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1981 TURFGRASS RESEARCH SUMMARY

UNIVERSITY OF ILLINOIS

AT URBANA-CHAMPAIGN

(NOT FOR PUBLICATION)

1981 TURFGRASS RESEARCH SUMMARY

This booklet presents the results for 1981 of experiments being conducted in turfgrass management at the University of Illinois. We hope that the information contained in this booklet will be of value when making management decisions. Several new experiments were established in 1981. These experiments are mentioned briefly in this report but will be given more in depth coverage as we start to collect data.

The weather in Champaign-Urbana for 1981 was characterized by excessive moisture and moderate temperatures. Because there was very little stress on the turf, in some experiments there were fewer differences between treatments in 1981 than in previous years. The results of the experiments should be reviewed with this in mind.

The Research Summary provides the data we have obtained in 1981. It does not give a total picture of our research effort. We urge you to attend our field day which will be held on July 28, 1982 to observe the turf plots in person. We feel that after seeing the plots the information presented in this booklet will be more meaningful.

We would like to thank you, the turfgrass professionals of Illinois, for your support of our program at the University of Illinois. Through your membership in the Illinois Turfgrass Foundation and attendance at the annual conference and golf days, funds are raised to conduct research in turfgrass science. Without your support, our activities would be greatly reduced. We would like to thank the Illinois Turfgrass Foundation for publishing this report in cooperation with the University of Illinois.

David Wehner
Tom Fermanian
Jean Haley

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USDA NATIONAL KENTUCKY BLUEGRASS TRIAL

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

Kentucky bluegrass (Poa pratensis) is the primary turfgrass used for home lawns in Illinois. The many available cultivars of Kentucky bluegrass differ considerably in characteristics such as quality, color, density, texture, stress tolerance, and resistance to disease. The University of Illinois turf program is one of 35 participants in a nationwide Kentucky bluegrass cultivar evaluation. This study will examine the responses of 84 cultivars to various environments and cultural regimes. At our Urbana research facility the trial has been established on a silt loam soil. A duplicate trial has been established on a pure sand soil at our Kilbourne facility. The soil at these sites differs primarily in nutrient and moisture holding capacity.

Urbana

The Urbana evaluation was established on September 15, 1980. Plot size is 5 x 6 feet and each cultivar is replicated three times in a randomized complete block design. Prior to establishment the area was fertilized with a 12-12-12 analysis material at the rate of 1 lb. N/1000 sq. ft. 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. The turf was mowed 2 to 3 times per week at 1.5 inches. The plots were not irrigated, however excessive rainfall during the summer months prevented any drought stress from occuring until late September.

Those cultivars with average quality ratings exceeding 7.5 are judged superior. Most cultivars in this group had medium quality evaluated as spring greenup on March 26, 1981 (Table 1). This was also true for the drought stress evaluation taken September 25, 1981. Generally, cultivars rated high in overall quality were found to have medium drought tolerance.

Several cultivars exhibited excellent spring greenup in the Urbana trial. The cultivar K3-162 was significantly greener at the time of evaluation than any of the other 83 entries. Bristol, Dormie, Kenblue and South Dakota common were judged superior in both spring greenup and drought tolerance, however their overall quality was only rated fair. (Table 1).

Kilbourne

The trial at the Illinois River Valley Sand Field, Kilbourne was established April 6, 1981. Dolomitic limestone was applied to the area at 1.5 tons/A in the fall of 1980. Prior to seeding, fertilizer was applied as 34-0-0 (1.6 lb N/1000 sq. ft.), 0-44-0 (110 lb/A), 0-0-60 (280 lb/A) and potassium magnesium sulfate (180 lb/A). Both complete analysis fertilizers (water soluble nitrogen source) and slow-release nitrogen fertilizers were applied throughout the year, totalling 6.5 lb. N/1000 sq. ft. Granular Tupersan, a preemergence crabgrass herbicide was applied at seeding at a rate of 6 lb. ai./A. A second application of Tupersan WP was made on May 18 at a rate of 6 lb. ai/A. Basagran at 1 quart/A was applied on September 19 and September 28 to control nutsedge. Irrigation is essential for turf growing in a pure sand soil. Although excessive rainfall characterized the 1981 growing season plots were still irrigated to prevent moisture stress. Plots were irrigated as follows: 3.0"/April in 10 applications, 1.3"/May in 5 applications, 2.8"/June in 4 applications, 3.4"/July in 4 applications, 4.2"/August in 5 applications and 2.5"/September in 3 applications.

