekly from each treatment and stored in a freezer until subsequent analyses for the remaining DCPA. The methods of Branham, 1984 were used for the extraction and analyses of all treatments.

In the field experiment eight rates of DCPA were applied to the randomized plots (4 replications) which had been treated with glyphosate and seeded with crabgrass before. Seedlings (in 25 x 25 cm block) were counted after 10 days and 21 days after application. Ten plants were randomly taken from each plot to measure the average dry weight.

RESULTS

Temperature and moisture levels significantly affect the rate of degradation of DCPA. Temperature is the primary factor in determining the rate of degradation. Moisture level can be a limiting factor for some temperature ranges. The half-life of DCPA (Days required for lose of 1/2 of initial activity) as effected by soil temperature and moisture is summarized in Table 1. The field study indicated that over 90% control of crabgrass was possible with the 4.0 lb ai/A rate (Table 2). The result of soil study has not been analyzed yet.

Table 1. Calculated half-life of DCPA (in days).

Moisture	Soil Temperature (C) 35	30	25	20	15	10	subtotal
Wet	18.9	15.4	15.4	14.7	34.5	49.0*	147.7
Med	18.9	11.2	11.2	25.2	35.7	49.0*	151.2
Dry	24.5	21.0	25.2	30.8	49.0*	49.0*	199.5
Subtotal	62.3	47.6	51.8	60.7	119.0	147.0	

* : over 49 days.

Table 2. Effect of DCPA application rate on Crabgrass control.

DCPA rate g/sq m	lb/1000 sq ft	No. of crabgrass No/sq m	control %	Average dry wt mg
0.00	0.0	1046 a *	0	118.75 a *
0.057	0.5	920 ab	13	102.50 a
0.113	1.0	774 b	26	71.50 b
0.170	1.5	554 c	53	54.50 bc
0.226	2.0	432 cd	59	47.50 c
0.283	2.5	284 de	73	45.00 c
0.340	3.0	152 ef	85	33.00 cd
0.396	3.5	138 ef	87	32.25 cd
0.453	4.0	98 f	91	20.50 de
1.189	10.5	4 f	100	2.50 e

* : Mean comparison within column with T-test(lsd) at 5% error level.

POSTEMERGENCE CONTROL OF CRABGRASS

D. J. Wehner and J. E. Haley

INTRODUCTION

Crabgrass (Digitaria sp.) is one of the most frequently occurring weeds in turf stands. It can be controlled by application of either preemergence or postemergence herbicides. The advantage of postemergence treatment is that herbicide use is reduced since applications are made only where the weed occurs. Preemergence herbicides are often applied on areas that do not have a crabgrass problem. A dense turf stand mowed at the proper height will discourage the invasion of crabgrass which reduces or eliminates the need for a preemergence application. The problem with postemergence treatment is that the primary herbicides used in this manner are organic arsenicals (DSMA, AMA, MSMA) which usually require retreatment and can be phytotoxic to the turfgrass stand. The purpose of this research was to evaluate new herbicides compared to a standard treatment with MSMA for postemergence control of crabgrass.

MATERIALS AND METHODS

The herbicides tridiphane (Dow Chemical Co.), Acclaim (fenoxaprop, Hoechst Roussel Agri-Vet Co.), Daconate 6 (MSMA, SDS Biotech), EH 795 and EH 805 (mixtures of MSMA + 2,4-D + MCPP + dicamba, PBI Gordon) and a combination of Acclaim + Trimec were applied at the rates indicated in Table 1 on 19 June 1985 to crabgrass in the 3 leaf to 1 tiller stage. In addition, Acclaim and Daconate 6 were applied to crabgrass in the 2 to 4 tiller stage (Table 2) on 18 July and again on 29 July to crabgrass in the 4 to 6 tiller stage (Table 3). All treatments were applied with a small plot sprayer that delivers 3.5 gallons of water per 1000 square feet. Plots were 3 x 10 feet and there were three replications of each treatment. An untreated check plot was included with each replication. The turfgrass stand was perennial ryegrass. The percent crabgrass in the plot was evaluated several times after application of the treatments. Irrigation was provided as needed to insure good germination and establishment of crabgrass.

RESULTS AND DISCUSSION

The results of this study are presented in Tables 1, 2, and 3. The first spray was made on crabgrass in the 3 leaf to 1 tiller stage. The results indicate that tridiphane at all rates, two applications of EH 795, two applications of EH 805, Acclaim at the 0.18 lb ai/A rate, and two applications of Daconate 6 provided good control of crabgrass as indicated by the weed ratings taken on 15 July. A lower level of control from Acclaim occurred where Trimec was tank mixed with the treatment prior to application. The phenoxy herbicides in Trimec reduced the effectiveness of the Acclaim. The large percentage of crabgrass found in these plots on 21 August indicated that further germination and development of crabgrass occurred after the 19 June application date.

Acclaim was very effective in controlling crabgrass that had reached the 2 to 4 tiller stage (Table 2) and the 4 to 6 tiller stage (Table 3). Daconate 6 provided a somewhat lower level of control than Acclaim. The good control found with Acclaim on these dates indicates that most of the crabgrass had germinated prior to the application of the 18 July treatments.

Table 1. The evaluation of herbicides for postemergence control of crabgrass applied at the 3 leaf to 1 tiller stage of growth on June 19, 1985.[1]

Herbicide	Rate lb ai/A	% Cover of Plot with Crabgrass[2] 7/02	7/15	8/21
Tridiphane	1.0	1.0b	2.3c-e	51.7b-e
Tridiphane	1.5	1.7b	2.3c-e	55.0b-e
Tridiphane	2.0	1.0b	1.0ed	30.0ef
Tridiphane	1.0 + 1.0*	0.7b	0.0e	10.3f
EH 795	5 oz ai/1000 sq ft	0.7b	7.0b-d	50.0b-e
EH 795	5 oz + 5 oz ai/1000 sq ft**	2.0b	0.3e	33.7c-f
EH 805	5 oz ai/1000 sq ft	0.7b	10.3b	70.0a-c
EH 805	5 oz + 5 oz ai/1000 sq ft**	2.0b	1.7de	33.3d-f
Acclaim	0.12	0.7b	8.3bc	66.7a-d
Acclaim	0.18	0.7b	2.3c-e	65.0a-e
Acclaim + Trimec	0.18 + 4 pts product/A	1.7b	11.7b	85.0ab
Acclaim + Trimec	0.25 + 4 pts product/A	0.7b	8.3bc	71.7ab
Daconate 6	2.0 + 2.0**	2.3b	2.3c-e	55.0b-e
Check	---	16.7a	31.7a	98.3a
$LSD_{0.05}$		3.7	6.6	36.4

[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]Percent cover of plot with crabgrass represents the area of the treated plot covered by crabgrass plants.

*The second application was made 30 days after the first application.

**The second application was made 10 days following the first application.

Table 2. The evaluation of herbicides for postemergence control of crabrass applied at the 2-4 tiller stage of growth on July 18, 1985.[1]

Material	Rate lb ai/A	% Cover[2] 8/21
Acclaim	0.18	5.3c
Acclaim	0.25	1.0c
Daconate 6	2 + 2*	18.3b
Check	---	86.7a
$LSD_{0.05}$		10.7

Table 3. The evaluation of herbicides for postemergence control of crabrass applied at the 4-6 tiller stage of growth on July 29, 1985.[1]

Material	Rate lb ai/A	% Cover[2] 8/21
Acclaim	0.25	1.0c
Acclaim	0.35	1.0c
Daconate 6	2 + 2*	13.3b
Check	---	98.3a
$LSD_{0.05}$		8.3

[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 represents the area of the treated plot covered by crabgrass plants.

*The second application was made 10 days following the first.

AN EVALUATION OF ACCLAIM FOR PHYTOTOXICITY TO KENTUCKY BLUEGRASS AND CREEPING BENTGRASS

D. J. Wehner and J. E. Haley

INTRODUCTION

The herbicide Acclaim (fenoxaprop, Hoechst Roussel Agri-Vet) has been shown to be an effective postemergence control of crabgrass. Information is needed to determine if there is phytotoxicity associated with the use of this herbicide on Kentucky bluegrass and creeping bentgrass. The purpose of this study was to evaluate the phytotoxicity of Acclaim with and without several safeners on Kentucky bluegrass and creeping bentgrass.

MATERIALS AND METHODS

Acclaim, with and without safeners was applied at the rates indicated in Table 1 to a stand of Toronto creeping bentgrass on 27 August 1985 and to a stand of Kentucky bluegrass at the rates indicated in Table 2 on 12 July 1985. The treatments were applied with a small plot sprayer that delivers 3.5 gallons of water per 1000 square feet. Plots were observed for phytotoxicity and ratings were made two times after the application of the treatments. The creeping bentgrass was mowed at 0.25 inches while the Kentucky bluegrass was mowed at 1.5 inches. Rainfall occurred approximately three hours after the application of the treatments to the Kentucky bluegrass turf. Plot size was 3 x 10 feet with three replications of each treatment. An untreated check plot was included with each replication.

RESULTS AND DISCUSSION

Acclaim at the 0.08 and 0.12 lb ai/acre rate caused discoloration to Toronto creeping bentgrass as evidenced by the phytotoxicity ratings taken on 6 September and 13 September (Table 1). The discoloration disappeared approximately 1 to 2 weeks later. The injury reduced somewhat by the addition of the safeners, however, was still judged as unacceptable. The low rate of Acclaim (0.04 lb ai/acre) did not injure the creeping bentgrass. We have not tested this rate for control of crabgrass.

There was no phytotoxicity from Acclaim applications evident on the Kentucky bluegrass turf (Table 2). Although rain occurred several hours after treatment application, the manufacturer has indicated that Acclaim is rapidly absorbed by the leaf and that the precipitation probably did not affect our results. Some of the safeners tended to cause a slight enhancement of color as evidenced by the quality ratings numerically higher than the control. According to the Acclaim label, some phytotoxicity may occur on Kentucky bluegrass when treatments are made earlier in the summer. We will be testing this herbicide again in 1986 to determine if earlier applications are phytotoxic to Kentucky bluegrass.

Table 1. Phytotoxicity of Acclaim applied to a creeping bentgrass putting green on August 27, 1985.[1]

Herbicide	Rate lb ai/A	Safener[2]	Rate[3]	Phytotoxicity[4] 9/06	Phytotoxicity[4] 9/13
None	--	1	1	9.0a	9.0a
None	--	1	2	8.7a	9.0a
None	--	2	1	9.0a	9.0a
None	--	2	2	9.0a	9.0a
Acclaim	0.04	1	1	8.3ab	8.3a-c
Acclaim	0.08	1	1	7.7bc	8.7ab
Acclaim	0.12	1	1	7.7bc	8.3a-c
Acclaim	0.04	1	2	8.7a	9.0a
Acclaim	0.08	1	2	9.0a	9.0a
Acclaim	0.12	1	2	7.7bc	7.0cd
Acclaim	0.04	2	1	8.7a	8.3a-c
Acclaim	0.08	2	1	8.7a	8.3a-c
Acclaim	0.12	2	1	7.7bc	8.0a-d
Acclaim	0.04	2	2	9.0a	9.0a
Acclaim	0.08	2	2	8.7a	7.7a-d
Acclaim	0.12	2	2	7.3c	7.7a-d
Acclaim	0.04	-	-	9.0a	9.0a
Acclaim	0.08	-	-	7.0cd	7.3b-d
Acclaim	0.12	-	-	6.3d	6.7d
Check	--	-	-	9.0a	9.0a
$LSD_{0.05}$				0.8	1.3

[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]Safener formulations are undisclosed.

[3]Safener rates are as follows: safener 1, rate 1 = 9.5 ml material A per 1 gram material C; safener 1, rate 2 = 19.1 ml material A per 1 gram material C; safener 2, rate 1 = 5 ml material B per 1 gram material C; safener 2, rate 2 = 10 ml material B per 1 gram material C.

[4]Phytotoxicity evaluations are made on a 1-9 scale where 9 = no visible phytotoxic effects and 1 = complete necrosis.

Table 2. Quality of a Kentucky bluegrass turf treated with Acclaim plus safeners on July 12, 1985.[1]

Herbicide	Rate lb ai/A	Safener[2]	Rate[3]	Quality[4] 7/26	Quality[4] 8/30
None	--	1	1	7.0	5.7
None	--	1	2	7.3	5.7
None	--	2	1	6.0	4.7
None	--	2	2	7.0	5.0
Acclaim	0.12	1	1	6.0	5.0
Acclaim	0.18	1	1	6.7	5.0
Acclaim	0.25	1	1	6.0	5.0
Acclaim	0.35	1	1	5.7	5.0
Acclaim	0.12	1	2	7.0	6.0
Acclaim	0.18	1	2	7.0	6.3
Acclaim	0.25	1	2	6.7	5.0
Acclaim	0.35	1	2	6.3	6.3
Acclaim	0.12	2	1	6.7	4.7
Acclaim	0.18	2	1	7.0	6.3
Acclaim	0.25	2	1	6.7	5.7
Acclaim	0.35	2	1	5.7	5.3
Acclaim	0.12	2	2	6.7	6.0
Acclaim	0.18	2	2	7.3	6.0
Acclaim	0.25	2	2	7.3	6.3
Acclaim	0.35	2	2	6.7	6.0
Acclaim	0.12	-	-	6.3	6.0
Acclaim	0.18	-	-	6.7	5.3
Acclaim	0.25	-	-	6.7	5.7
Acclaim	0.35	-	-	6.0	5.7
Check	--	-	-	6.7	5.3
$LSD_{0.05}$				NS	NS

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

[2]Safener formulations are undisclosed.

[3]Safener rates are as follows: safener 1, rate 1 = 9.5 ml material A per 1 gram material C; safener 1, rate 2 = 19.1 ml material A per 1 gram material C; safener 2, rate 1 = 5 ml material B per 1 gram material C; safener 2, rate 2 = 10 ml material B per 1 gram material C.

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

THE USE OF POSTEMERGENCE HERBICIDES ON TALL FESCUE

J. E. Haley and T. W. Fermanian

INTRODUCTION

Two herbicides currently under development for postemergence broadleaf weed control in tall fescue turf are Telar (chlorsulfuron) and Escort (DPX T6376). Both herbicides are used at very low rates making them cost effective for weed control with an added potential as growth regulators. These traits are especially important for herbicides used on tall fescue turf where low maintenance is a key consideration. Herbicides that control broadleaf weeds and at the same time reduce turf growth and seedhead production would be useful to the turfgrass industry. The object of this study was to determine the effect of these materials on turfgrass phytotoxicity, stand thinning and seedhead production. Since Telar and Escort are both resistant to degradation in the soil, the carry over of herbicide from one season to the next is of concern. This study will extend over three years to measure the long term effects of repeated applications.

A second experiment was initiated in 1985 to evaluate the phytotoxic effects of M6316 (Harmony) and DPX-L5300, two experimental herbicides for cereals and to further examine Escort.

Experiment I

MATERIALS AND METHODS

The products tested were Telar at 0.19, 0.56 and 1.31 oz ai/A and Escort at 0.24, 0.48 and 0.72 oz ai/A. These were applied in a 0.25% v/v solution of the surfactant X77. Also included in the test was a treatment of 2,4-D (1.0 lb ai/A) plus Banvel (at 0.25 lb ai/A) as an industry standard for broadleaf weed control. Treatments were replicated 3 times and an untreated check plot was included with each replication. All materials were applied 11 May 1984 and 3 May 1985 to 3 x 10 feet plots of tall fescue turf using a CO_2 propelled backpack sprayer at a spray volume of 40 gallons/A. Plots were <u>not</u> mowed following application until September.

RESULTS

In 1984, tall fescue plots were evaluated for damage from herbicides 2, 3, 4, 5 and 7 weeks after treatment. In general, turf treated with Escort had more injury than turf treated with Telar, although the highest rate of Telar produced serious injury for several weeks. Turf injury with Telar at 0.19 and 0.56 oz ai/A was mild to moderate. Some injury was seen with the 2,4-D + Banvel combination but this was never significantly different than the control. All rates of Escort gave excellent control of seedhead production.

Good to excellent control of seedhead production was found with all rates of Telar. No control of seedhead production was seen with the 2,4-D + Banvel combination.

In 1985 the same general trends were observed with the phytotoxicity ratings as in 1984 (Table 1). During 1985 no injury was observed with Banvel. Few seedheads appeared in any of the Telar or Escort treated plots (Table 2). With most rates of Telar and Escort height was significantly lower than turf height in the untreated check plots up to 38 days following herbicide application (Table 2).

Experiment II

MATERIALS AND METHODS

Treatments in the second experiment were Escort at 0.075, 0.15, 0.30 and 0.6 oz ai/A, DPX L5300 at 0.5 and 1.0 oz ai/A and M6316 at 0.5, 1.0 and 2.0 oz ai/A. These materials were applied in a 0.25 % v/v solution of the surfactant X77. The herbicide 2,4-D at 1.0 lb ai/A was included as the industry standard for broadleaf weed control. Treatments were replicated 3 times and an untreated check plot was included with each replication. All materials were applied 3 May 1985 to 3 x 10 feet plots of tall fescue using a CO_2 propelled backpack sprayer at a spray volume of 40 gallons of water/A. Plots were not mowed following application until September.

RESULTS

Only minor turf injury was observed up to 25 days after application with M6316 at all rates (Table 3). Moderate injury was observed with Escort and L5300 (Table 3). With Escort at 0.6 oz ai/A this injury was observed as long as 53 days following herbicide application. No injury was found on tall fescue treated with 2,4-D.

Turf height was significantly reduced when compared to the check with all treatments through 25 days after application (Table 4). The exception to this was M6316 at 0.5 oz ai/A and 2,4-D at 1 lb ai/A. All turf treated with herbicide had significantly fewer seedheads than found in the check plots.

Table 1. The evaluation of the phytotoxic effects of postemergence herbicides on tall fescue.[1]

		Phytotoxicity[2]					
	Rate	2 WAT*	3 WAT	4 WAT	5 WAT	6 WAT	7 WAT
Material	oz ai/A	5/20	5/28	6/03	6/10	6/17	6/25
Telar	0.19	7.7b	7.7b	7.7b	7.0b	8.7a	8.3a
Telar	0.56	6.7bc	6.3c	5.7c	6.3b	6.3b	7.0b
Telar	1.31	6.7bc	5.3cd	4.7d	4.3d	5.3cd	6.3bc
Escort	0.24	6.0cd	6.0cd	5.7c	5.3c	5.7c	6.3bc
Escort	0.48	6.3c	5.3cd	4.7d	4.7cd	5.0d	6.3bc
Escort	0.72	5.0d	5.0d	4.0e	4.0d	5.0d	6.0c
2,4-D + Banvel	1.0 lb ai/A + 0.25 lb ai/A	9.0a	9.0a	9.0a	9.0a	9.0a	9.0a
Control	---	9.0a	9.0a	9.0a	9.0a	9.0a	9.0a
$LSD_{0.05}$		1.2	1.0	0.5	0.7	0.6	1.0

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

[2]Phytotoxicity evaluations are made on a 1-9 scale where 9 = no visible phytotoxic effects and 1 = necrotic.