Cultivars differed widely in rate of establishment (Table 2). On July 15 the plots were infected with Pythium blight, a disease more frequently seen in Illinois on perennial ryegrass. Environmental conditions at this time were ideal fo a pythium outbreak (i.e. hot, wet, humid) and air movement over the plot was poor thus contributing to the severity of the disease. Recovery from this disease varied with the cultivar (Table 2).

Crabgrass (Digitaria spp.) and nutsedge (Cyperus spp.) proved to be major weed problems following the pythium infection. No postemergent crabgrass control was applied but two applications of Basagran made in the fall successfully controlled the nutsedge. October quality ratings reflect disease susceptibility and weed infestation (Table 2).

Both the Urbana and Kilbourne plots are relatively immature stands. Cultivar evaluations taken at these sites over the next several years will provide a better picture of individual cultivar performance.

Table 1. Evaluation of Kentucky Bluegrass varieties during the 1981 growing season — Urbana.

Cultivar	Greenup[1] 3/26/81	Quality[2] 5/7/81	7/8/81	10/8/81	Over all dates	Drought[3] 9/25/81
Adelphi	7.0	7.7	7.7	7.7	7.7	9.0
Glade	6.7	7.3	8.7	7.7	7.6	9.0
Birka	7.0	8.7	9.0	6.3	7.8	7.7
Monopoly	6.7	9.0	8.7	8.0	8.3	9.0
Ram 1	7.0	7.3	8.0	8.0	7.4	9.0
Fylking	7.0	7.3	7.3	6.3	6.8	9.0
Cheri	6.7	7.7	7.7	7.0	7.4	9.0
243	7.0	6.7	6.3	7.0	6.5	9.0
Wabash	7.0	9.0	8.0	8.3	8.1	9.0
Nugget	3.3	5.0	7.3	6.7	6.0	6.3
239	7.0	7.7	7.3	7.0	7.1	9.0
S-21	7.7	7.7	5.7	5.3	6.0	9.0
PSU-190	7.0	8.0	8.3	7.3	7.6	9.0
PSU-150	7.0	9.0	8.3	7.7	8.2	6.3
PSU-173	7.0	8.3	8.7	8.0	8.1	9.0
Kimono	6.3	7.0	8.3	7.3	7.7	9.0
Baron	7.0	7.0	7.7	8.7	7.6	9.0
Enmundi	7.0	7.3	8.3	8.3	7.8	9.0
Plush	6.7	7.3	6.7	8.0	7.3	9.0
Parade	7.0	8.3	7.3	7.7	7.5	9.0
Trenton	7.0	8.7	8.0	8.3	8.0	9.0
Rugby	6.7	8.0	7.3	7.7	7.7	9.0
SV-01617	7.0	7.3	7.3	7.3	6.9	9.0
Banff	6.7	8.7	8.7	7.7	8.1	9.0
Dormie	7.7	6.3	7.7	4.3	5.8	5.0
Holiday	6.0	7.7	7.3	7.0	7.3	7.7
Geronimo	7.0	8.0	7.3	6.3	7.2	7.7
Aspen	7.0	7.0	7.0	7.7	7.0	9.0
MLM-18011	7.3	7.3	7.0	8.0	7.1	9.0
CEB VB 3965	7.0	7.3	7.7	8.7	7.9	9.0
Touchdown	7.0	7.0	8.0	7.7	7.6	9.0
Welcome	7.0	7.7	7.3	8.3	7.5	9.0
WW Ag 463	6.7	8.0	8.0	8.0	7.9	9.0
WW Ag 480	6.3	6.7	8.0	8.3	7.8	9.0
Bono	7.7	8.3	8.7	6.7	7.7	7.7
Kenblue	8.0	5.7	4.3	5.7	5.1	5.0
Harmony	5.7	6.3	7.0	6.3	6.6	7.7
America	7.0	6.7	7.7	7.7	7.3	9.0
Vanessa	6.3	7.3	8.3	7.0	7.7	7.7
Mosa	6.3	7.3	8.7	7.7	7.8	9.0

Table 1. Evaluation of Kentucky Bluegrass varieties during the 1981 growing season — Urbana.