*WAT refers to weeks after treatment.

Table 2. The evaluation of plant growth and seedhead development of tall fescue treated with postemergence herbicides.[1]

	Rate	Height[2]				Percent
		25 DAT[4]	38 DAT	55 DAT	87 DAT	Seedhead[3]
Material	oz ai/A	5/28	6/10	6/27	7/29	5/28
Telar	0.19	8.2b	9.4cd	12.0b	20.0	2.0b
Telar	0.56	7.9bc	9.7bc	11.3bc	19.4	1.0b
Telar	1.31	6.4c	7.5d	10.0c	17.0	0.3b
Escort	0.24	6.7bc	8.3cd	10.6bc	16.2	0.0b
Escort	0.48	7.6bc	9.0cd	10.6bc	19.9	0.3b
Escort	0.72	7.3bc	8.0cd	10.0c	17.8	0.0b
2,4-D +	1.0 lb ai/A +					
Banvel	0.25 lb ai/A	13.4a	12.1a	14.5a	21.4	25.0a
Check	--	11.8a	11.6ab	12.5b	19.0	25.0a
$LSD_{0.05}$		1.7	1.9	2.0	NS	4.2

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

[2]Height refers to the average height in centimeters of the turfgrass plants.

[3]Percent seedheads represents the average percent of turfgrass plants in the treated plot, bearing seedheads.

[4]DAT refers to days after treatment.

Table 3. The evaluation of the phytotoxic effects of postemergence broadleaf herbicides on a tall fescue turf.[1]

	Rate	Phytotoxicity[2]					
		17 DAT[*]	25 DAT	31 DAT	38 DAT	45 DAT	53 DAT
Material	oz ai/A	5/20	5/28	6/03	6/10	6/17	6/25
Escort	0.075	6.7c	6.3b	8.0bc	8.0b	9.0a	9.0a
Escort	0.15	6.3c	5.7b	6.7d	7.0c	8.7a	8.3bc
Escort	0.3	6.0cd	4.3c	5.3e	5.3d	7.0b	8.0c
Escort	0.6	5.3de	4.3c	4.7e	4.3e	5.7c	6.7d
L5300	0.5	6.3c	6.7b	8.3ab	9.0a	9.0a	8.7ab
L5300	1.0	6.3c	6.0b	8.0bc	9.0a	8.7a	9.0a
L5300	2.0	5.0e	6.0b	7.3cd	7.3c	7.7b	8.3bc
M6316	0.5	8.3ab	9.0a	9.0a	9.0a	9.0a	8.7ab
M6316	1.0	8.0b	8.3a	9.0a	9.0a	9.0a	9.0a
M6316	2.0	7.7b	8.7a	9.0a	9.0a	9.0a	9.0a
2,4-D	1.0 lb ai/A	9.0a	9.0a	9.0a	9.0a	9.0a	9.0a
Check	----	9.0a	9.0a	9.0a	9.0a	9.0a	9.0a
$LSD_{0.05}$		0.7	1.0	0.8	0.4	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]Phytotoxicity evaluations are made on a 1-9 scale where 9 = no visible phytotoxic effects and 1 = complete necrosis.

[*]DAT refers to days after application.

Table 4. The effects of postemergence broadleaf herbicides on plant height and seedhead production when applied to tall fescue.[1]

Material	Rate oz ai/A	Height[2] 25 DAT* 5/28	38 DAT 6/10	53 DAT 6/25	87 DAT 7/29	Percent Seedheads[3] 5/28
Escort	0.075	9.2c-e	12.3	13.1c	23.1	3.3fg
Escort	0.15	8.1e	12.4	13.9bc	30.5	0.3g
Escort	0.3	8.0ef	10.4	13.4c	22.3	0.3g
Escort	0.6	6.3f	13.6	11.0d	21.0	0.0g
L5300	0.5	9.7c-e	12.8	15.7ab	27.3	8.3e
L5300	1.0	9.4c-e	10.8	14.8a-c	21.9	5.0ef
L5300	2.0	8.9de	11.4	13.3c	23.0	2.0fg
M6316	0.5	11.7ab	10.4	16.8a	27.4	18.3c
M6316	1.0	10.4b-d	9.4	14.3bc	24.4	13.3d
M6316	2.0	10.8bc	12.4	14.5bc	25.7	2.3fg
2,4-D	1.0 lb ai/A	12.7a	11.8	14.7a-c	25.4	40.0b
Check	---	12.9a	11.6	13.9bc	23.8	46.7a
$LSD_{0.05}$		1.8	NS	2.2	NS	4.5

[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]Height refers to the average height in centimeters of the turfgrass plants.

[3]Percent seedheads represents the average percent of turfgrass plants bearing seedheads.

*DAT refers to days after treatment.

EVALUATION OF HERBICIDES FOR BROADLEAF WEED CONTROL IN TURF

J. E. Haley and D. J. Wehner

INTRODUCTION

The purpose of this research was to evaluate several herbicides for postemergence control of broadleaf plantain (Plantago major L.), buckhorn plantain (Plantago lanceolate L.) and white clover (Trifolium repens L.) in a mixed Kentucky bluegrass - tall fescue turfgrass stand and for control of wild violets (Viola spp.) in a shaded Kentucky bluegrass stand.

Plantain and White Clover Control

MATERIALS AND METHODS

The first experiment evaluated plantain and clover control. Herbicides were applied 2 July 1985 in 3.5 gallons of water per 1000 sq ft (Table 1). Plot size was 3 x 8 feet and each treatment was replicated 3 times. An untreated check was included within each replication. Weed control evaluations were made on a scale of 1-9, where 9 = a large, healthy weed population and 1 = no weeds present. Ratings were made 13 August 1985.

RESULTS

Excellent control of both plantain species was obtained with all materials at all rates (Table 2). Good control of white clover was found with all materials at all rates (Table 2). However white clover control ratings of 2 or lower were found with EH 680 at 3 pt product/A, EH 791 at 3 pt product/A, Turflon D at 4 pt product/A and Riverdale Triamine at 4 pt/A.

Wild Violet Control

MATERIALS AND METHODS

The second experiment evaluating wild violet control, examined the same herbicides and rates used in the plantain/clover evaluation. Also included in this trial were three rates of CGA 131036 (Ciba Geigy) and 1 rate of Telar (DuPont) (Table 1). Herbicides were applied 21 May 1985 in 3.5 gallons water per 1000 sq ft. Plot size was 3 x 6 feet and each treatment was replicated 3 times. An untreated check plot was included within each replication. Weed control evaluations were recorded as the percent decrease of wild violets in the treated plots when compared with the check. Ratings were made 21 July and 21 August 1985.

RESULTS

The best control of wild violets on the July rating date was found with all rates of Turflon D, Turflon Superamine, CGA 131036 and Telar (Table 3). By August only Turflon D at 4 pt product/A, Turflon Superamine at 4 pt product/A, CGA 131036 at 25 gram ai/A and 60 gram ai/A and Telar provided 75% or greater control (Table 3). This would indicate that with some materials at lower rates a second application of herbicide is needed later in the season for best control of wild violets.

Table 1. Herbicides evaluated for postemergence control of broadleaf and buckhorn plantains, white clover and wild violets.

Herbicide	Active Ingredients	Manufacturer
EH 680 ester formulation	2,4-D, MCPP, Dicamba	PBI/Gordon Corporation
EH 791 ester formulation	2,4-D, MCPP, Dicamba	PBI/Gordon Corporation
EH 637 amine formulation	2,4-D, MCPP, Dicamba	PBI/Gordon Corporation
EH 553 amine formulation	2,4-D, MCPP, Dicamba	PBI/Gordon Corporation
Turflon D ester formulation	2,4-D, Triclopyr	Dow Chemical
Turflon Superamine	2,4-D, Triclopyr	Dow Chemical
Riverdale Triamine	2,4-D, MCPP, 2,4-DP	Riverdale Chemical Company
Riverdale Ester	2,4-D, MCPP	Riverdale Chemical Company
CGA 131036 20DG*	-----	Ciba Geigy
Telar 75DG*	Chlorsulfuron	DuPont

*These materials were only tested in the wild violet control evaluation. They were appliedin a 0.25% v/v solution of the surfactant X77.

Table 2. Postemergence control of plantain and clover six weeks following herbicide application.[1]

Material	Rate pints product/A	Weed Control[2] Plantain	White Clover
EH 680	3.0	2.0b	1.0d
EH 791	3.0	1.7b	2.0b-d
EH 637	4.0	2.3b	4.3bc
EH 553	4.0	1.3b	3.0b-d
Turflon D	3.0	2.7b	4.3bc
Turflon D	3.5	2.3b	4.3bc
Turflon D	4.0	2.0b	1.7cd
Turflon Superamine	3.0	2.0b	4.7b
Turflon Superamine	3.5	1.3b	2.3b-d
Turflon Superamine	4.0	1.3b	3.3b-d
Riverdale Triamine	3.0	3.0b	3.7b-d
Riverdale Triamine	4.0	2.0b	1.7cd
Riverdale Ester	3.0	1.3b	3.7b-d
Check	---	9.0a	9.0a
$LSD_{0.05}$		2.3	3.0

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

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

Table 3. Evaluation of herbicides for wild violet control in a Kentucky bluegrass turf.[1]

Material	Rate pints product/A	Percent Control[2] 7/21	Percent Control[2] 8/21
EH 680	3.0	40.8bc	36.7e-h
EH 791	3.0	41.4bc	46.2e-g
EH 637	4.0	39.4bc	29.0f-h
EH 553	4.0	41.7bc	29.2f-h
Turflon D	3.0	85.9a	59.4c-e
Turflon D	3.5	96.1a	72.8b-d
Turflon D	4.0	87.0a	75.3a-d
Turflon Superamine	3.0	82.2a	44.4e-g
Turflon Superamine	3.5	90.3a	72.5b-d
Turflon Superamine	4.0	94.7a	80.2a-c
CGA 131036	10 grams ai/A	84.6a	53.7d-f
CGA 131036	25 grams ai/A	97.4a	90.4ab
CGA 131036	60 grams ai/A	100.0a	100.0a
Telar	25 grams ai/A	100.0a	93.7ab
Riverdale Triamine	3.0	46.7b	26.7gh
Riverdale Triamine	4.0	50.0b	17.8h
Riverdale ester	3.0	21.7c	21.7gh
$LSD_{0.05}$		22.9	25.5

[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 control represents the percent decrease of wild violets in the treated plots when compared with the untreated check.

DEVELOPMENT OF AgAssistant:

A TOOL FOR THE CONSTRUCTION OF COMPUTER-BASED EXPERT SYSTEMS

T. W. Fermanian, R. S. Michalski, and B. Katz

In April 1983, a research project entitled "A Computer-Oriented Methodology for Representing and Conducting Inferences on Agricultural Knowledge: A Case Problem of Turfgrass Establishment and Maintenance" was initiated through a grant from the University of Illinois Research Board. The goal of this project was to develop a methodology for computer representation of expert knowledge in agriculture through a joint effort between the Departments of Horticulture and Computer Science. In addition to Dr. Fermanian and Dr. Michalski, two graduate students (Bruce Katz, Department of Computer Science, and Haibo Liu, Department of Horticulture) are currently working on the project. An additional graduate research assistant, Jim Kelly, has recently been added to the project in January 1986.

In a test of this methodology, two expert systems in the general areas of turfgrass establishment (TGA) and weed identification and control (WEED) are being developed. These systems will provide advice to professional turfgrass managers, county extension advisors, educators, farmers, and homeowners on the establishment and maintenance of turfgrasses.

AgAssistant, an expert systems development tool, has been developed as part of the project. AgAssistant is based on the general-purpose expert system ADVISE that was developed at the University of Illinois Department of Computer Science. AgAssistant is written in Turbo-Pascal and implemented on the IBM PC/XT. The IBM PC/XT was chosen due to its portability and wide availability. AgAssistant contains a program, Generalization of Example by Machine (GEM), which can induce rules through examples of expert decisions. This tool for knowledge acquisition is not available in other microcomputer expert system shells. GEM greatly simplifies and reduces the time necessary to develop new expert systems.

Turfgrass Establishment Advisor (TEA), an expert system to advise on turfgrass establishment, will contain rules for the appropriate selection of turfgrass cultivars and the necessary steps in turfgrass establishment. Many of these rules will be induced from examples of their performance in the regional turfgrass cultivar evaluation trials in Illinois. In general, most of the example sets will be large and complex. This project has just begun, with the first version of TEA being available sometime in 1987.

The weed identification expert system, WEED, provides an efficient identification system. Expert systems technology offers a new approach to weed or other pest identification. Traditional tools for identification of pests have been dichotomous keys. In order for an unknown pest to be successfully identified, the appropriate identifying characteristics have to be present and distinguishable on the sample. Oftentimes partial information results in nonidentification, with little clue as to the correct information. A rule-based expert system can provide the ability to make a knowledgeable decision on the identification of an unknown pest with only fragmented or partial information. WEED has rules for 42 common grassy weeds found in turf throughout the United States. The WEED system has been under development for the past 18 months and will be ready in the latter part of 1986.

New Areas of Future Research

Recent support through the University of Illinois College of Agriculture and the Agriculture Experiment Station has provided the project with two additional graduate research assistantships. This support was provided as seed to develop an expanded project in knowledge acquisition and expert systems development in agriculture and to attract further funding for additional systems development. Recently the Illinois Turfgrass Foundation has also contributed funding for the purchase of an IBM PC/AT necessary for the further development of AgAssistant.

With the expansion of these projects, the second area of research can proceed. Statistical analysis has served agricultural research well. Like all tools, however, it has inherent weaknesses along with its strengths. Statistical analysis is based on numerical procession rather than symbolic processing. Agriculture scientists often evaluate an experiment in subjective, qualitative terms (that is, good, fair, poor, etc.), than convert these evaluations to a numeric scale (1, 2, 3, etc.) for analysis. Conceptual data analysis through machine learning programs might be a more advantageous process for the evaluation of this type of knowledge. Experiments will be designed to test this hypothesis and understand the optimal combination of both techniques.

PREEMERGENCE AND POSTEMERGENCE ACTIVITY OF CUTLESS AND RUBIGAN ON THE GERMINATION AND DEVELOPMENT OF ANNUAL BLUEGRASS AND CREEPING BENTGRASS

J. E. Haley and T. W. Fermanian

INTRODUCTION

Annual bluegrass (Poa annua) is often the major component of golf course turf. It competes well with creeping bentgrass (Agrostis palustris) when irrigation is frequent, nitrogen levels are high, and mowing heights are low. Even when mowing heights are 0.25 inches or less, annual bluegrass is able to produce vast quantities of seed. Annual bluegrass is often considered an undesirable golf turf. It is susceptible to winter damage and is difficult to maintain as a quality turf during stressful summer months. The purpose of this study was to evaluate the effects of Cutless (El-500) and Rubigan on the growth rate of annual bluegrass and creeping bentgrass before and soon after seedling emergence.

MATERIALS AND METHODS

Seeds of both species, Poa annua and Agrostis palustris cv. 'Penneagle' were sown in dry, sterilized, unmodified Kirkland silt loam soil. P. annua was seeded at 2 lb/1000 sq ft. A. palustris cv. Penneagle was sown at 1 lb/1000 sq ft. Germination of P. annua was at least 88% and germination of A. palustris cv. Penneagle was at least 72%. Seed was applied by hand to the soil surface and lightly "raked" into the soil.

Preemergence and postemergence treatments consist of Cutless at 0.5, 0.75, 1.0, and 2.0 lb ai/A and Rubigan at 2.5 lb ai/A. An untreated control was also included as a treatment. Preemergence treatments were applied December 5, 1984, to seeded, dry soil. After application, pots were placed on a mist bench. By December 10, both species had started to germinate. Postemergence control treatments were applied December 21, 1984. All turf was at least 1 inch in height at the time of application. After treatment, the pots were returned to the mist bench until December 24, 1984. At this time they were removed from the mist and watered as needed.

All herbicides were applied in a pesticide spray chamber using a spray volume of 25 gpa at 1/2 the treatment rate in each of two applications. This gave a total spray volume of 50 gpa for each desired rate. The nozzle tip used was a Teejet 8002E with a 30 inch swath. Pots were aligned in the chamber so that they were treated with only the center 6 inches of the spray pattern. The nozzle traveled at a speed of 1.0 mph. The pressure at the nozzle tip was 20 psi.

RESULTS AND DISCUSSION

Evaluations were made six weeks following treatment (see Table 1 through Table 4). Measurements were made on January 16, 1985, for the preemergence applications and February 1, 1985, for the postemergence applications.

Phytotoxicity (or crop injury) was rated visually utilizing a 1 through 9 scale where 9 represents no visible injury and 1 represents complete necrosis. Most injury to both species occurred with the postemergence application of all materials, especially with Rubigan and the highest rate of Cutless. Plant injury was also apparent in both species with a preemergence application of Rubigan. Injury with Rubigan was most visible as wilting and spotting. Postemergence injury with Cutless was visible as tip dieback.

Percent cover was evaluated by visual estimation of each pot covered with turf. Cutless at 2.0 lb ai/A and the Rubigan treatment significantly reduced turf cover for both species. All treatments significantly reduced turf cover when the treatments were applied prior to seed germination. Percent cover was least affected by lower rates of Cutless when applied as a postemergent treatment.

Height measurements represent the average height in centimeters of the turf canopy. All treatments resulted in reduced growth to both species. The exception was Rubigan applied as a postemergent to annual bluegrass. With that treatment, height measurements were not significantly lower than the control.

Clipping weights represent the dried weight in grams/m^2 of the turf plants harvested at soil level six weeks following treatment. All treatment weights were significantly lower than the controls for both species and application times. The consistently measured reduction in growth of both species with any applications of Cutless or Rubigan indicates significant activity of the materials on young seedlings of both species regardless of application techniques.

The reader is cautioned to evaluate the results of this study carefully. The trends suggested by this data represent one study in a greenhouse environment.