Cultivar	Greenup[1] 3/26/81	Quality[2] 5/7/81	7/8/81	10/8/81	Over all dates	Drought[3] 9/25/81
Cello	6.7	8.0	8.7	8.0	8.0	9.0
WW Ag 478	6.0	6.3	8.7	9.0	8.0	9.0
Piedmont	7.7	8.3	6.7	7.7	7.2	9.0
Majestic	8.0	7.3	6.0	6.7	6.5	9.0
Bonnieblue	7.0	7.0	8.0	9.0	7.8	9.0
Vantage	7.0	8.3	7.0	7.0	7.0	9.0
Merit	7.0	6.7	7.3	7.0	7.1	9.0
Argyle	8.0	7.3	5.7	6.0	5.8	7.7
Charlotte	7.0	7.3	6.3	6.3	6.7	7.7
A20-6	6.3	7.0	8.7	8.7	8.3	7.7
A20	7.0	8.0	8.3	7.7	8.1	7.7
H-7	6.3	6.0	6.7	7.7	6.7	9.0
I-13	6.7	7.0	8.0	9.0	7.9	9.0
A20-6A	6.7	7.7	8.7	9.0	8.3	9.0
N535	7.0	6.7	7.3	8.0	7.1	9.0
1528T	7.0	6.0	6.7	8.7	6.8	9.0
Shasta	7.3	7.0	7.3	8.0	7.4	9.0
Columbia	7.0	8.0	7.7	8.0	7.9	9.0
Apart	7.0	6.0	5.0	5.3	5.3	9.0
A-34	7.0	8.0	7.0	7.3	7.2	9.0
Sydsport	6.3	8.0	9.0	8.7	8.3	9.0
Mer pp 300	6.3	7.0	7.7	7.7	7.3	9.0
Mer pp 43	7.0	7.0	7.3	5.3	5.9	5.0
Mona	6.7	8.0	8.3	8.0	7.8	9.0
Lovegreen	7.0	7.3	8.0	5.7	6.6	7.7
Bristol	7.3	7.0	7.0	8.0	7.3	5.0
Victa	7.0	7.7	8.7	8.3	8.0	9.0
Enoble	5.7	7.3	7.3	7.3	7.2	7.7
SH-2	6.3	8.3	8.0	8.3	7.8	9.0
NJ 735	6.3	7.0	7.0	7.0	6.9	9.0
S.D. Common	7.3	8.0	5.3	5.0	5.8	5.0
Merion	7.0	8.0	7.3	6.0	7.2	7.7
BA-61-91	7.0	6.7	7.7	8.7	7.5	9.0
Bayside	7.0	7.7	6.7	6.7	6.8	7.7
225	7.0	8.7	8.0	8.3	8.1	9.0
Mystic(P-141)	8.0	7.0	8.3	7.3	7.7	9.0
Admiral	7.0	7.3	6.7	8.3	7.3	9.0
Eclipse	7.0	8.0	6.7	8.0	7.4	9.0
Escort	6.3	9.0	8.0	8.7	8.3	5.0
K3-162	9.0	8.3	7.0	7.3	7.6	9.0
K3-179	7.0	8.3	7.7	8.3	7.9	9.0
K3-178	7.0	8.7	8.3	8.0	8.2	9.0
K1-152	7.0	8.3	7.7	8.0	7.9	9.0
Barblue	8.0	9.0	6.3	7.3	7.3	9.0

[1]Greenup ratings are made on a scale of 1 through 9, 9 representing early greenup and 1 representing dormancy.

[2]Quality ratings are made on a scale of 1 through 9, 9 representing ideal turf quality.

[3]Drought ratings are made on a scale of 1 through 9, 9 representing resistance to drought stress.

Table 2. Evaluation of Kentucky Bluegrass varieties during the 1981 growing season — Kilbourne.

Cultivar	Percent Cover 70 days after seeding 6/19/81	Percent Cover 21 days after Pythium outbreak 8/5/81	Quality[2] 10/26/81
WW AG 463	71.7	83.3	6.7
Banff	68.3	80.0	7.0
Barblue	66.7	55.0	5.0
Columbia	66.7	60.0	5.7
Mona	66.7	70.0	5.3
K3-162	65.0	71.7	4.7
K3-178	63.3	75.0	5.3
Plush	63.3	68.3	5.0
Charlotte	61.7	58.3	3.7
K1-152	61.7	75.0	6.0
PSU-190	61.7	65.0	3.7
Rugby	61.7	60.0	4.7
Welcome	60.0	58.3	4.0
Bayside	58.3	65.0	4.3
Kenblue	58.3	50.0	3.7
Trenton	58.3	60.0	6.0
Escort	56.7	60.0	4.7
SV-01617	56.7	51.7	4.0
Vantage	56.7	43.3	3.3
225	56.7	65.0	5.3
239	56.7	66.7	5.0
Argyle	55.0	60.0	4.0
S.D. Common	55.0	50.0	3.7
WW AG 478	55.0	50.0	3.7
Fylking	53.3	58.3	4.7
PSU-173	53.3	53.3	3.3
Admiral	51.7	53.3	4.3
America	51.7	61.7	4.0
N535	51.7	63.3	5.0
Vanessa	51.7	66.7	4.0
A-34	50.0	63.3	4.0
A20-6A	50.0	60.0	5.0
MER PP 300	50.0	41.7	3.0
Touchdown	50.0	53.3	4.0
Monopoly	48.3	53.3	3.7
PSU-150	48.3	63.3	4.0
Sydsport	48.3	65.0	4.7
Bonnieblue	46.7	55.0	4.0
Bono	46.7	53.3	3.0
Holiday	46.7	58.3	3.3
Merion	46.7	48.3	3.3

Table 2. Evaluation of Kentucky Bluegrass varieties during the 1981 growing season — Kilbourne.

Mosa	46.7	56.7	4.0
Wabash	46.7	56.7	5.0
WW AG 480	46.7	46.7	4.3
Majestic	45.0	48.3	4.0
Cheri	43.3	66.7	3.7
Geronimo	43.3	46.7	3.3
MLM-18011	43.3	61.7	4.3
Parade	43.3	45.0	3.7
Apart	41.7	40.0	4.3
Kimono	41.7	51.7	3.3
MER PP 43	41.7	28.3	1.7
Piedmont	41.7	41.7	4.0
S-21	41.7	41.7	3.0
Shasta	41.7	45.0	3.3
1528 T	41.7	50.0	4.0
Aspen	40.0	51.7	4.7
Merit	40.0	60.0	3.7
Adelphi	38.3	50.0	5.0
K3-179	38.3	50.0	3.3
Bristol	36.7	36.7	3.7
Enoble	36.7	48.3	3.3
Lovegreen	36.7	48.3	3.0
NJ 735	36.7	41.7	3.0
RAM - 1	36.7	50.0	4.0
Glade	33.3	53.3	4.0
Harmony	33.3	46.7	3.3
Baron	30.0	45.0	3.3
H - 7	30.0	31.7	3.0
Dormie	28.3	33.3	2.7
Eclipse	28.3	48.3	3.7
Victa	26.7	31.7	2.7
243	25.0	41.7	3.3
A20-6	23.3	36.7	2.7
BA-61-91	23.3	36.7	2.3
Birka	23.3	38.3	2.7
Mystic (P141)	23.3	28.3	2.0
A 20	21.7	26.7	3.3
Cello	21.7	33.3	2.7
I-13	21.7	33.3	3.3
CEB VB 3965	20.0	30.0	2.0
Enmundi	20.0	40.0	3.3
SH-2	13.3	30.0	2.7
Nugget	11.7	16.7	1.7

[1]Data are the mean percent cover of the plots with Kentucky bluegrass 70 days after seeding, June 19.