Table 1. The evaluation of Cutless and Rubigan applied to annual bluegrass prior to seed germination.[1]

Material	Rate lb ai/A	Phytotoxicity[2]	Percent Cover[3]	Height[4] (cm)	Clipping Weights[5]
Cutless	0.5	9.0a	76.7b	4.4b	39.7b
Cutless	0.75	9.0a	40.8c	1.6c	19.6c
Cutless	1.0	9.0a	33.3c	1.6c	16.3cd
Cutless	2.0	8.8a	12.8d	1.1c	9.3d
Rubigan	2.5	4.2b	5.3d	3.6b	10.3d
Control	---	9.0a	100.0a	9.6a	81.6a
$LSD_{0.05}$		0.6	14.1	0.8	8.7

Table 2. The evaluation of Cutless and Rubigan applied to annual bluegrass when seedlings are 1 inch in height.[1]

Material	Rate lb ai/A	Phytotoxicity[2]	Percent Cover[3]	Height[4] (cm)	Clipping Weights[5]
Cutless	0.5	7.7b	93.3ab	3.1b	51.7b
Cutless	0.75	7.5bc	89.2b	2.9b	47.9b
Cutless	1.0	6.7c	76.7c	2.7b	44.6bc
Cutless	2.0	5.0d	58.3d	2.4b	34.3c
Rubigan	2.5	3.8e	69.2c	8.6a	41.3bc
Control	---	8.7a	100.0a	9.6a	97.9a
$LSD_{0.05}$		1.0	9.3	4.1	11.4

[1]All values represent the mean of 6 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 to 9 scale, where 9 = no visible damage to the turf and 1 = complete necrosis.

[3]Percent cover indicates the percent of the pot area covered by turfgrass plants.

[4]Height measurements represent the average height in cm of the turf canopy.

[5]Clipping weights represent the dried weight in grams/m^2 of the turf plants harvested at soil level.

Table 3. The evaluation of Cutless and Rubigan applied to creeping bentgrass prior to seed germination.[1]

Material	Rate lb ai/A	Phytotoxicity[2]	Percent Cover[3]	Height[4] (cm)	Clipping Weights[5]
Cutless	0.5	9.0a	42.5b	1.6c	12.0b
Cutless	0.75	9.0a	17.5c	1.1c	5.4cd
Cutless	1.0	9.0a	11.7cd	1.0c	9.2bc
Cutless	2.0	9.0a	4.0d	0.8c	2.2d
Rubigan	2.5	2.8b	1.7d	3.7b	3.3d
Control	---	9.0a	100.0a	9.4a	40.8a
$LSD_{0.05}$		0.5	13.3	0.9	5.4

Table 4. The evaluation of Cutless and Rubigan applied to creeping bentgrass when seedlings are 1 inch in height.[1]

Material	Rate lb ai/A	Phytotoxicity[2]	Percent Cover[3]	Height[4] (cm)	Clipping Weights[5]
Cutless	0.5	8.8a	93.3a	2.2c	34.3bc
Cutless	0.75	8.3a	90.8a	1.8cd	44.1b
Cutless	1.0	7.2b	51.7b	1.5cd	25.0c
Cutless	2.0	1.8d	7.3c	0.8d	6.5d
Rubigan	2.5	3.3c	39.2b	7.4b	35.4bc
Control	---	8.7a	100.0a	10.4a	58.2a
$LSD_{0.05}$		0.6	13.3	1.1	13.1

[1]All values represent the mean of 6 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 to 9 scale, where 9 = no visible damage to the turf and 1 = complete necrosis.

[3]Percent cover indicates the percent of the pot area covered by turfgrass plants.

[4]Height measurements represent the average height in cm of the turf canopy.

[5]Clipping weights represent the dried weight in grams/m^2 of the turf plants harvested at soil level.

EVALUATION OF CUTLESS AND NITROGEN FERTILIZER RATES ON CREEPING BENTGRASS GROWTH

T. W. Fermanian and J. E. Haley

INTRODUCTION

Cutless, a turfgrass growth retardant, has demonstrated the capability to suppress annual bluegrass growth. This capability could be useful when increasing bentgrass populations in a mixed annual bluegrass and creeping bentgrass stand. The general use of Cutless for this purpose, however, raises a number of questions concerning the appropriate management of turf treated with Cutless. A prime consideration is the need to understand how fertilization will affect the performance of Cutless. Soluble nitrogen fertilizers applied to Cutless-treated turfs have shown the ability to override the growth-inhibiting effects of this material. This study was designed to determine the effects of varying rates of Cutless 50WP and urea fertilizer on the growth rates of creeping bentgrass.

MATERIALS AND METHODS

A field experiment, located at the Ornamental Horticulture Research Center, was designed to test combinations of applications of Cutless and urea fertilizer. Cutless rates were 0, 0.38, 0.50, and 0.75 lb ai/A. Urea (46-0-0) rates were 0, 0.38, 0.75, and 1.5 lb nitrogen (N)/1000 sq ft. These materials were applied alone and in all possible combinations (Table 1). All treatments were applied 9 May 1985 to a 0.75 inch high creeping bentgrass turf (Agrostis palustris cv. 'Penncross'). Cutless was applied with a CO^2 propelled backpack sprayer at a spray volume of 40 gal/A. Granular urea was applied to each plot by hand. Plots were irrigated immediately after application of Cutless and N. The entire experimental area was not mowed following applications of all treatments. Plot size was 3 x 12 feet, with three replications of each treatment. All plots were monitored and evaluated for crop injury, color, and growth rate.

RESULTS

The average height of the turf in each plot was obtained at 20, 32, and 46 days after the initial treatment. The results of the analysis of these measurements are listed in Table 1. Twenty days after treatment, there was no significant difference in turf height among any plots receiving 0.38 lb N/1000 sq ft or less, regardless of any application of Cutless. For the same days, plots receiving 0.75 lb N/1000 sq ft only showed an increased growth on plots to which Cutless was not applied or on which the 0.38 lb ai/A rate was used. Plots receiving 0.75 lb N/1000 sq ft or more showed significantly reduced growth when Cutless was applied at 0.75 lb ai/A or more, as compared to the nonCutless treated plots receiving the same levels of fertilization. The same general trends were also evident at 32 and 46 days after treatment, with a general increase in the height measurement.

Evaluations of turf color were obtained at 13, 25, and 47 days after treatment. An initial observation showed that, for the first two measurement periods, Cutless-treated plots receiving no fertilization were a significantly darker green than were the check plot receiving no Cutless or N. Also, at 13 days after treatment, plots receiving any rate of Cutless and 1.5 lb N/1000 sq ft were significantly darker green in color than were plots receiving no Cutless and 1.5 lb N/1000 sq ft. All other fertilized plots had a similar color whether or not they were treated with any rate of Cutless. The effects of the application of N or Cutless alone were not apparent at 47 days after treatment. However, plots treated with 0.75 lb N/1000 sq ft and any rate of Cutless were significantly darker green in color than plots not treated with Cutless at the same level of fertilization.

Any conclusions from the results of this evaluation are preliminary and require subsequent years of evaluation for further support. This experiment did show some general trends, however. Turf receiving moderate to high levels of N fertilization showed much greater reduction in plant growth rates than plots which were not fertilized. The same plots also appeared to be darker green in color than plots of the same level of fertilization without Cutless treatment.

Table 1. The evaluation of Cutless and nitrogen fertilizer on creeping bentgrass growth.[1]

Material	Cutless	Nitrogen	Height[2]			Color[3]		
	lb ai/A	lb N/1000 sq ft	5/29	6/10	6/24	5/22	6/03	6/25
Cutless + Urea	0.38	0	5.0f	5.7fg	6.5g-j	6.0d	6.0e	5.0d
Cutless + Urea	0.5	0	5.1f	5.2g	6.2ij	6.0d	6.0e	5.0d
Cutless + Urea	0.75	0	5.1ef	5.4g	6.1j	6.0d	5.7e	5.0d
Cutless + Urea	0.38	0.38	5.2ef	5.9e-g	7.2f-i	7.0c	6.0e	5.0d
Cutless + Urea	0.50	0.38	5.1ef	6.2d-g	7.1f-j	7.0c	6.7d	5.7bc
Cutless + Urea	0.75	0.38	5.2ef	5.8fg	6.3h-j	7.0c	6.7d	5.3cd
Cutless + Urea	0.38	0.75	5.9bc	7.3b-d	8.3de	8.0b	7.0cd	6.0ab
Cutless + Urea	0.5	0.75	5.2ef	6.1e-g	7.2e-h	8.0b	7.7ab	6.0ab
Cutless + Urea	0.75	0.75	5.2d-f	7.0c-e	7.4e-g	8.0b	7.3bc	6.0ab
Cutless + Urea	0.38	1.50	6.1bc	8.4ab	10.4b	8.7a	7.3bc	5.7bc
Cutless + Urea	0.50	1.50	5.9b-d	8.4ab	10.0b	9.0a	8.0a	6.3a
Cutless + Urea	0.75	1.50	5.5c-f	6.7d-f	8.9cd	9.0a	8.0a	6.3a
Cutless + Urea	0	0.38	5.8b-e	8.0bc	7.6ef	7.0c	6.7d	5.3cd
Cutless + Urea	0	0.75	6.3b	7.8bc	9.4bc	7.0c	7.0cd	5.0d
Cutless + Urea	0	1.50	7.6a	9.4a	11.4a	8.0b	8.0a	5.0d
Check	0	0	5.0f	5.8fg	6.2ij	5.3e	5.0f	5.0d
$LSD_{0.05}$			0.7	1.1	1.1	0.3	0.6	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]Height refers to the average height in cm of the turfgrass plants.

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

KENTUCKY BLUEGRASS CULTIVAR RESPONSE TO THE APPLICATION OF LIMIT, A PLANT GROWTH RETARDANT

T. W. Fermanian and J. E. Haley

INTRODUCTION

While the response of several cultivars of Kentucky bluegrass to amidochlor (Limit) has been evaluated for the past several years, many cultivars of Kentucky bluegrass have not been tested. Because of the variability in growth habit and response to cultural practices exhibited by the wide range of bluegrass varieties, there is a need to also evaluate their response to growth retardants. Meeting these objectives would require the use of an area where multiple cultivars were growing in isolated plots. The USDA Kentucky bluegrass trial planted in 15 September 1980 provided an ideal location to evaluate individual cultivar responses to the application of amidochlor. Due to space limitations, plot size was inherently small. This experiment, however, provided valuable information for future evaluation of cultivar response to plant growth retardants.

MATERIALS AND METHODS

The USDA Kentucky bluegrass trial consists of 84 cultivars each replicated three times. On May 5, 1983 half of each 6 x 5 foot plot was treated with amidochlor at a rate of 2.0 lb ai/A. These same plots were treated again on May 7, 1984 and April 24, 1985 with amidochlor at 2.5 lb ai/A. Treatments were made using a CO_2 propelled backpack sprayer at a spray volume of 40 gallons per acre. During the 1985 growing season the area was fertilized with 2 lb N/1000 sq ft (18-5-9). No preemergence herbicides were used. The area was irrigated as needed to prevent wilt.

RESULTS

Each Kentucky bluegrass cultivar growth response to the application of amidochlor was evaluated by measuring the mean plant height prior to mowing. In 1983 height measurements were taken four weeks after the treatment was applied. In general, most cultivars showed a significant reduction in the growth rate as compared to their untreated half. In the case of BA-61-91, Baron, Birka, Bristol, Enmundi, Glade, Harmony, Holiday, Merit, Nugget, PSU 191, S.D. Common, Vanessa, Victa, Welcome, and Midnight (1528T), no differences in the growth rate could be measured. Quality ratings in 1983 were recorded both three weeks and seven weeks after treatment. With a few exceptions, most cultivars did not show any loss in quality as compared to their untreated half. A20-6, MER PP 300, and Piedmont showed a significant reduction in quality for both dates of evaluation. While the disease dollar spot (*Sclerotinia homoeocarpa*) was observed after the period of activity had ended, no differences were found between treated and untreated portions of the same cultivar.

During the 1984 growing season mean plant height was evaluated four weeks following plant growth retardant treatment. Although the mean height of the treated turfgrass was lower than the mean height of the untreated turf several cultivars did not show a significant reduction in growth (Table 1). Cultivars which did not show a significant effect (reduced growth) include Adelphi, A20, A20-6, BA-61-91, Cello, Challenger (N535), Escort, H7, I-13, Mer PP 300, Mona, Mosa, Nugget, Parade, Piedmont, Plush, PSU-190, S-21, S.D. Common, Shasta, Sydsport, Touchdown, Vanessa, Welcome and WW AG 478. It should be noted that BA-61-91, Nugget, S.D. Common, Vanessa and Welcome exhibited no significant growth reduction for the second year.

Seedhead production was also evaluated during the 1984 growing season. The estimated portion of each plot cover with seedheads is listed in Table 2. Seedhead production in non-treated plots ranged from slightly less than 4% to 100% cover. This would indicate the ability of Limit to reduce seedhead numbers was not related to seedhead production.

Evaluations of plant height the percentage of seedheads covering the plot were made in 1985. All cultivars treated with Limit exhibited reduced growth. For 31 cultivars (37%), however, the reduced growth was not significantly different than the untreated portion of the plot. Seedhead development was also less in the Limit treated portion of all plots, but not significantly different for 32 cultivars (38%).

Height measurements were generally inconsistent over the three years of evaluation. Only H-7, Nugget and Welcome exhibited no significant reduction in growth each year. The measurement of seedhead development showed greater variation than other measurements of plant response. Cultivars which did not show a significant reduction in the number of seedheads on the Limit treated portion of the plot for both the 1984 and 1985 season include Argyle, A-20, BA-61-91 (Gnome), CEB VB 3965, Eclipse, Enmundi, Glade, Harmony, Holiday, I-13, Kenblue, K3-162, MLM 18011, Nugget, Piedmont, PSU-150, S.D. Common, Victa, WW AG 463, and WW AG 478.

The results of this study indicate that there is tremendous variation among Kentucky bluegrass cultivars for susceptibility to the effect of plant growth retardants. This study will be followed up in future years to evaluate the long range effects of plant growth retardant use.

Table 1. The effect of Limit on the height and seedhead production of 84 Kentucky bluegrass cultivars.[1]

Cultivar	Treatment[2]	Height[3]			% Seedheads[4]	
		5/31/83	6/06/84	5/21/85	6/05/84	5/22/85
A-34	Mon 4621	6.2*	7.2*	8.7*	13.3	5.0*
	Check	8.4	11.2	15.8	20.0	20.0
Adelphi	Mon 4621	5.7	6.9	7.2*	11.7	0.7*
	Check	7.2	9.1	12.7	26.7	23.3
Admiral	Mon 4621	6.2*	6.4*	8.4	10.0*	10.0*
	Check	8.3	10.6	13.9	33.3	50.0
America	Mon 4621	5.4*	6.3*	7.5*	23.3*	2.3*
	Check	7.5	9.5	13.1	78.3	46.7
Apart	Mon 4621	6.1*	6.7*	7.3	25.0	11.7*
	Check	8.6	11.8	12.3	56.7	66.7
Argyle	Mon 4621	7.4	7.6*	9.3*	16.7	11.7
	Check	8.9	14.5	17.2	18.3	50.0
Aspen	Mon 4621	5.9*	6.7*	8.7*	13.7*	6.7*
	Check	8.2	9.5	13.9	66.7	63.3
A-20	Mon 4621	6.2*	7.4	7.7	13.3	4.7
	Check	8.6	9.6	13.1	43.3	33.3
A 20-6	Mon 4621	5.9*	6.7	7.2	3.7*	0.7
	Check	7.9	9.2	10.2	10.0	5.3
A20-6A	Mon 4621	6.3*	7.0*	7.2*	20.0	2.3*
	Check	8.2	10.9	10.9	36.7	16.7
BA-61-91	Mon 4621	5.5	6.5	6.3*	38.3	13.3
	Check	7.1	9.0	9.8	58.3	60.0
Banff	Mon 4621	6.0*	6.2*	8.1*	18.3*	10.0*
	Check	8.6	13.4	15.1	88.3	71.7
Barblue	Mon4621	5.7*	6.5*	8.0*	8.3*	5.3*
	Check	7.8	11.2	13.2	58.3	60.0
Baron	Mon 4621	5.6	6.4*	6.8*	40.0	12.0*
	Check	7.9	9.3	9.8	51.7	46.7
Bayside	Mon 4621	7.5*	9.2*	10.4	8.3	3.7*
	Check	9.2	13.7	15.3	18.3	20.0

(continued)

Table 1. The effect of Limit on the height and seedhead production of 84 Kentucky bluegrass cultivars (continued).[1]

Cultivar	Treatment[2]	Height[3]			% Seedheads[4]	
		5/31/83	6/06/84	5/21/85	6/05/84	5/22/85
Birka	Mon4621	6.7	7.9*	8.0	8.3	1.0*
	Check	8.0	10.6	11.7	25.0	21.7
Bonnieblue	Mon 4621	5.8*	6.6*	8.7*	15.0	7.0*
	Check	8.1	10.5	13.8	28.3	55.0
Bono	Mon 4621	6.7*	6.8*	7.3*	3.7*	0.3
	Check	8.5	11.0	11.9	16.7	6.7
Bristol	Mon 4621	5.5*	6.2*	7.8	40.0	10.3*
	Check	8.2	9.8	12.3	80.0	76.7
CEB VB 3965	Mon 4621	6.2*	5.6*	8.0	30.0	16.7
	Check	8.0	10.4	10.7	43.3	36.7
Cello	Mon 4621	6.1*	6.4	7.9*	8.7*	6.7*
	Check	8.2	9.3	11.3	26.7	31.7
Charlotte	Mon 4621	5.7	7.4*	7.7*	7.0*	7.0
	Check	8.3	12.2	15.3	13.3	20.0
Cheri	Mon 4621	5.4*	7.0*	7.1	15.0	5.3*
	Check	7.5	8.8	10.1	28.3	30.0
Columbia	Mon 4621	5.7*	6.4*	8.5	38.3*	13.3*
	Check	8.7	11.6	14.3	100.0	93.3
Dormie	Mon 4621	6.8	8.1*	7.2*	23.3*	11.7
	Check	8.1	12.3	14.4	53.3	50.0
Eclipse	Mon 4621	6.1*	7.1*	8.0	16.7	1.0
	Check	8.4	10.2	14.4	20.0	16.7
Enmundi	Mon 4621	7.4*	7.6*	7.9*	13.3	1.3
	Check	9.0	10.7	12.7	16.7	4.3
Enoble	Mon 4621	6.3*	7.1*	13.7	23.3*	11.7*
	Check	8.3	11.3	14.5	63.3	43.3
Escort	Mon 4621	6.3*	7.5	9.3*	30.0	3.7*
	Check	8.6	11.4	15.5	43.3	26.7
Fylking	Mon 4621	6.1*	6.8*	7.8*	2.3*	2.3*
	Check	8.8	12.1	13.5	10.0	15.0