[2]Quality ratings are made on a scale of 1 through 9, 9 representing ideal turf quality.

KENTUCKY BLUEGRASS BLEND EVALUATION

J. E. Haley and D. J. Wehner

The intraspecific variability of Kentucky bluegrass has allowed selection of cultivars that differ widely in their color, texture, density, and environmental adaptation. The use of a blend, the combination of two or more cultivars of the same species, provides even greater genetic variability than the use of a single cultivar. Blending reduces the possibility of severe damage due to a disease and improves the general adaptation of the turf under differing environmental conditions. Blending superior varieties allows the desired features of each component to be incorporated while reducing the effects of specific weaknesses on general turfgrass quality.

The purpose of this study is to examine the quality of several Kentucky bluegrass cultivars alone and blended with one other cultivar. There are 20 cultivars alone or in combination. They include:

Adelphi	Touchdown-Adelphi	
Majestic	Majestic-Brunswick	
Merion	Merion-Brunswick	
Ram #1	Merion-Majestic	
Brunswick	Baron-Majestic	
Baron	Baron-Brunswick	
Touchdown	Experimental Varieties:	
Columbia		
Majestic-Touchdown	BFC-46-1	P-1528T
	BFB-35-1	

Plots were established August 24, 1978 and are 5 ft x 6 ft with each cultivar or blend replicated 6 times. The turf is mowed 2-3 times per week at 1.5 inches. Fertilizer is applied 3 times per year in 1 lb N/1000 sq ft increments. Plots are irrigated as needed to prevent wilt.

Due to a large _Poa annua_ infestation after seeding and an extremely dry spring and summer in 1979, the plots did not become well established until the following year.

All cultivars and blends exhibited good to excellent quality during the 1981 growing season (Table 3). The observed differences in quality among the cultivars and blends, were not large, most quality ratings were 7.0 or greater. At the October evaluation, all plots containing Merion showed reduced turf quality.

Table 3. Kentucky bluegrass blend evaluation.

Cultivar	Quality[1] 6/2	7/8	10/9
Adelphi	8.2NS[2]	8.3ab[3]	8.0a
Majestic	7.5	7.2cd	6.8abc
Merion	7.5	7.5bcd	6.0c
Ram #1	8.3	8.7a	8.0a
Brunswick	7.8	7.8abcd	7.2abc
Baron	8.2	8.0abcd	8.0a
Touchdown	7.5	7.8abcd	6.8abc
Columbia	8.0	8.2abc	7.7ab
Majestic-Touchdown	8.2	7.8abcd	7.0abc
Majestic-Adelphi	7.0	7.3bcd	7.2abc
Brunswick-Adelphi	7.7	8.3ab	8.0a
Touchdown-Adelphi	8.7	8.7a	7.8ab
Majestic-Brunswick	7.7	7.3bcd	7.0abc
Merion-Brunswick	7.8	7.3bcd	6.5bc
Merion-Majestic	7.7	7.0d	6.5bc
Baron-Majestic	8.0	7.5bcd	7.3abc
Baron-Brunswick	7.5	7.5bcd	7.0abc
BFC-46-1	7.5	8.0abcd	7.3abc
BFB-35-1	8.2	7.7bcd	7.8ab
P-1528T	7.8	7.7bcd	6.8abc

[1]Quality ratings are made using a scale of 1 through 9, 9 representing the ideal turfgrass quality.

[2]Means within this date have no statistical significant difference at the .05 level.

[3]Within a date, means with the same letter are not significantly different at the .05 level.