(continued)

Table 1. The effect of Limit on the height and seedhead production of 84 Kentucky bluegrass cultivars (continued).[1]

		Height[3]			% Seedheads[4]	
Cultivar	Treatment[2]	5/31/83	6/06/84	5/21/85	6/05/84	5/22/85
Geronimo	Mon 4621	6.7*	8.1*	8.2*	31.7	15.0
	Check	8.8	13.2	12.9	28.3	28.3
Glade	Mon 4621	6.3*	6.8*	7.4*	0.3	0.0
	Check	8.0	10.2	10.5	10.0	1.3
H-7	Mon 4621	7.0	6.9	7.9	0.0*	0.3
	Check	8.6	9.2	10.9	13.3	8.3
Harmony	Mon 4621	6.4*	7.9*	8.3*	25.0	28.3
	Check	7.6	11.3	12.4	38.3	58.3
Holiday	Mon 4621	6.3	7.9*	8.2*	28.3	1.3
	Check	7.4	10.3	11.8	46.7	55.0
I-13	Mon 4621	6.0*	6.7	7.4	0.3	0.3
	Check	8.1	9.7	11.0	3.7	1.0
Kenblue	Mon 4621	7.7	7.2*	9.3*	11.7	10.0
	Check	9.5	12.6	14.9	13.3	15.0
Kimono	Mon 4621	6.2	7.6*	8.3	2.0*	0.7*
	Check	7.9	10.8	11.2	9.3	7.3
K1-152	Mon 4621	6.2*	6.5*	7.6*	15.0*	10.0
	Check	8.0	10.8	13.3	48.3	50.0
K3-162	Mon 4621	7.2*	8.7*	9.7*	1.7	8.3
	Check	9.5	13.3	14.6	8.3	10.0
K3-178	Mon 4621	6.1*	6.6*	8.1*	36.7*	16.7*
	Check	9.1	12.0	15.5	93.3	96.7
K3-179	Mon 4621	5.9*	6.9*	8.3	10.0*	4.0*
	Check	8.1	11.6	13.3	18.3	18.3
Lovegreen	Mon 4621	6.7*	7.3*	7.4	11.7	0.7*
	Check	8.3	10.7	10.4	30.0	10.0
Majestic	Mon 4621	5.8	7.6*	9.1*	11.7*	16.7*
	Check	8.3	11.8	12.8	30.0	58.3
MER PP 300	Mon 4621	5.5*	6.6	6.3*	50.0	11.7*
	Check	7.3	9.4	9.0	50.0	33.3

(continued)

Table 1. The effect of Limit on the height and seedhead production of 84 Kentucky bluegrass cultivars (continued).[1]

Cultivar	Treatment[2]	Height[3] 5/31/83	6/06/84	5/21/85	% Seedheads[4] 6/05/84	5/22/85
MER PP 43	Mon 4621	6.7*	8.3*	7.5*	16.7	8.7*
	Check	9.0	13.0	14.0	38.3	51.7
Merion	Mon 4621	6.1*	6.3*	7.9*	11.7*	4.0*
	Check	9.3	11.8	14.7	43.3	63.0
Merit	Mon 4621	5.1	6.4*	5.9	50.0	12.0*
	Check	6.7	9.2	9.7	70.0	45.0
MLM 18011	Mon 4621	6.0*	6.9*	8.2*	31.7	8.7
	Check	8.0	11.5	13.2	60.0	45.0
Mona	Mon 4621	6.1*	7.0	8.3*	31.7*	15.0*
	Check	8.8	10.6	15.2	85.0	93.3
Monopoly	Mon 4621	6.7*	8.1*	9.2	21.7*	1.3*
	Check	8.9	12.3	14.6	50.0	30.0
Mosa	Mon 4621	6.1*	6.4	7.8*	28.3	10.0*
	Check	8.2	10.9	11.4	33.3	30.0
NJ 735	Mon 4621	6.2*	7.0*	7.9*	11.7*	5.3*
	Check	8.5	11.1	11.9	28.3	21.7
Nugget	Mon 4621	5.7	6.9	7.4	8.7	3.0
	Check	6.8	9.6	9.2	21.7	11.7
Challenger	Mon 4621	5.4*	6.7	7.3*	18.3	10.0*
	Check	7.6	11.3	14.1	20.0	30.0
Parade	Mon 4621	6.8*	8.0	10.0	21.7	13.3*
	Check	9.4	11.3	15.1	40.0	36.7
Piedmont	Mon 4621	6.8*	7.4	9.0*	11.7	10.0
	Check	8.5	11.5	15.8	16.7	33.3
Plush	Mon 4621	5.9*	7.4	7.6	4.0*	4.0
	Check	7.7	10.2	10.4	13.3	11.7
PSU-150	Mon 4621	6.2*	7.3*	7.9	4.7	3.0
	Check	8.4	11.5	14.8	10.0	8.0
PSU-173	Mon 4621	6.3*	7.5*	8.2	7.7	0.7*
	Check	8.7	12.3	12.7	16.7	7.3

(continued)

Table 1. The effect of Limit on the height and seedhead production of 84 Kentucky bluegrass cultivars (continued).[1]

		Height[3]			% Seedheads[4]	
Cultivar	Treatment[2]	5/31/83	6/06/84	5/21/85	6/05/84	5/22/85
PSU-190	Mon 4621	6.5*	7.7	8.4*	20.0	5.3*
	Check	7.9	11.0	13.7	21.7	20.0
P-141	Mon 4621	5.6*	6.7*	7.1*	1.0*	0.0
	Check	7.3	8.7	10.1	8.3	4.0
Ram 1	Mon 4621	5.6*	6.6*	8.1*	2.3*	0.7
	Check	7.6	8.7	10.2	15.0	6.3
Rugby	Mon 4621	6.2*	7.3*	8.8*	26.7*	10.0*
	Check	8.4	12.6	15.3	96.7	91.7
S.D. Common	Mon 4621	7.4*	7.6	8.3*	7.0	11.7
	Check	9.4	11.7	16.2	16.7	33.3
S-21	Mon 4621	6.9*	8.0	8.7*	23.3	11.7*
	Check	9.0	10.3	17.3	36.7	41.7
Somerset	Mon 4621	6.3*	6.8*	7.8*	8.3*	0.3*
	Check	8.7	8.7	12.2	38.3	21.7
Shasta	Mon 4621	6.4*	7.6	8.8*	36.7*	13.3*
	Check	8.8	11.9	14.2	100.0	100.0
SV-01617	Mon 4621	6.0*	6.6*	7.9	2.3*	4.7
	Check	9.1	12.5	14.0	15.0	16.7
Sydsport	Mon 4621	5.7*	6.7	6.9	8.3	6.7*
	Check	7.7	9.7	10.0	26.7	25.0
Touchdown	Mon 4621	6.7*	7.0	8.4	1.0*	2.0*
	Check	8.3	9.6	12.6	11.7	10.0
Trenton	Mon 4621	5.8*	7.5*	9.2*	23.3*	10.0*
	Check	8.6	13.3	13.0	88.3	85.0
Vanessa	Mon 4621	6.8*	7.3	8.6*	28.3	13.3*
	Check	8.2	10.2	13.0	38.3	41.7
Vantage	Mon 4621	7.0	7.7*	9.7*	13.3*	11.7*
	Check	8.6	13.5	16.1	21.7	26.7
Victa	Mon 4621	5.4	6.2*	6.4	36.7	10.0
	Check	7.3	8.7	9.7	46.7	43.3

(continued)

Table 1. The effect of Limit on the height and seedhead production of 84 Kentucky bluegrass cultivars (continued).[1]

Cultivar	Treatment[2]	Height[3] 5/31/83	Height[3] 6/06/84	Height[3] 5/21/85	% Seedheads[4] 6/05/84	% Seedheads[4] 5/22/85
Wabash	Mon 4621	5.9*	7.3*	10.6	0.3*	1.0*
	Check	9.0	11.7	13.9	8.3	3.7
Welcome	Mon 4621	6.9	7.0	7.4	0.3*	0.3*
	Check	7.7	9.4	9.2	5.0	7.3
WW AG 463	Mon 4621	6.3*	7.0*	8.7*	18.3	10.0
	Check	8.6	9.8	12.4	70.0	50.0
WW AG 478	Mon 4621	5.1*	6.4	6.5*	2.0	18.3
	Check	6.6	7.9	8.5	23.3	40.0
WW AG 480	Mon 4621	6.1*	6.5*	7.4*	13.3*	8.3*
	Check	8.8	11.1	12.0	30.0	30.0
Midnight	Mon 4621	6.0	6.7*	7.9*	3.3*	0.0*
	Check	7.0	9.6	10.5	11.7	8.3
225	Mon 4621	6.6*	7.3*	7.8	20.0*	10.0
	Check	8.3	10.0	11.2	36.7	35.0
239	Mon 4621	6.1*	6.7*	7.6*	26.7	16.7*
	Check	8.8	11.7	13.5	83.3	56.7
Nassau	Mon 4621	5.9*	7.1*	7.9*	31.7*	10.0*
	Check	8.3	11.2	14.2	90.0	61.7

[1]All values represent the mean of 3 replications. Plants were treated May 5, 1983, May 7, 1984 and April 24, 1985.

[2]Treatments of Mon 4621 (Limit) were made to 1/2 the plot for 3 consecutive years. The untreated half was used as a check plot.

[3]Height refers to the average height in centimeters of the turfgrass plants.

[4]Percent seedheads represents the average percent of turfgrass plants bearing seedheads.

*Means are significantly different at the 0.05 level as determined by a T test of each mean pair.

THE EVALUATION OF LATE FALL FERTILIZATION

D. J. Wehner and J. E. Haley

INTRODUCTION

The idea behind late fall fertilization is to keep the shoot of the grass plant green as it enters winter. Because air temperatures in late fall restrict shoot growth, the food manufactured by the shoot is placed in reserve or used for root growth resulting in a healthier plant. Also, less fertilization is needed in early spring because the previous year's application promotes rapid greenup. The practice of late fall fertilization got started in the transition zone where it is possible to keep turf green almost all year. Northern turfgrass managers have found that late fall fertilization also works well in the cool humid regions of the country. The purpose of this study is to evaluate fertilizer programs with and without a late fall application of nitrogen. In addition, several different nitrogen sources are being evaluated for application in late fall.

MATERIALS AND METHODS

The trial was established September 7, 1982 on a 3 month old stand of Baron Kentucky bluegrass and on an adjacent 3 month old stand of Newport Kentucky bluegrass. The materials being evaluated are urea (45-0-0), IBDU (31-0-0), and CIL-SCU (32-0-0). Materials are applied as lbs nitrogen/1000 sq ft as follows:

Trt.	First Mowing	June 1	July 15	Sept. 1	Nov. 1
1.	1.25 urea	1.0 urea	0.75 urea	1.0 urea	0
2.	0	1.0 urea	0.75 urea	1.0 urea	1.25 urea
3.	0	1.0 urea	0.75 urea	1.0 urea	1.25 SCU
4.	0.5	1.0 urea	0.75 urea	1.25 urea	0
5.	0	2.0 IBDU	0	2.0 IBDU	0
6.	0	2.0 SCU	0	2.0 SCU	0
7.	0	2.0 IBDU	0	0	2.0 IBDU
8.	0	2.0 SCU	0	0	2.0 SCU
9.	0	1.0 IBDU	0	1.0 IBDU	1.5 IBDU
10.	0	1.0 SCU	0	1.0 SCU	1.5 SCU
11.	check	---	---	---	---

Plot size is 3 x 12 feet and materials are applied by hand.

RESULTS

This study was concluded in the fall of 1985. The results of the study have helped refine our understanding of the use of late fall fertilization. Turf receiving a late fall application of urea, SCU, or IBDU (treatments 2,3,7,8,9 and 10) showed better spring color than turf that was not fertilized in November (treatments 1 and 4) (Tables 1 and 2). The September application of IBDU (treatment 5) provided enough N in the Spring for good color but the September application of SCU (treatment 6) did not. The use of late fall fertilization allows a reduction in the amount of N that has to be applied in the early Spring. However, the turf still benefits from some fertilization prior to June 1 as evidenced by the superior color during May of turf receiving N at the first mowing. The need for N in the Spring depends on the appearance that is desired. For lawn care companies that cannot return to the lawn in less than 6-8 weeks, it may be necessary to apply some nitrogen in round 1 even though the lawn was fertilized in the late fall.

For managers using slow release N, good results can be obtained by applying half the Fall application in September and half in November (treatments 9 and 10). Postponing a September application of a SCU until November (treatment 8) resulted in a lower quality turf appearance in early Fall compared to where the application was split.

The results from both cultivars showed similar trends with the exception that the Newport plots started active growth earlier in the Spring than the Baron plots.

Table 1. The evaluation of a late fall fertilization program on a Baron Kentucky bluegrass turf.[1]

	lb N/1000 sq ft					Color[2]								
Material	First Mowing	6/1	7/15	9/1	11/1	4/12	4/19	4/26	5/03	5/10	5/20	5/28	6/03	6/10
Urea	1.25	1.0	0.75	1.0	0	3.0f	4.0f	4.3f	9.0a	9.0a	9.0a	9.0a	8.0a	8.7a
Urea	0	1.0	0.75	1.0	1.25	5.3bc	7.3bc	6.7d	7.7cd	6.7c	5.3e	6.0d	5.3e	7.3c
Urea +	0	4.0	0.75	1.0	0									
SCU					1.25	5.3bc	7.0cd	7.0cd	8.0bc	7.0c	6.3d	7.0c	6.7bc	7.3c
Urea	0.5	1.0	0.75	1.25	0	3.7ef	4.0f	4.0f	8.7ab	8.0b	8.0b	8.0b	7.0b	8.0b
IBDU	0	2.0	0	2.0	0	6.0ab	7.3bc	7.3bc	8.0bc	7.0c	7.0c	6.7c	6.3cd	5.3e
SCU	0	2.0	0	2.0		4.3de	5.0e	5.0e	7.0d	5.7d	6.0d	6.0d	5.3e	6.3d
IBDU	0	2.0	0	0	2.0	5.0cd	6.7d	7.0cd	7.7cd	7.0c	7.0c	6.7c	6.3cd	5.3e
SCU	0	2.0	0	0	2.0	6.3a	8.0a	8.0a	9.0a	7.3bc	7.0c	7.0c	6.3cd	7.0c
IBDU	0	1.0	0	1.0	1.5	5.3bc	7.7ab	8.0a	8.3a-c	7.3bc	7.0c	6.7c	6.3cd	6.0d
SCU	0	1.0	0	1.0	1.5	6.0ab	8.0a	7.7ab	8.0bc	7.0c	7.0c	7.0c	6.0d	7.0c
Check	0	0	0	0	0	2.0g	2.0g	2.0g	2.3e	2.3e	2.3f	4.7e	4.0f	4.0f
$LSD_{0.05}$						0.7	0.5	0.6	0.7	0.7	0.5	0.6	0.5	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.

(continued)

Table 1. The evaluation of a late fall fertilization program on a Baron Kentucky bluegrass turf (continued).[1]

	lb N/1000 sq ft					Color[2]								
Material	First Mowing	6/1	7/15	9/1	11/1	6/17	6/25	7/02	7/10	7/15	7/23	7/30	8/06	8/13
Urea	1.25	1.0	0.75	1.0	0	9.0a	9.0a	9.0a	7.3bc	8.0ab	7.3bc	9.0a	9.0a	9.0a
Urea	0	1.0	0.75	1.0	1.25	7.7b	8.0b	7.3bc	6.7cd	7.3b	7.7bc	8.0bc	9.0a	8.0b
Urea +	0	1.0	0.75	1.0	0									
SCU					1.25	8.0b	8.0b	8.0ab	7.7b	7.7b	7.7bc	8.7ab	8.7a	8.0b
Urea	0.5	1.0	0.75	1.25	0	9.0a	8.0b	7.7b	7.7b	7.7b	7.0c	9.0a	9.0a	9.0a
IBDU	0	2.0	0	2.0	0	5.3de	5.7cd	6.3cd	7.0bc	7.3b	8.3ab	8.0bc	8.3ab	9.0a
SCU	0	2.0	0	2.0	0	9.0a	9.0a	9.0a	8.7a	8.7a	9.0a	8.0bc	7.7bc	7.7bc
IBDU	0	2.0	0	0	2.0	5.7d	6.3c	5.3d	6.7cd	7.7b	8.3ab	7.3cd	8.3ab	8.0b
SCU	0	2.0	0	0	2.0	9.0a	9.0a	9.0a	9.0a	8.7a	9.0a	7.0d	7.3c	7.3cd
IBDU	0	1.0	0	1.0	1.5	5.0e	5.0d	5.3d	6.0d	6.3c	7.0c	7.0d	7.3c	7.7bc
SCU	0	1.0	0	1.0	1.5	6.7c	7.3b	7.3bc	7.3bc	7.3bc	8.0a-c	6.0e	7.0c	7.0d
Check	0	0	0	0	0	4.0f	3.0e	3.0e	3.0e	3.0d	3.0d	3.0f	3.0d	3.0e
$LSD_{0.05}$						0.5	0.7	1.0	0.9	0.9	1.0	0.7	0.7	0.5

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

(continued)

Table 1. The evaluation of a late fall fertilization program on a Baron Kentucky bluegrass turf (continued).[1]

	lb N/1000 sq ft					Color[2]								
Material	First Mowing	6/1	7/15	9/1	11/1	8/21	8/30	9/06	9/13	9/20	9/26	10/14	10/23	11/06
Urea	1.25	1.0	0.75	1.0	0	8.0ab	7.3a-c	6.3bc	7.0bc	7.7a-c	8.7ab	7.7bc	7.0d	6.7cd
Urea	0	1.0	0.75	1.0	1.25	7.3b	6.0e	6.0c	6.7b-d	8.7a	8.7ab	7.7bc	7.7bc	7.3a-c
Urea +	0	1.0	0.75	1.0	0									
SCU					1.25	7.7b	6.3de	6.7bc	6.3cd	8.3ab	8.7ab	7.7bc	7.3cd	6.3d
Urea	0.5	1.0	0.75	1.25	0	8.0ab	7.0b-d	6.3bc	6.3cd	8.3ab	9.0a	8.3ab	8.0b	7.0b-d
IBDU	0	2.0	0	2.0	0	9.0a	8.0a	7.3ab	7.0bc	7.0cd	8.0b	8.0b	9.0a	8.0a
SCU	0	2.0	0	2.0	0	7.3b	6.7c-e	6.3bc	6.3cd	8.0a-c	9.0a	9.0a	9.0a	7.7ab
IBDU	0	2.0	0	0	2.0	9.0a	7.7ab	8.0a	8.0a	7.3b-d	8.0b	7.0c	7.0d	6.7cd
SCU	0	2.0	0	0	2.0	7.3b	6.0e	6.3bc	6.3cd	5.7e	4.7c	5.7d	5.3e	4.3e
IBDU	0	1.0	0	1.0	1.5	8.0ab	6.7c-e	6.7bc	7.3ab	6.3de	8.0b	7.7bc	7.7bc	7.3a-c
SCU	0	1.0	0	1.0	1.5	6.0c	5.0f	5.7c	6.0d	6.3de	8.0b	7.0c	7.0d	6.7cd
Check	0	0	0	0	0	2.7d	3.0g	3.7d	4.0e	3.7f	3.7d	3.0e	4.0f	3.0f
$LSD_{0.05}$						1.0	0.7	1.2	0.9	1.1	1.0	0.7	0.6	0.8

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

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

Table 2. The evaluation of a late fall fertilization program on a Newport Kentucky bluegrass turf.[1]

	lb N/1000 sq ft					Color[2]								
Material	First Mowing	6/01	7/15	9/1	11/1*	4/12	4/19	4/26	5/03	5/10	5/20	5/28	6/03	6/10
Urea	1.25	1.0	0.75	1.0	0	4.0d	4.0e	4.3d	9.0a	9.0a	9.0a	9.0a	8.0a	8.0a
Urea	0	1.0	0.75	1.0	1.25	7.0a	6.3bc	6.3bc	6.3e	6.0ef	5.0d	6.0ef	5.3e	7.0b
Urea +	0	1.0	0.75	1.0	0									
SCU					1.25	6.0b	6.3bc	7.0ab	7.3b-d	6.3de	6.0c	6.7cd	6.0d	7.0b
Urea	0.5	1.0	0.75	1.25	0	5.0c	5.3cd	4.3d	7.7bc	7.7b	7.0b	8.0b	7.0b	8.0a
IBDU	0	2.0		2.0	0	6.3ab	7.0ab	7.3a	7.0c-e	7.0c	6.0c	6.0ef	6.0d	5.0d
SCU	0	2.0		2.0	0	5.0c	5.0de	6.0c	6.7de	5.7f	5.3d	5.7f	5.3e	6.3c
IBDU	0	2.0		0	2.0	6.0b	6.7ab	7.0ab	7.0c-e	6.7cd	7.0b	6.3de	6.3cd	5.0d
SCU	0	2.0		0	2.0	7.0a	7.7a	7.7a	8.0b	7.0c	7.0b	6.7cd	6.0d	7.0b
IBDU	0	1.0		1.0	1.5	7.0a	7.0ab	7.3a	7.3b-d	6.7cd	6.7b	6.7cd	6.0d	5.0d
SCU	0	1.0		1.0	1.5	7.0a	7.3ab	7.3a	7.0c-e	6.3de	6.7b	7.0c	6.7bc	6.7bc
Check	0	0		0	0	2.3e	2.0f	2.0e	2.7f	3.0g	3.3e	4.3g	5.0e	4.0e
$LSD_{0.05}$						0.7	1.1	0.8	0.7	0.6	0.6	0.6	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]Color evaluations are made on a scale of 1-9, where 9 = very dark green and 1 = straw color.

*This treatment was not applied in 1985.

(continued)

Table 2. The evaluation of a late fall fertilization program on a Newport Kentucky bluegrass turf (continued).[1]

	lb N/1000 sq ft					Color[2]								
Material	First Mowing	6/1	7/15	9/1	11/1*	6/17	6/25	7/02	7/10	7/15	7/23	7/30	8/06	8/13
Urea	1.25	1.0	0.75	1.0	0	9.0a	8.7ab	8.3ab	7.0bc	7.0b	7.7b	9.0a	9.0a	8.7ab
Urea	0	1.0	0.75	1.0	1.25	7.7c	8.0b	6.7de	6.0de	6.3bc	7.0b	8.3b	9.0a	8.0bc
Urea +	0	1.0	0.75	1.0	0									
SCU					1.25	8.0bc	8.3ab	7.0cd	7.0bc	6.7bc	7.7b	8.3b	9.0a	8.7ab
Urea	0.5	1.0	0.75	1.25	0	8.7ab	8.3ab	7.7bc	6.0de	6.3bc	7.3b	9.0a	9.0a	9.0a
IBDU	0	2.0	0	2.0	0	4.3ef	5.0d	6.0ef	7.3bc	6.7bc	8.7a	8.0bc	9.0a	9.0a
SCU	0	2.0	0	2.0	0	9.0a	9.0a	9.0a	8.7a	8.0a	9.0a	7.7c	8.0b	7.7cd
IBDU	0	2.0	0	0	2.0	5.3d	6.3c	7.0cd	7.7b	7.0b	9.0a	7.7c	9.0a	9.0a
SCU	0	2.0	0	0	2.0	9.0a	9.0a	9.0a	8.7a	8.0a	9.0a	7.0d	7.7b	7.7cd
IBDU	0	1.0	0	1.0	1.5	5.0de	5.0d	5.3f	5.7e	6.0c	7.7b	6.0e	7.7b	7.7cd
SCU	0	1.0	0	1.0	1.5	7.3c	8.0b	8.0b	6.7cd	7.0b	7.7b	5.7e	7.0c	7.0d
Check	0	0	0	0	0	4.0f	4.0e	3.0g	3.0f	3.0d	3.0c	3.0f	3.0d	3.0e
$LSD_{0.05}$						0.7	1.0	0.8	0.9	1.0	0.8	0.6	0.5	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.

*This treatment was not applied in 1985.

(continued)

Table 2. The evaluation of a late fall fertilization program on a Newport Kentucky bluegrass turf (continued).[1]

	lb N/1000 sq ft					Color[2]								
Material	First Mowing	6/1	7/15	9/1	11/1*	8/21	8/30	9/06	9/13	9/20	9/26	10/14	10/23	11/06
Urea	1.25	1.0	0.75	1.0	0	8.3ab	7.0bc	7.3ab	7.0ab	7.3a-c	9.0a	8.0b	7.7b	7.0b-d
Urea	0	1.0	0.75	1.0	1.25	7.3cd	6.7c	6.7a-c	7.0ab	7.7ab	8.7ab	7.7b	7.0bc	6.3d
Urea +	0	1.0	0.75	1.0	0									
SCU					1.25	8.0bc	6.3c	7.3ab	7.0ab	7.7ab	9.0a	8.0b	7.7b	7.7b
Urea	0.5	1.0	0.75	1.25	0	7.3cd	6.3c	6.3bc	6.3b	8.3a	9.0a	8.0b	7.7b	7.3bc
IBDU	0	2.0	0	2.0	0	9.0a	7.7ab	7.3ab	7.0ab	6.7b-d	8.0bc	8.0b	9.0a	8.7a
SCU	0	2.0	0	2.0	0	7.3cd	6.3cd	6.3bc	6.3b	8.0a	9.0a	9.0a	9.0a	9.0a
IBDU	0	2.0	0	0	2.0	9.0a	8.0a	7.7a	7.7a	6.7b-d	7.3cd	6.7c	6.7cd	6.7cd
SCU	0	2.0	0	0	2.0	7.0d	6.3c	6.0c	6.3b	5.7d	5.0e	5.0d	6.0d	4.7e
IBDU	0	1.0	0	1.0	1.5	7.3cd	6.3c	7.3ab	6.7ab	6.3cd	7.0d	7.3bc	7.7b	7.7b
SCU	0	1.0	0	1.0	1.5	6.0e	5.0d	5.7c	6.0b	6.7b-d	7.3cd	7.3bc	7.3bc	7.3bc
Check	0	0	0	0	0	3.0f	3.0e	3.3d	4.0c	3.0e	3.3f	3.3e	3.3e	3.3f
$LSD_{0.05}$						0.9	0.9	1.3	1.2	1.1	0.9	0.7	0.8	0.9

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

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

*This treatment was not applied in 1985.

EVALUATION OF CHELATED IRON AND NITROGEN SOURCES IN A FERTILIZATION PROGRAM

D. J. Wehner and J. E. Haley

INTRODUCTION

Iron is usually not deficient in the soils of Illinois. However, iron, when applied at a high enough rate, can enhance the color (make darker green) of turfgrass plants. The use of iron can reduce the amount of N needed to maintain acceptable color. With iron, the color remains acceptable but the growth of the plant is not as vigorous as would be found with a larger amount of nitrogen. The drawback in using iron is that the effect on the color is only temporary and can dissipate before another application can be made. Previous research at the University of Illinois has shown that fertilizing the turf with 0.5 pound of nitrogen per 1000 square feet plus iron gave color equal to fertilizing with 1.0 pound of nitrogen per 1000 square feet. The purpose of this research was to further evaluate the use of iron. In our previous research, the best results with iron were found where chelated iron was applied at the rate of 2.0 pounds of actual iron per acre in combination with a reduced rate of nitrogen. In the current study we are utilizing chelated iron with Formolene, Fluf, and urea in a four application schedule that resembles a typical lawn care program.

MATERIALS AND METHODS

Fertilizer treatments consist of nitrogen from either Formolene, Fluf, or urea with or without iron. The basic program consists of 4 applications of fertilizer providing 1 pound of actual N per 1000 sq ft per application. Iron (Fe) is substituted for 0.5 pounds of N per 1000 sq ft in either round 1 and 2, round 2 and 3, or round 3 only (Table 1.). Sequestrene 330 is the iron source and is applied at the rate of 2 lb Fe/A. The treatments were applied on 3 May, 2 July, 8 August, and 23 October 1985 in a volume of 3.5 gallons of water per 1000 square feet. The turf is a blend of Parade, Adelphi, Glade and Rugby Kentucky bluegrass. Plot size is 3 x 12 feet and each treatment is replicated 3 times. An untreated check plot is included in each replication. Color ratings were taken weekly throughout the season and clippings were returned to the plots.

RESULTS AND DISCUSSION

The results of this study parallel the results of our previous research with iron. That is, when the plant is growing slowly, the effect of iron is visible for 5 to 7 weeks but, when there is adequate rainfall, the effect of iron on color does not persist. During 1985, we had adequate rainfall for most of the summer. Dry weather occurred at the beginning of the growing season but was followed by frequent occurrences of rainfall. The data indicate that the turf receiving N + iron compared favorably with the turf receiving only N during round 1 (applied 3 May) when the weather was dry but, during the later rounds, the effect of iron lasted only about 3 weeks.

This study will be continued for 2 more years so that we may adequately characterize the effect of these fertilization programs on turfgrass color.

Table 1. The evaluation of iron and nitrogen sources in a fertilization program[1].

	1 lb N/1000 sq ft + oz Fe/1000 sq ft*				Color[2]							
Material	Rnd 1	Rnd 2	Rnd 3	Rnd 4	5/10	5/20	5/28	6/03	6/10	6/17	6/27	7/02
Formolene	1.0+0	1.0+0	1.0+0	1.0+0	8.0a-d	7.7bc	8.3a-c	7.0ab	6.3a-c	6.7ab	6.0a-d	7.0a
Formolene+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	7.7b-d	8.0ab	8.0a-d	6.7b	5.7cd	6.7ab	6.0a-d	7.0a
Formolene+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	7.7b-d	7.3bc	8.3a-c	7.0ab	7.0a	6.7ab	6.3a-c	7.0a
Formolene+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	7.3cd	7.3bc	8.7ab	7.0ab	7.0a	6.3a-c	6.7ab	6.7ab
FLUF	1.0+0	1.0+0	1.0+0	1.0+0	7.0de	7.0c	7.0de	5.7cd	6.3a-c	5.7c	5.0d	6.3bc
FLUF+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	7.3cd	7.3bc	7.3c-e	6.7b	6.0bc	6.0bc	5.7b-d	6.7ab
FLUF+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	7.3cd	7.7bc	8.0a-d	6.3bc	6.7ab	6.3a-c	6.0a-d	7.0a
FLUF+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	7.0de	7.3bc	7.0de	5.7cd	6.3a-c	6.0bc	6.3a-c	7.0a
Urea	1.0+0	1.0+0	1.0+0	1.0+0	8.0a-d	8.0ab	7.7b-e	6.3bc	6.7ab	6.7ab	6.3a-c	7.0a
Urea+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	9.0a	8.7a	8.7ab	7.0ab	6.7ab	7.0a	7.0a	7.0a
Urea+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	8.3a-c	8.0ab	9.0a	6.7b	7.0a	7.0a	6.7ab	7.0a
Urea+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	8.7ab	8.0ab	9.0a	7.7a	7.0a	7.0a	6.7ab	7.0a
Check	---	---	---	---	6.0e	6.0d	6.7e	5.0d	5.0d	5.7c	5.3cd	6.0c
$LSD_{0.05}$					1.0	0.9	1.0	0.8	1.0	0.7	1.0	0.5

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

*Round 1 treatments were applied 3 May, Round 2 treatments were applied 2 July, Round 3 treatments were applied 8 August and Round 4 treatments were applied 23 October.

(continued)

Table 1. The evaluation of iron and nitrogen sources in a fertilization program (continued).[1]

	1 lb N/1000 sq ft + oz Fe/1000 sq ft*				Color[2]							
Material	Rnd 1	Rnd 2	Rnd 3	Rnd 4	7/10	7/15	7/23	7/30	8/6	8/13	8/21	8/28
Formolene	1.0+0	1.0+0	1.0+0	1.0+0	8.7ab	9.0a	7.7ab	8.0bc	8.0a	7.7ab	7.0a	7.0a
Formolene+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	8.0b	8.0b	7.0b	7.3de	7.0b	6.3ef	6.0b-d	6.0b-d
Formolene+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	8.7ab	8.3ab	7.0b	7.3de	7.3b	6.7de	6.3a-c	6.0b-d
Formolene+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	9.0a	9.0a	8.0a	8.3b	8.0a	7.3bc	7.0a	7.0a
FLUF	1.0+0	1.0+0	1.0+0	1.0+0	8.3ab	8.3ab	8.0a	9.0a	8.0a	7.7ab	7.0a	7.0a
FLUF+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	8.0b	8.0b	7.7ab	7.0e	7.0b	7.0cd	6.0b-d	6.0b-d
FLUF+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	8.0b	8.3ab	7.0b	7.3de	7.3b	7.0cd	6.0b-d	6.3a-c
FLUF+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	8.3ab	8.3ab	7.3ab	8.0bc	7.0b	7.0cd	6.7ab	6.7ab
Urea	1.0+0	1.0+0	1.0+0	1.0+0	9.0a	9.0a	7.7ab	8.3b	8.0a	7.7ab	6.7ab	6.7ab
Urea+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	8.7ab	8.3ab	8.0a	7.7cd	7.3b	6.7de	5.7cd	6.0b-d
Urea+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	9.0a	8.7ab	7.3ab	7.7cd	7.0b	6.7de	5.3d	5.7cd
Urea+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	8.7ab	9.0a	7.7ab	8.3b	8.0a	8.0a	5.7cd	7.0a
Check	--	--	--	--	4.7c	5.0c	5.7c	5.7f	6.0c	6.0f	5.3d	5.3d
$LSD_{0.05}$					0.7	0.9	0.7	0.6	0.6	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.

*Round 1 treatments were applied 3 May, Round 2 treatments were applied 2 July, Round 3 treatments were applied 8 August and Round 4 treatments were applied 23 October.

(continued)

Table 1. The evaluation of iron and nitrogen sources in a fertilization program (continued).[1]

Material	1 lb N/1000 sq ft + oz Fe/1000 sq ft*				Color[2]						
	Rnd 1	Rnd2	Rnd 3	Rnd 4	9/06	9/13	9/20	9/26	10/14	10/23	11/6
Formolene	1.0+0	1.0+0	1.0+0	1.0+0	8.0a	7.7a	8.0a	6.7ab	6.7bc	6.7ab	6.7bc
Formolene+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	7.0cd	7.0ab	7.7ab	6.0b	6.7bc	7.0a	7.0bc
Formolene+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	6.7d	7.0ab	6.7d	6.0b	6.3bc	6.0c	6.7bc
Formolene+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	7.0cd	6.7ab	7.3bc	6.7ab	6.3bc	6.0c	7.0bc
FLUF	1.0+0	1.0+0	1.0+0	1.0+0	8.0a	7.0ab	8.0a	7.0a	7.7a	7.0a	7.3ab
FLUF+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	7.3bc	6.7ab	7.3bc	6.3ab	6.7bc	6.7ab	6.3c
FLUF+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	7.0cd	6.7ab	7.0cd	6.3ab	6.0cd	6.0c	4.3e
FLUF+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	7.0cd	6.7ab	7.0cd	6.0b	7.0ab	6.3bc	5.3d
Urea	1.0+0	1.0+0	1.0+0	1.0+0	8.0a	7.7a	8.0a	6.7ab	7.0ab	7.0a	8.0a
Urea+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	8.0a	7.3a	8.0a	7.0a	7.0ab	7.0a	8.0a
Urea+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	7.0cd	6.0b	7.0cd	6.0b	6.3bc	6.0c	7.3ab
Urea+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	7.7ab	7.0ab	7.0cd	7.0a	6.0cd	6.0c	7.0bc
Check	---	---	---	---	4.0e	4.0c	3.7e	4.3c	5.3d	5.0d	3.0f
$LSD_{0.05}$					0.7	1.0	0.6	0.8	0.8	0.4	0.8

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

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

*Round 1 treatments were applied 3 May, Round 2 treatments were applied 2 July, Round 3 treatments were applied 8 August and Round 4 treatments were applied 23 October.

LIQUID NITROGEN RESIDUAL STUDY

D.L. Martin and D.J. Wehner

INTRODUCTION

Several new nitrogen sources are available to the lawn care industry. The main characteristic of these materials is that there is a reduced potential for turfgrass burn when applying them compared to a liquid urea solution. Questions exist as to whether or not they provide a longer residual response than a standard application of urea. The purpose of this study was twofold: first to determine if these new sources provide a longer response than a standard application of urea; and second to evaluate turf response to these materials applied four times per year at eight week intervals. Sulfur Coated Urea and Nitroform were included in this study as slow release sources for comparison.

MATERIALS AND METHODS

This experiment was initiated June 21, 1983 on a Kentucky bluegrass stand composed of the cultivars Bristol, Bonnieblue and Parade. The turfgrass stand was established in the fall of 1982. Each treatment was replicated four times as a 3 x 12 foot plot in a randomized complete block design. The liquid treatments were applied to the plots with a CO2 pressurized backpack sprayer. The spray volume applied was 4 gallons per 1000 sq ft, using an 8015E nozzle. Granular materials were applied by hand. The dates of the 1984 treatments were May 10, July 9, September 7 and November 11. In 1985, the fertilizer treatments were applied on April 3, June 5, and August 2.

The nitrogen sources applied as liquids in this study include Melamine 55-0-0 (formerly Super 60), Urea (46-0-0), FLUF (18-0-0), Cleary's 16-2-4, FLUF + Trugreen, Formolene (30-0-2), Mello 15-3-6, and Nitroform (38-0-0). Trugreen is a micronutrient fertilizer. FAN (20-0-0), which had been included in the 2 previous years of this study, was not applied in 1985 due to discontinuation of the formulation used at the inception of this study. Materials applied as granulars included Sulfur Coated Urea (CIL 32-0-0) and Oxamide (32-0-0). A control treatment which received no nitrogen source was included in each replication. All fertilizer treatments were applied at 1 lb actual nitrogen per 1000 sq ft in the three years of this study.

Color and growth rates were monitored on a weekly basis in this study. Color was rated visually, using a scale of 1-9, where 9 = very dark green and 1 = straw color. Growth rates were measured on the basis of fresh clipping weights. Clippings were not returned to the plots after being weighed. After the treatments were applied, the plots were irrigated to wash material from the leaves into the soil. Irrigation practices in the study duplicated those of a home lawn situation, with the plots receiving irrigation to avoid wilting of the turfgrass.

RESULTS AND DISCUSSION

Color ratings taken from the experimental plots in 1985 appear in Table 1. Spring greenup ratings were taken for 1 week prior to the first application in 1985. Color ratings from all fertilizer treated turf were significantly higher than those for the non-treated control turf prior to the first application in 1985. The highest color ratings during greenup were from turf treated with Oxamide and Sulfur Coated Urea. All treatments failed to provide satisfactory spring greenup.

Turf treated with water soluble materials such as urea, Mello 15-3-6, and Formolene demonstrated a quicker greenup than the flowable ureaformaldehyde sources such as FLUF, FLUF + Trugreen and Cleary's 16-2-4 after the first application, however this trend was not present after the second and third applications in 1985. Unlike the 1983 and 1984 growing seasons where FLUF + Trugreen and Cleary's 16-2-4 treated turf usually ranked higher than FLUF treated turf, the rankings were inconsistent in 1985. As in the 1983 and 1984 growing seasons, Sulfur Coated Urea and Oxamide consistently had the highest color ratings throughout 1985. Color ratings taken from turfgrass treated with materials other than Sulfur Coated Urea and Oxamide usually did not rank significantly higher than color ratings from turfgrass treated with urea in all three years of this study. Clipping weight trends closely followed those trends previously discussed for color ratings. Figure 1 shows the mean clipping weights from turfgrass plots treated with urea, FLUF, Formolene and Oxamide in 1985.

Table 1. Color response of Kentucky bluegrass to various fertilizer treatments applied April 3, June 5 and August 2, 1985.[1]

Nitrogen	Color Ratings[2]										
Source	4/03	4/10	4/17	4/26	5/03	5/10	5/20	5/28	6/04	6/13	6/19
Melamine 55-0-0	3.5c	6.0d	6.5b	6.8c	7.3b	6.8bc	7.3b	5.5cd	6.8b	5.3e	6.3d
Urea	5.0ab	7.5ab	8.0a	7.5a-c	8.0ab	7.3a-c	7.0b	6.3b	7.0b	7.0b	7.3bc
FLUF	4.3bc	6.8b-d	6.5b	6.8c	7.8ab	6.5c	7.0b	5.8bc	6.8b	6.5bc	6.8cd
Cleary's 16-2-4	4.8b	6.5cd	7.3ab	6.8c	7.3b	6.5c	7.0b	5.8bc	6.8b	5.5de	6.8cd
Oxamide	5.8a	8.0a	8.0a	8.0ab	8.3a	7.5a-c	8.0a	7.8a	8.0a	8.8a	8.8a
FLUF + Trugreen	4.3bc	6.5cd	6.5b	7.3bc	7.8ab	7.3a-c	7.0b	6.0bc	7.0b	6.3b-d	6.3d
Formolene	4.8b	7.3a-c	7.8a	8.3a	7.5ab	7.8ab	7.0b	6.0bc	7.0b	7.0b	7.0b-d
Mello 15-3-6	5.0ab	7.3a-c	7.8a	7.8ab	7.8ab	6.8bc	7.0b	5.8bc	6.8b	6.0c-e	6.5cd
Nitroform	4.5b	6.0d	6.5b	6.8c	7.3b	7.3a-c	7.3b	5.8bc	7.0b	6.3b-d	6.8cd
CIL-SCU	5.8a	7.5ab	8.0a	8.3a	8.3a	8.0a	8.0a	7.3a	8.0a	7.0b	7.8b
Control	2.5d	4.3e	4.0c	4.8d	5.8c	5.0d	6.0c	5.0d	6.3c	4.3f	5.0e

Nitrogen	Color Ratings2										
Source	6/26	7/03	7/11	7/18	7/24	7/30	8/09	8/14	8/21	8/28	9/06
Melamine 55-0-0	6.0c	6.0e	6.5cd	7.0b	7.0b	5.8d	8.0b	7.8ab	7.5c	7.8cd	7.0b
Urea	6.7bc	6.8cd	7.0bc	7.0b	7.0b	6.3c	8.0b	8.0ab	7.8bc	7.3d	6.8b
FLUF	6.7bc	7.0c	7.3b	7.0b	7.0b	6.3c	8.0b	7.8ab	7.8bc	8.3bc	7.0b
Cleary's 16-2-4	6.4c	7.0c	7.0bc	7.0b	7.0b	6.3c	8.0b	8.3a	8.0bc	8.0c	7.0b
Oxamide	9.0a	8.5a	8.8a	7.8a	7.8a	7.3a	9.0a	7.8ab	8.5ab	8.8ab	7.8a
FLUF + Trugreen	6.0c	7.0c	7.3b	7.0b	7.0b	6.3c	8.0b	8.0ab	8.5ab	7.8cd	7.0b
Formolene	6.3c	7.0c	7.3b	7.0b	7.0b	6.3c	8.0b	7.8ab	7.8bc	8.3bc	7.0b
Mello 15-3-6	6.3c	6.5d	7.3b	7.0b	7.0b	6.3c	8.3b	8.0ab	7.5c	7.8cd	7.0b
Nitroform	6.0c	7.0c	7.3b	7.8a	7.8a	6.8b	8.3b	8.5a	8.3a-c	8.0c	7.0b
CIL-SCU	7.7b	8.0b	8.3a	8.0a	8.0a	7.3a	9.0a	8.5a	9.0a	9.0a	8.0a
Control	4.7d	5.3f	6.0d	6.0c	6.0c	5.0e	6.0c	7.3b	6.0d	6.3e	6.0c

(continued)

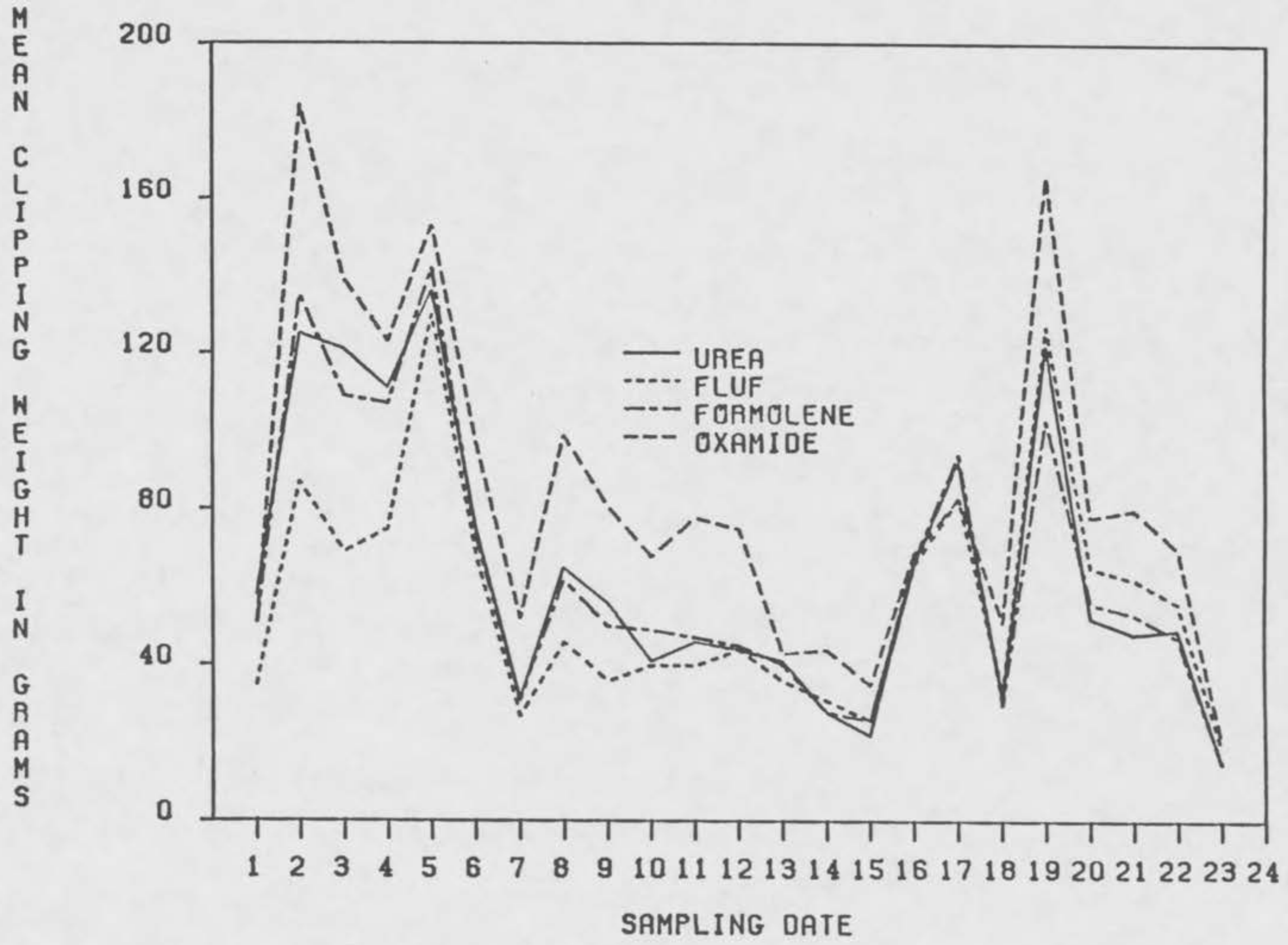
Table 1. Color response of Kentucky bluegrass to various fertilizer treatments applied April 3, June 5 and August 2, 1985 (continued).[1]

Nitrogen Source	Color Ratings[2]		
	9/13	9/18	9/26
Melamine 55-0-0	7.3b	7.3b	6.8cd
Urea	7.5ab	7.5ab	6.8cd
FLUF	7.5ab	7.5ab	6.8cd
Cleary's 16-2-4	7.8ab	7.8ab	6.8cd
Oxamide	8.0a	8.0a	7.8a
FLUF + Trugreen	7.8ab	7.8ab	7.0bc
Formolene	7.5ab	7.5ab	7.0bc
Mello 15-3-6	7.5ab	7.5ab	7.3b
Nitroform	7.8ab	7.8ab	7.0bc
CIL-SCU	8.0a	8.0a	8.0a
Control	7.5ab	7.5ab	6.5d

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

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

Figure 1. Mean clipping weights of turf treated with urea, FLUF, Formolene and Oxamide in 1985.[1]



[1]All values represent the mean of 4 replications.

[2]Sampling date 1 = 4/17/85.

EXPERIMENTAL NITROGEN SOURCE EVALUATION

D. J. Wehner and J.E. Haley

INTRODUCTION

The rapid growth of the lawn care industry has generated interest by fertilizer manufacturers in developing products that will capture a share of this new market. Arcadian Corporation supported the evaluation of 10 experimental N sources in 1985. The experimental sources were compared to several N fertilizers currently available to the lawn care industry.

MATERIALS AND METHODS

The fertilizer treatments listed in Table 1 were applied on 20 June 1985 to a blend of Parade, Adelphi, Glade and Rugby Kentucky bluegrass turf. No additional applications were made. All materials except A22248, A22249, and SCU (sulfur coated urea, LESCO) were applied as liquids using 3.5 gallons of water per 1000 square feet. The granular materials were applied by hand. All sources were applied at the rates of 1 and 2 pounds of actual nitrogen per 1000 square feet. Color ratings were taken weekly after fertilizer application. Clippings were removed from the plots. Irrigation was applied as needed to prevent drought stress. No rainfall or irrigation occurred for 48 hours after the treatments were applied.

RESULTS AND DISCUSSION

The experimental N sources were compared to Fluf, NG 1515, and SCU. The color ratings taken after treatment application are presented in Table 1 (1 pound N per 1000 square feet) and Table 2 (2 pounds N per 1000 square feet). Turfgrass color enhancement from the 1 pound of N application lasted approximately 54 days, after which time, the fertilized turf and the control received similar color ratings. The SCU-treated turf however, rated higher than the nonfertilized turf through the conclusion of the study at 71 days. With this exception, differences among treatments were minimal. Treatment A22245 burned the turf resulting in low color ratings for the first 2 weeks of the study. Turf fertilized with the granular materials A22248 and SCU showed a slower initial response to fertilization.

Turfgrass response to application of 2 pounds of N per 1000 square feet lasted approximately 71 days after which time visible differences between treatments disappeared. The turf fertilized with SCU received the highest color ratings at the 54 day evaluation until the end of the study. As was found at the lower application rate, differences between treatments were minimal. All treatments except SCU resulted in turfgrass appearance similar to that found with an application of urea.

Table 1. Color response of Kentucky bluegrass to various experimental fertilizers applied at 1 lb N per 1000 square feet on June 20, 1985.[1]

Nitrogen Source	% N	Color Ratings[2] 5 DAT*	12 DAT	20 DAT	25 DAT	33 DAT	40 DAT	47 DAT	54 DAT	62 DAT	71 DAT
A22240	20	7.3ab	8.0cd	7.3c-e	7.0e	7.0d	7.7de	7.0de	7.0d	6.0d	5.7c-e
A22241	20	6.3c-e	7.0fg	7.0de	7.0e	7.0d	7.0f	7.0de	7.0d	6.0d	5.3d-f
A22242	20	6.0de	7.0fg	6.7e	7.0e	7.0d	7.3ef	6.7e	7.0d	6.0d	5.0ef
A22243	20	6.7b-d	7.3ef	7.3c-e	7.0e	7.0d	7.0f	7.0de	7.0d	6.0d	5.7c-e
A22244	20	6.3c-e	7.0fg	7.0de	7.7cd	7.0d	7.3ef	7.3cd	7.0d	6.0d	5.7c-e
A22245	20	3.0h	6.0h	7.3c-e	7.3de	7.0d	7.3ef	7.0de	7.0d	6.0d	5.7c-e
A22246	20	6.7b-d	8.0cd	7.3c-e	7.7cd	7.3cd	7.3ef	7.0de	7.0d	6.3cd	5.3d-f
A22247	20	6.7b-d	7.3ef	7.0de	7.0e	7.0d	7.0f	7.0de	7.0d	6.0d	5.0ef
A22248(G)	34.5	5.0fg	5.7h	7.0de	7.0e	7.3cd	8.0cd	7.7bc	7.3cd	6.0d	5.0ef
A22249(G)	42	6.7b-d	7.3ef	7.3c-e	7.0e	7.0d	7.0f	7.0de	7.0d	6.0d	5.0ef
Urea	46	7.0bc	7.7de	7.0de	7.3de	7.7bc	7.7de	7.7bc	7.3cd	6.3cd	5.3d-f
FLUF	18	6.3c-e	7.0fg	7.0de	7.0e	7.0d	7.0f	7.0de	7.0d	6.0d	5.0ef
NG1515	30	7.0bc	7.7de	7.3c-e	7.3de	7.0d	8.0cd	7.7bc	7.7bc	6.0d	5.0ef
NG612	18	6.7b-d	7.0fg	6.7e	7.0e	7.0d	7.0f	7.0de	7.0d	6.0d	5.0ef
SCU	36	6.0de	6.7g	7.3c-e	7.7cd	7.7bc	7.7de	7.7bc	7.3cd	7.0b	6.7ab
Check	--	5.7ef	5.0i	5.3f	6.0f	6.0e	5.7g	5.7f	6.0e	6.0d	4.7f
$LSD_{0.05}$		0.8	0.6	0.7	0.6	0.5	0.6	0.5	0.5	0.4	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.

*DAT refers to days after treatment.

Table 2. Color response of Kentucky bluegrass to various experimental fertilizers applied at 2 lb N per 1000 sq ft on June 20,1985.[1]

Nitrogen Source	% N	Color Ratings[2] 5 DAT*	12 DAT	20 DAT	25 DAT	33 DAT	40 DAT	47 DAT	54 DAT	62 DAT	71 DAT
A22240	20	7.0bc	8.3bc	8.3ab	8.0bc	8.3a	8.3bc	8.0b	8.0b	7.0b	6.0b-d
A22241	20	7.0bc	8.0cd	8.0a-c	8.0bc	8.0ab	7.7de	8.0b	8.0b	7.0b	6.0b-d
A22242	20	7.0bc	8.7ab	8.0a-c	8.0bc	8.0ab	8.3bc	8.0b	8.0b	7.0b	6.3a-c
A22243	20	7.3ab	8.3bc	7.3c-e	7.7cd	8.0ab	7.7de	7.0de	7.3cd	7.0b	6.0b-d
A22244	20	6.3c-e	7.7de	7.7b-d	8.0bc	8.0ab	8.3bc	8.0b	8.0b	7.0b	6.0b-d
A22245	20	3.0h	6.7g	8.0a-c	8.0bc	8.0ab	8.0cd	8.0b	8.0b	7.0b	5.0ef
A22246	20	7.0bc	8.7ab	8.3ab	8.0bc	8.0ab	8.3bc	8.0b	8.0b	6.7bc	5.3d-f
A22247	20	7.0bc	8.3bc	8.0a-c	8.0bc	8.0ab	8.0cd	7.3cd	7.7bc	7.0b	6.3a-c
A22248(G)	34.5	4.7g	6.0h	7.3c-e	7.7cd	7.7bc	9.0a	8.7a	8.0b	6.7bc	6.3a-c
A22249(G)	42	8.0a	9.0a	8.7a	8.3ab	8.3a	9.0a	8.0b	8.0b	7.0b	6.3a-c
Urea	46	7.3ab	9.0a	8.7a	8.0bc	8.0ab	8.7ab	7.7bc	8.0b	7.0b	6.0b-d
FLUF	18	7.3ab	8.0cd	7.0de	7.7cd	7.7bc	7.3ef	7.0de	7.7bc	7.0b	5.3d-f
NG 1515	30	7.3ab	8.0cd	8.0a-c	8.0bc	8.0ab	8.0cd	8.0b	7.7bc	6.7bc	5.3d-f
SCU	36	6.3c-e	7.7de	8.3ab	8.7a	8.0ab	9.0a	9.0a	9.0a	7.7a	7.0a
Check	--	5.7ef	5.0i	5.3f	6.0f	6.0e	5.7g	5.7f	6.0e	6.0d	4.7f
$LSD_{0.05}$		0.8	0.6	0.7	0.6	0.5	0.6	0.5	0.5	0.4	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.

*DAT refers to days after treatment.

INSECT AND INSECTICIDE UPDATE

R. Randell

INTRODUCTION

For the year 1985, insect activity in home lawns was less than average for most areas of the state. There was more concern with questionable insecticide performance than with severe insect populations and damage. This concern will continue into future years.

INSECTS

The usual insects appeared in the state with some visible damage. Control applications were made and lawns recovered. Sod webworms caused brown areas in lawns in July, August, and even September in some areas. Many of the adult moths flying about in late summer were free of any disease, therefore, the 1986 population should survive the winter at a normal or above average population. Chinch bugs again appeared at each end of the state. The hairy chinch bug was a pest of bluegrass in Cook, DuPage and some surrounding counties. The southern chinch bug attacked zoyziagrass in the southern one-third of the state. These bugs suck plant juices from grass plants in sunny and drought areas of lawns. Greenbugs migrated into the central section of the state in July. Many circular areas beneath trees appeared to be dying. The green plant lice could be found in the green border around the dying area. Some damaged areas were treated, but many were not and most recovered by late August. Annual white grub activity has been reduced in 1983 and 1984 due to drought conditions during egg laying in July of each year. Adult beetles during July, 1985 were few but the surplus moisture in many areas provided for excellent egg laying, and eventually slight to moderate grub damage occurred in early to mid September. High early fall temperatures, lack of soil moisture, and a grub population of 5 to 10 grubs per square foot brought sudden visible grub damage in a great many home lawns. This was true even in lawns with a preventative treatment application. Oftanol applied as a preventative treatment in June an July quite often failed to effectively control grubs, even at low to moderate populations. Why the sudden failure of Oftanol to provide consistent control over a 2 to 5 month period is not understood.

INSECTICIDES

Chemical suggested for use to control turfgrass insects in 1985 included diazinon, Dursban, trichlorfon (Proxol or Dylox), Oftanol, Turcam, and Orthene. It was hoped that Triumph would receive federal label registration for 1985 but it did not.

Oftanol was not consistent in performance. Diazinon is being reviewed by Federal EPA because of its toxicity to waterfowl. For the past 25 or more years this chemical has been effective against certain insects with a moderate toxicity to the user. However, it has always had a high rating of toxicity to geese and ducks.

A granular formulation of Proxol was used in grub control plots with good success. Turcam performed well in grub control tests as a 75 percent wettable powder as well as an experimental 35 percent concentrate.

SUMMARY

During 1986, the potential for annual grub increase in population is higher than in 1985. The climate and soil conditions in July will determine success of egg laying. It is hoped that the problems with both Oftanol and diazinon will be solved and both will be available in 1986 for turfgrass insect control.

PLANT PATHOLOGY RESEARCH REPORT - 1985

H. T. Wilkinson

DEPARTMENT OF PLANT PATHOLOGY

Disease development was mild on turfgrass during the 1985 growing season. High levels and frequent rain showers combined with the cool temperatures in Central Illinois produce few severe disease outbreaks. In the northern section of the state, pockets of drought and water stressed were accompanied by the development of summer patch and necrotic ring spot.

Research on the biology and control of patch diseases is continuing at the University of Illinois. Currently, tissue culture techniques are being used to identify increased levels of resistance to summer patch on Poa pratensis. A new graduate student from the Department of Horticulture is currently developing the necessary tissue culture techniques for this program. A disease nursery for summer patch and necrotic ring spot in bluegrass was planted last year and will be inoculated with the respective pathogens this season. Chemical treatments and epidemiological studies will be started this spring on these important diseases.

The study on the effects of sod age, sod type, and sod bed soil has been completed and the results will be made available in 1986. Generally, younger sod out performed older sod in root speed and extensiveness. Cultivating the soil prior to laying sod definitely improved the rooting of sod and this effect was greatest on sod 2 years or older. Peat and mineral sods showed very few differences in the tests performed, but complete analysis of the data is necessary before the question of which sod is "better" can be answered.

In a new study, it was found that slow release forms of nitrogen improved the rooting of 2 year old sod when applied to the sod bed soil immediately prior to transplanting the sod. The effects and best rates of prefertilization during the seasonal variation of soil temperature will be conducted in 1986.

Over seventy fungi have been isolated from zoysiagrass affected by zoysia patch. Several of the fungi are currently being tested for their ability to produce those symptoms characteristic of zoysia patch. The efficacy of commercially available fungicides for control of this disease has produced no recommendations to date. Observations on diseased turfgrass have indicated that vertically slitting the turf or over seeding with ryegrass can retard disease development. The disease has been diagnosed in NY, IN, MO, TN, IL, KS, AK, and OK.

Forty different fungi have been identified as inhabitants of zoysia seed. The fungi live on the seed surface and within the seed itself. The impact of these fungi on seed germination and survival of germinating seedlings is unknown at this time. The identification of the fungi is not known at this time. Research will determine the identification of the fungi and in which seed tissues these different fungi reside.

CONTROL OF SUMMER PATCH AND NECROTIC RING SPOT

H. T. Wilkinson

Field control of summer patch and necrotic ring spot were attempted using multiple applications of Banner 1.1. The compound was applied at the rate of 2.0 oz product /1000 sq ft. Applications were made on 30 May and 6 July. The locations where the chemicals were applied were in Champaign and Indian Lakes, IL. At both locations, severe summer patch and necrotic ring spot had appeared during 1982-1983.

RESULTS

The disease killed about 35% of the untreated areas of bluegrass. The dead grass appeared as typical rings with very defined borders. The areas of turfgrass treated with Banner 1.1 developed only about 20% disease. That is a reduction of about 15% of the diseased area. In addition, the intensity of those treated areas of turfgrass that did develop disease was reduced by about 50% compared to the intensity of the disease in the untreated controls.

COMMENTS

These studies should be conducted for at least 3-5 years on the same location. It is my belief that these two diseases are perennial and grow each year. It will more than likely require several years for any effective chemical toxin to reduce the potential of these diseases to kill large areas of turfgrass during the appropriate environmental conditions.

RECOVERY OF DISEASED TURFGRASS AND THE EFFECTS OF FUNGICIDE RESIDUES ON DISEASE DEVELOPMENT

H. T. Wilkinson

This research examines the effects of nitrogen (1 lb/1000 sq ft/4 months) in combination with selected fungicides. Two effects are being observed: 1) the extent and rate that diseased turfgrass recovers from a severe level of disease attack; and 2) the amount of disease that develops during the year subsequent to treatment application. This study is not complete at this time. The value of this research for understanding the side effects of fungicides on the soil biotica is unquestionable. Only a small sample of the data is presented below, but it represents the total results.

Table 1. The recovery of turfgrass from dollar spot and the effects of fungicide residues on dollar spot development.

Chemical Treatment	Rate oz product/1000 sq ft	Dollar Spot (0 - 100%) Recovery Fall 1984	 Residual Spring 1985
Bayleton	2.0	0	5
Bayleton + Nitrogen	2.0	15	1
Acti-dione Thiram	4.0	40	15
Acit-dione Thiram + Nitrogen	4.0	20	3
Vorlan	4.0	1	3
Vorlan + Nitrogen	4.0	0	5
Chipco 26019	2.0	1	10
Chipco 26019 + Nitrogen	2.0	10	3
Tersan 1991	2.0	50	3
Tersan 1991 + Nitrogen	2.0	40	3
Daconil	11.0	5	3
Daconil + Nitrogen	11.0	1	10
Dyrene	8.0	0	1
Dyrene + Nitrogen	8.0	5	5
Fungo	2.0	20	3
Fungo + Nitrogen	2.0	40	5
Control	---	35	1
Control + Nitrogen	---	20	7

THE EFFECT OF BAYLETON ON *Poa pratensis* SOD INTERFACING

H. T. Wilkinson

This research was designed to examine the effect of Bayleton on the interfacing of bluegrass sod. Bayleton (25WP) was applied according to label recommendations at various rates to the sod less than 12 weeks prior to the transplanting of the sod. The sod was two years old and contained a mixture of cultivars. The treated sod was transplanted to the University of Illinois Turf Research Farm and allowed to grow for about six months. The strength of the sod roots was then measured. The results are presented in Table 1.

Table 1. The effect of Bayleton on the root strength of *Poa pratensis* sod.

Fungicide	Rate oz ai/1000 sq ft	Root Strength (lbs of Pull) R1	R2	R3	Mean
Bayleton	1.0	328	320	360	336
Bayleton	2.0	358	394	368	370
Bayleton	3.0	288	294	280	287
Bayleton	4.0	276	284	262	274
Check	---	394	358	320	357

THE SELECTION OF BACTERIA ANTAGONISTIC TO *Pythium* spp. PATHOGENIC TO TURFGRASS

H. T. Wilkinson and R. Avenius.

A procedure was developed to identify bacteria suppressive to cottony blight (CB) of turfgrass caused by *P.* spp. Bacteria isolated from rhizosphere of *Triticum sativum* were predominantly of the genus *Pseudomonas.* Each of 25 isolates displaying antagonism of Pythium growth on culture medium were assayed for suppressiveness to CB. Bacterial isolates with rifampicin insensitivity were suspended in 10^{-3} mM $MgSO_4$ and sprayed onto grass previously inoculated with a single P. sp. Disease development and epiphytic colonization were measured to determine the suppressiveness of the bacteria. The level of *in vitro* antagonism by a single bacterial isolate varied among the *P.* spp.: the level of *in vitro* antagonism on a single *P.* sp. varied greatly among bacterial isolates. Most antagonistic bacteria failed to suppress disease development. Several isolates reduced disease development by 25% compared to treatments lacking bacteria.

INTEGRATION OF FUNGICIDE MIXTURES AND NITROGEN FOR DISEASE MANAGEMENT

H. T. Wilkinson

This research is directed at determining if disease (dollar spot) can be managed in a more balanced ecosystem by employing two chemical fungicides, used at reduced rates, and nitrogen. The dollar spot disease was selected as a convenient system to use for this research, however it is likely that the results of this study will pertain to other disease systems as well. The treatments were applied to Agrostis palustris cv. Penneagle starting in late July. The treatments were applied every to weeks, for a total of ten weeks. Note that all chemicals are listed as ounces of formulated material per 1000 sq ft. Nitrogen was applied at 0.2 lb/1000 sq ft per application.

Table 1. Integration of fungicide mixtures and nitrogen for dollar spot management.

Fungicide Treatments					% Dollar
Chemical 1	Rate*	Chemical 2	Rate	Chemical 3	Spot
Bayleton	0.25	----	-	----	25
----	-	Acti-dione thiram	2.0	----	40
Bayleton	0.25	Acti-dione thiram	2.0	----	20
----	-	----	-	nitrogen	75
Bayleton	0.25	----	-	nitrogen	30
----	-	Acti-dione thiram	2.0	nitrogen	30
Bayleton	0.25	Acti-dione thiram	2.0	nitrogen	1
Bayleton	0.50	----	-	----	1
Bayleton	0.50	Acti-dione thiram	2.0	----	1
Bayleton	0.50	----	-	nitrogen	1
Bayleton	0.50	Acti-dione thiram	2.0	nitrogen	1
----	-	Dyrene	4.0	----	5
----	-	Dyrene	4.0	nitrogen	5
Bayleton	0.25	Dyrene	4.0	----	0
Bayleton	0.25	Dyrene	4.0	nitrogen	0
Bayleton	0.50	Dyrene	4.0	----	0
Bayleton	0.50	Dyrene	4.0	nitrogen	0
----	-	Vorlan	2.0	----	0
----	-	Vorlan	2.0	nitrogen	0
Bayleton	0.25	Vorlan	2.0	----	0
Bayleton	0.25	Vorlan	2.0	nitrogen	0
Bayleton	0.50	Vorlan	2.0	----	0
Bayleton	0.50	Vorlan	2.0	nitrogen	0
Check	-	----	-	----	50
Chipco	0.25	----	-	----	50
Chipco	0.25	Acti-dione thiram	2.0	----	30
Chipco	0.25	----	-	nitrogen	50
Chipco	0.25	Acti-dione thiram	2.0	nitrogen	25
Chipco	0.50	----	-	----	50
Chipco	0.50	Acti-dione thiram	2.0	----	25
Chipco	0.50	Acti-dione thiram	2.0	nitrogen	25
Chipco	0.25	Dyrene	4.0	----	5
Chipco	0.25	Dyrene	4.0	nitrogen	1
Chipco	0.50	Dyrene	4.0	----	1
Chipco	0.50	Dyrene	4.0	nitrogen	0
Chipco	0.25	Vorlan	2.0	----	0
Chipco	0.25	Vorlan	2.0	nitrogen	0
Chipco	0.50	Vorlan	2.0	----	0
Chipco	0.50	Vorlan	2.0	nitrogen	0

*Fungicide rate is given in oz of product per 1000 sq ft.

YELLOW RING ON *Poa pratensis* CAUSED BY *Trechispora alnicola*

H. T. Wilkinson

Trechispora alnicola (Bourd. & Galz) Liberta is the causal agent of yellow ring disease of *Poa pratensis*. This is the first report of *T. alnicola* as a pathogen of *Poa pratensis*. The fungus infects the roots and crown tissues which results in root necrosis and the destruction of chlorophyll in the leaves. The severity of the disease will vary within a growing season, but symptoms can be seen from May to October. The disease is associated with bluegrass turf that has accumulated about 2.0 cm or more thatch.

At least 21 *P. pratensis* cultivars are susceptible to this fungus. The pathogen appears to be dispersed in water and by machinery. Infection by *T. alnicola* does not result in the death of bluegrass and infected grass can recover by producing new roots, rhizomes and leaves or by increasing the chlorophyll in previously yellowed leaves. The fungicide, pentachloranitrobenze will reduce the severity of the disease and the rate of disease development but will not completely prevent pathogenesis.

In June - October of 1982-1984, rings of yellowed leaves (0.1-1.5m diam.) were observed in bluegrass turf (*Poa pratensis* L.). The yellow rings have been observed in Illinois, Iowa, Wisconsin, Indiana, New York, New Jersey, Pennsylvania, and Ohio. The yellow rings have been observed in twenty-five turfgrass cultivars of *P. pratensis*. The yellow rings are associated with *P. pratensis* turfgrass that is about two years old, heavily thatched (>2.0 cm thick), and has a dense mass of white mycelium associated with the thatch layer. *Poa pratensis* turfgrass developing the yellowed grass, generally has received 1.4-1.8 kg Nitrogen/92.9 m^2/year), supplemental irrigation, and broad leaf herbicide treatments.

The yellowed grass leaves are not always apparent in the sward. In the months of November-March, no symptoms of yellowed leaves are apparent. During April-May, the grass plants comprising rings appear darker green and grow more rapidly compared to uninfected turfgrass. The rings of dark green grass leaves will turn yellow in late May or June. The symptoms of yellowed grass leaves may disappear and reappear several times during a single season. The ring-shaped bands are 0.1-0.15 m thick and do not appear to change during a single growing season or from one year to the next. Rings of yellowed grass plants will occur in the same location in the sward each season and the ring diameters will enlarge. The rate the rings enlarge is apparently dependent on the climatic and edaphic conditions that prevail.

WEATHER DATA FOR URBANA STATION

DATE	TEMPERATURE MAX	TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	SOIL TEMPERATURE GRASS MIN	SOIL TEMPERATURE SOIL MAX	SOIL TEMPERATURE SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01MAR85	42	25	32	31	38	34	0	92	60	NO DEW
02MAR85	44	29	33	31	38	33	0.25	100	60	NO DEW
03MAR85	46	31	36	32	45	35	0	94	48	NO DEW
04MAR85	56	43	44	34	44	35	0.75	100	60	NO DEW
05MAR85	59	27	45	34	46	33	0.65	100	55	NO DEW
06MAR85	29	20	35	32	36	33	0	80	54	LIGHT
07MAR85	36	26	35	33	37	34	0.02	100	56	
08MAR85	48	33	35	33	38	33	0	100	66	LIGHT
09MAR85	52	30	40	35	47	37	0	100	48	MODERATE
10MAR85	58	31	41	36	47	37	0	100	40	LIGHT
11MAR85	58	42	41	38	48	44	1.61	100	40	NO DEW
12MAR85	57	32	44	39	48	40	0.05	100	68	LIGHT
13MAR85	47	34	42	39	48	40	0.13	100	38	NO DEW
14MAR85	41	30	40	37	41	37	0.03	100	70	MODERATE
15MAR85	48	30	41	37	47	36	0	100	48	
16MAR85	48	28	44	38	50	36	0	100	40	LIGHT
17MAR85	52	29	44	38	50	36	0	100	36	MODERATE
18MAR85	42	19	39	34	44	35	0	100	40	
19MAR85	47	30	39	35	47	35	0	94	32	NO DEW
20MAR85	64	38	44	37	53	37	0.1	100	38	NO DEW
21MAR85	57	30	45	39	55	41	0	94	34	NO DEW
22MAR85	46	32	41	37	47	41	0	80	36	NO DEW
23MAR85	50	36	41	38	45	40	0.03	100	64	NO DEW
24MAR85	48	34	42	39	46	40	0.11	100	60	NO DEW
25MAR85	42	34	41	38	43	40	0.09	100	55	NO DEW
26MAR85	45	31	41	37	46	38	0	100	64	MODERATE
27MAR85	63	45	44	38	53	38	0.19	100	36	NO DEW
28MAR85	68	52	50	44	55	48	0.01	100	62	NO DEW
29MAR85	79	45	54	50	65	53	0	100	46	NO DEW
30MAR85	58	38	51	46	57	47	0.72	100	44	NO DEW
31MAR85	48	35	47	44	47	45	0.54	100	60	NO DEW
TOTAL							5.28			
AVERAGE	50.9	32.9	41.6	37.2	46.8	38.4		97.9	50.3	
ACCUMULATIVE TOTAL							11.47			

WEATHER DATA FOR URBANA STATION

DATE	TEMPERATURE MAX	TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	SOIL TEMPERATURE GRASS MIN	SOIL TEMPERATURE SOIL MAX	SOIL TEMPERATURE SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01APR85	46	29	45	38	48	37	0.03	100	64	NO DEW
02APR85	46	36	42	38	46	36	0	100	64	MODERATE
03APR85	51	39	44	38	50	36	0	92	40	NO DEW
04APR85	60	45	48	43	58	44	0.03	100	62	NO DEW
05APR85	70	38	50	46	59	48	1.31	100	48	NO DEW
06APR85	58	35	48	43	49	42	0.15	100	44	NO DEW
07APR85	48	37	45	43	46	41	0	100	36	NO DEW
08APR85	58	27	45	40	49	39	0	100	28	NO DEW
09APR85	40	24	41	37	44	36	0.03	94	46	LIGHT
10APR85	43	28	43	38	50	36	0	100	40	NO DEW
11APR85	49	35	40	40	43	38	0	100	46	NO DEW
12APR85	46	40	50	46	54	49	0.03	100	63	
13APR85	64	49	53	47	70	50	0	100	46	NO DEW
14APR85	70	51	53	51	62	56	0.35	100	34	NO DEW
15APR85	58	53	53	51	58	55	0.13	100	84	MODERATE
16APR85	66	37	57	50	62	48	0	80	26	NO DEW
17APR85	72	37	62	57	64	58	0	100	43	
18APR85	74	38	57	50	67	53	0	100	46	LIGHT
19APR85	80	58	58	54	71	57	0	100	54	NO DEW
20APR85	78	54	60	55	72	60	0	100	36	WET
21APR85	80	55	60	56	73	60	0	100	34	NO DEW
22APR85	82	58	62	58	75	65	0	94	32	NO DEW
23APR85	78	60	61	59	70	65	0	92	54	NO DEW
24APR85	76	54	67	58	70	60	0.39	100	40	NO DEW
25APR85	59	48	60	53	64	53	0	100	64	HEAVY
26APR85	80	53	62	54	71	53	0	88	34	LIGHT
27APR85	80	54	62	57	75	58	0.2	100	64	NO DEW
28APR85	68	48	63	58	69	58	0	82	50	NO DEW
29APR85	70	42	64	56	72	56	0	100	34	LIGHT
30APR85	74	49	64	55	74	56	0	64	26	NO DEW
TOTAL							2.66			
AVERAGE	64.1	43.7	54	49	61.2	50.1		96.2	46.1	
ACCUMULATIVE TOTAL							14.13			

WEATHER DATA FOR URBANA STATION

DATE	TEMPERATURE MAX	TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	GRASS MIN	SOIL MAX	SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01MAY85	76	55	63	57	73	59	0.48	100	40	LIGHT
02MAY85	63	48	60	55	64	54	0.98	100	56	LIGHT
03MAY85	66	43	58	52	61	51	0	70	20	NO DEW
04MAY85	70	48	60	53	70	53	0	100	24	NO DEW
05MAY85	70	52	61	57	72	61	0	96	26	LIGHT
06MAY85	77	60	62	55	67	59	0.05	100	50	
07MAY85	72	48	65	58	72	58	0	100	30	NO DEW
08MAY85	74	47	63	57	72	56	0	100	26	LIGHT
09MAY85	80	51	70	57	79	52	0	100	35	NO DEW
10MAY85	80	50	70	60	77	62	0	100	40	
11MAY85	76	56	67	60	77	62	0	96	50	NO DEW
12MAY85	80	62	66	62	75	67	0	100	46	NO DEW
13MAY85	82	55	72	64	79	65	0	100	38	HEAVY
14MAY85	83	47	69	63	80	62	0.63	100	28	NO DEW
15MAY85	82	51	73	65	79	64	0.64	100	48	NO DEW
16MAY85	64	54	65	60	67	60	0	96	54	NO DEW
17MAY85	80	46	62	58	61	57	0.21	100	76	LIGHT
18MAY85	71	44	59	56	63	53	0.01	100	40	LIGHT
19MAY85	73	54	60	58	69	58	0	100	46	MODERATE
20MAY85	76	58	66	58	75	61	0	86	26	NO DEW
21MAY85	78	57	65	60	75	62	0	100	26	MODERATE
22MAY85	76	50	70	61	81	65	0	82	28	NO DEW
23MAY85	64	54	64	57	67	58	0	64	34	NO DEW
24MAY85	75	51	66	58	75	58	0	78	26	NO DEW
25MAY85	82	52	69	60	81	61	0	88	26	NO DEW
26MAY85	84	64	69	64	80	68	0	70	30	NO DEW
27MAY85	88	58	75	62	82	69	0	95	50	NO DEW
28MAY85	72	53	68	62	69	62	0.23	100	60	LIGHT
29MAY85	72	48	69	61	78	53	0	100	40	LIGHT
30MAY85	81	56	74	63	79	64	0	100	48	
31MAY85	88	70	71	66	79	69	0.07	100	40	NO DEW
TOTAL							3.3			
AVERAGE	76	53	66.2	59.3	73.5	60.1		94.9	38.9	
ACCUMULATIVE TOTAL							17.43			

WEATHER DATA FOR URBANA STATION

DATE	TEMPERATURE MAX	TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	GRASS MIN	SOIL MAX	SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01JUN85	84	59	72	65	82	69	0	100	20	LIGHT
02JUN85	82	64	71	66	80	71	0.02	100	34	LIGHT
03JUN85	81	52	77	68	79	65	0.06	92	42	
04JUN85	86	55	72	65	80	65	0.02	100	32	LIGHT
05JUN85	68	58	66	63	70	66	0.02	100	84	LIGHT
06JUN85	74	55	68	62	72	64	0	90	46	NO DEW
07JUN85	74	59	67	63	73	62	0.03	100	34	NO DEW
08JUN85	84	64	71	64	78	65	0	100	46	NO DEW
09JUN85	90	69	75	69	85	74	0	96	26	NO DEW
10JUN85	90	63	78	69	87	74	0	54	20	NO DEW
11JUN85	89	55	76	70	61	69	0.78	100	40	
12JUN85	65	49	69	61	72	58	0.14	100	68	LIGHT
13JUN85	58	44	62	58	62	54	0	100	44	LIGHT
14JUN85	68	44	66	58	72	53	0	100	38	NO DEW
15JUN85	69	57	64	60	67	57	0.92	100	48	NO DEW
16JUN85	76	57	67	62	70	62	0.03	100	50	MODERATE
17JUN85	82	66	74	65	78	60	0.02	100	44	NO DEW
18JUN85	76	55	70	65	73	63	0	100	44	NO DEW
19JUN85	72	53	73	63	74	62	0.04	100	46	MODERATE
20JUN85	72	51	71	64	78	61	0	100	40	HEAVY
21JUN85	80	68	72	65	60	64	0.03	100	32	LIGHT
22JUN85	84	67	73	66	61	70	0	100	38	LIGHT
23JUN85	82	55	75	68	84	71	0	100	34	MODERATE
24JUN85	86	65	74	68	80	71	0.12	100	48	LIGHT
25JUN85	86	62	76	69	83	69	0	100	60	LIGHT
26JUN85	88	68	78	70	89	70	0	100	48	NO DEW
27JUN85	91	70	80	73	88	75	0.69	100	50	LIGHT
28JUN85	89	63	79	72	82	71	1.62	100	62	NO DEW
29JUN85	74	59	74	69	72	67	0.39	100	60	LIGHT
30JUN85	81	59	74	69	77	67	0	100	40	MODERATE
TOTAL							4.93			
AVERAGE	79.4	58.8	72.1	65.7	77.6	65.6		97.7	43.9	
ACCUMULATIVE TOTAL							22.36			

WEATHER DATA FOR URBANA STATION

DATE	TEMPERATURE MAX	TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	SOIL TEMPERATURE GRASS MIN	SOIL TEMPERATURE SOIL MAX	SOIL TEMPERATURE SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01JUL85	83	62	75	69	80	68	0.22	94	34	NO DEW
02JUL85	81	60	76	70	78	68	0.03	100	46	LIGHT
03JUL85	84	67	76	70	78	70	0.75	100	46	
04JUL85	82	61	78	71	81	67	0.01	100	44	MODERATE
05JUL85	84	62	74	71	77	69	0.01	100	54	LIGHT
06JUL85	84	58	77	71	84	69	0.06	100	44	LIGHT
07JUL85	80	67	86	71	84	73	0	100	48	HEAVY
08JUL85	86	64	77	72	87	73	0	100	44	LIGHT
09JUL85	86	74	76	72	85	74	0	100	57	NO DEW
10JUL85	84	67	77	74	83	75	0.3	100	58	LIGHT
11JUL85	79	61	79	70	85	71	0	100	45	LIGHT
12JUL85	80	64	76	71	81	71	0	100	44	HEAVY
13JUL85	82	68	78	76	81	74	0.02	96	66	
14JUL85	92	72	81	79	88	76	0	95	55	
15JUL85	89	66	77	71	86	70	1.14	100	58	HEAVY
16JUL85	80	61	80	69	85	72	0	100	50	
17JUL85	81	61	78	71	65	68	0	82	36	NO DEW
18JUL85	80	59	75	71	86	68	0	100	34	MODERATE
19JUL85	84	59	80	71	89	71	0	100	42	LIGHT
20JUL85	85	68	80	72	85	73	0.49	100	54	NO DEW
21JUL85	86	67	79	74	82	75	0	100	53	MODERATE
22JUL85	79	61	77	72	80	71	0.03	100	60	HEAVY
23JUL85	82	56	79	70	85	68	0	74	46	NO DEW
24JUL85	81	59	78	70	87	66	0	96	42	NO DEW
25JUL85	87	68	79	71	87	70	0	100	60	NO DEW
26JUL85	85	66	80	71	67	70	0.6	100	55	
27JUL85	83	58	72	71	80	68	0	100	43	LIGHT
28JUL85	82	60	79	71	87	63	0	100	38	NO DEW
29JUL85	80	61	85	73	89	76	0	100	60	LIGHT
30JUL85	88	60	80	72	87	73	0	100	80	NO DEW
31JUL85	89	59	81	75	79	74	0.38	100	85	NO DEW
TOTAL							4.54			
AVERAGE	83.5	63.2	78.3	71.7	83.8	70.9		98	51.2	
ACCUMULATIVE TOTAL							26.90			

WEATHER DATA FOR URBANA STATION

DATE	TEMPERATURE MAX	TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	GRASS MIN	SOIL MAX	SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01AUG85	86	60	76	71	79	70	0.11	100	54	HEAVY
02AUG85	76	57	72	68	74	65	0	100	44	MODERATE
03AUG85	79	57	76	69	82	64	0	100	24	
04AUG85	88	64	73	70	80	72	0	100	42	MODERATE
05AUG85	76	68	71	70	73	71	1.55	100	74	MODERATE
06AUG85	76	67	74	70	79	71	0.02	100	74	MODERATE
07AUG85	86	63	77	75	80	70	0.39	100	54	HEAVY
08AUG85	85	60	81	75	86	79	0	100	72	
09AUG85	88	61	78	73	85	70	0	100	85	
10AUG85	87	58	78	72	85	70	0.32	100	42	LIGHT
11AUG85	81	58	77	71	80	69	0	100	60	HEAVY
12AUG85	81	61	77	71	86	70	0	100	44	MODERATE
13AUG85	87	65	78	72	88	70	0	100	62	LIGHT
14AUG85	88	67	80	75	89	75	0.35	100	62	MODERATE
15AUG85	88	64	77	74	79	75	1.2	100	62	HEAVY
16AUG85	72	63	75	72	77	71	0.2	100	70	HEAVY
17AUG85	80	60	77	73	79	68	0	98	58	
18AUG85	84	65	80	76	83	72	0	95	55	
19AUG85	83	59	78	70	85	65	0	100	34	NO DEW
20AUG85	73	52	72	68	71	64	0.31	100	78	HEAVY
21AUG85	76	53	77	68	76	62	0	100	52	MODERATE
22AUG85	75	56	72	68	81	63	0	100	50	MODERATE
23AUG85	78	60	77	71	80	61	0	100	73	
24AUG85	77	57	73	70	79	70	0.15	100	64	MODERATE
25AUG85	80	52	73	68	77	66	0.01	100	26	MODERATE
26AUG85	72	59	71	62	78	67	0.02	100	68	HEAVY
27AUG85	76	53	71	66	76	66	0	100	56	MODERATE
28AUG85	78	53	73	66	83	67	0	100	60	HEAVY
29AUG85	82	59	81	64	86	67	0	100	54	
30AUG85	84	65	72	68	81	70	0.35	100	58	
31AUG85	84	58	75	70	80	69	0	100	60	MODERATE
TOTAL							4.98			
AVERAGE	80.3	59.8	75.5	70.4	80.5	68.7		99.7	57.1	
ACCUMULATIVE TOTAL							31.83			

WEATHER DATA FOR URBANA STATION

DATE	TEMPERATURE MAX	TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	GRASS MIN	SOIL MAX	SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01SEP85	82	57	74	71	80	69	0	100	26	HEAVY
02SEP85	86	60	74	71	84	74	0	100	52	NO DEW
03SEP85	88	63	77	72	87	75	0	100	46	HEAVY
04SEP85	84	68	72	71	84	73	0	100	60	MODERATE
05SEP85	79	69	73	72	78	74	0.02	100	40	LIGHT
06SEP85	90	71	73	72	84	74	0	100	50	
07SEP85	93	76	78	72	90	74	0	100	50	
08SEP85	94	65	80	74	91	78	0	100	50	MODERATE
09SEP85	90	68	79	75	90	77	0.15	100	46	HEAVY
10SEP85	88	60	78	73	88	73	0	100	48	LIGHT
11SEP85	72	58	72	68	77	69	0	100	72	
12SEP85	70	50	70	64	80	66	0	96	41	
13SEP85	66	42	69	62	78	61	0	100	38	LIGHT
14SEP85	69	39	70	65	72	62	0	90	35	
15SEP85	68	37	72	70	73	60	0	100	40	
16SEP85	75	45	75	72	77	63	0	100	35	
17SEP85	75	55	74	63	77	64	0	100	42	
18SEP85	78	54	66	62	74	63	0	100	65	
19SEP85	83	61	75	66	80	66	0	100	44	
20SEP85	86	60	74	69	80	69	0	100	38	
21SEP85	88	57	71	63	80	68	0	100	36	
22SEP85	78	64	76	69	80	67	0.08	100	49	
23SEP85	77	60	66	64	71	64	0.2	100	64	MODERATE
24SEP85	75	35	62	58	68	53	0.02	100	54	
25SEP85	65	41	63	58	69	53	0	68	28	
26SEP85	63	42	59	56	60	53	0.19	100	40	HEAVY
27SEP85	63	36	58	54	62	51	0.02	100	48	HEAVY
28SEP85	66	42	60	53	64	50	0	100	40	
29SEP85	75	47	63	58	68	55	0	95	35	
30SEP85	76	52	65	60	69	56	0.2	100	40	
TOTAL							0.88			
AVERAGE	76.4	54.5	70.8	65.9	77.2	65.2		99	45.1	
ACCUMULATIVE TOTAL							32.76			

WEATHER DATA FOR URBANA STATION

DATE	TEMPERATURE MAX	TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	GRASS MIN	SOIL MAX	SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01OCT85	60	33	61	53	65	48	0.01	100	70	
02OCT85	56	32	57	50	63	47	0	100	26	
03OCT85	61	36	56	51	62	49	0	100	35	
04OCT85	70	41	58	51	67	50	0.06	100	28	
05OCT85	59	44	57	50	60	48	0.4	96	56	
06OCT85	58	31	54	50	57	47	0	100	38	
07OCT85	68	40	54	50	62	51	0	100	30	NO DEW
08OCT85	75	58	55	40	65	54	0.01	60	23	
09OCT85	71	52	56	54	60	58	0.03	92	40	
10OCT85	78	57	60	55	67	59	0.01	100	48	LIGHT
11OCT85	62	48	59	55	62	56	0.04	100	94	MODERATE
12OCT85	64	48	64	52	64	50	0.18	100	100	MODERATE
13OCT85	77	45	65	60	67	57	0.01	100	47	
14OCT85	77	55	64	60	71	62	0	100	38	LIGHT
15OCT85	71	50	62	58	69	60	0.25	100	68	HEAVY
16OCT85	67	42	62	56	65	53	0	100	30	LIGHT
17OCT85	65	42	59	54	67	53	0	100	40	LIGHT
18OCT85	77	53	63	65	66	53	0	100	28	
19OCT85	73	62	60	57	63	58	0.02	100	90	
20OCT85	64	53	65	59	65	53	0.02	100	65	
21OCT85	60	57	60	55	62	55	0	100	70	
22OCT85	67	51	61	58	64	53	0	100	64	LIGHT
23OCT85	60	52	59	56	60	58	0	100	36	
24OCT85	72	53	66	56	66	57	0.27	100	64	
25OCT85	76	40	63	49	69	51	0	94	34	
26OCT85	76	39	59	51	65	50	0	82	20	NO DEW
27OCT85	70	45	60	54	65	49	0	100	38	
28OCT85	67	35	55	50	61	50	0	100	36	NO DEW
29OCT85	60	45	53	49	58	50	0	82	32	
30OCT85	53	43	50	48	52	49	0.12	100	48	NO DEW
31OCT85	57	44	50	49	53	49	0.04	100	38	
TOTAL							1.47			
AVERAGE	66.8	46.1	59.1	53.4	63.0	53.1		97	49.3	
ACCUMULATIVE TOTAL							34.23			