REGIONAL CULTIVAR EVALUATIONS

J. E. Haley and T. W. Fermanian

Turfgrass cultivar recommendations in Illinois are generally made from data obtained from turfgrass evaluation trials at the Urbana or Kilbourne research facilities. However, Illinois is a state over 400 miles long, with a wide range of temperatures, precipitation and soil conditions. A cultivar suited to central Illinois may not be suited to northern or southern Illinois. With this in mind, cultivar evaluation trials were established in Rock Island County, September 10, 1981 and DuPage County, September 23, 1981. A similar trial will be established at a southern location during the 1982 growing season. Cultivars being established at these sites are as follows:

Kentucky bluegrass

Adelphi	Sydsport
Parade	Victa
Aspen	Bonnieblue
Rugby	Shasta
Columbia	Touchdown
WTN-A-34	Mystic
WTN-A20	America
WTN-H7	Haga
WTN-I13	Baron
	Ram I

Perennial Ryegrass

Pennant	Loretta
Premier	Yorktown II
Manhattan	Diplomat
Lesco's CBS Blend	Fiesta
Goalie	Blazer
Pennfine	Dasher

Tall and Fine Fescue

Shannon	Scaldis
Falcon	Biljart
Olympic	Pennlawn
K31	Waldena
Rebel	Agram
Mustang	Jamestown

Local Evaluations

Rock Island

- Teske's Seed (40% perennial ryegrass, 60% Kentucky bluegrass mix)
- Prevail Low Maintenance (44% fine fescue, 28% Kentucky bluegrass, 14% perennial ryegrass, 10% annual ryegrass)
- Fast & Fine NK (29% fine fescue, 29% Kentucky bluegrass, 38% perennial ryegrass)
- Golf Lawn Seed Mix (73.5% Kentucky bluegrass, 24% perennial ryegrass)
- Evergreen Lawn Mix (55% Kentucky bluegrass, 20% red fescue, 20% perennial ryegrass)

DuPage

- Adelphi-Pennfine (75% Kentucky bluegrass, 25% perennial ryegrass)
- Columbia-Manhattan (75% Kentucky bluegrass, 25% perennial ryegrass)
- Victa-Yorktown (75% Kentucky bluegrass, 25% perennial ryegrass)
- Baron-Pennfine (75% Kentucky bluegrass, 25% perennial ryegrass)
- Merit
- Vantage

Plot size is 5 x 6 feet and each cultivar, mix or blend is replicated 3 times in a randomized complete block design. Prior to seeding a 12-12-12 analysis fertilizer was broadcast over the area at .75 lb. N/1000 sq. ft. Seed was applied by hand. Kentucky bluegrass cultivars and mixes were seeded at 2 lb./1000 sq. ft., tall fescue was seeded at 8 lb./1000 sq. ft. and perennial ryegrass was seeded at 4 lb./1000 sq. ft. The plots in Rock Island County were mulched with straw tacked down with terratac. No mulch was used in DuPage County.

Over a period of several years we hope to obtain from these trials data concerning quality, disease resistance and tolerance to environmental stress. With this information accurate recommendations can be made for each area of the state.

PERENNIAL RYEGRASS CULTIVAR EVALUATION

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

In the past, perennial ryegrass has usually been considered a temporary lawn or nursegrass in seed mixtures. In Illinois, deterioration 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.

Plots of 14 perennial ryegrass cultivars were established August 24, 1978. Plots measured 5 x 6 ft and each cultivar was replicated 3 times. Plots are mowed at 1.5 in, fertilized 3 times per year with 1 lb N/1000 square feet per application and are irrigated as needed to prevent wilt. The following cultivars were established in our trials:

Loretta	Yorktown
Citation	Derby
Manhattan	Pennfine
Omega	Regal
Birdie	Blazer
Caravelle	Fiesta
CBS M-16-7-78	M-456

Due to low soil moisture, the turf did not greenup until mid-April. With a few exceptions, turf quality remained high throughout the growing season. Heavy rainfall during July and August prevented serious deterioration of turfgrass quality usually seen during these normally hot, dry months (Table 4). Cultivars having an annual average quality rating of 7.4 or higher included the experimental variety M-456, Loretta and Derby. All other cultivars were rated as good with the exception of Birdie, Manhattan, Regal and Caravelle which maintained only fair quality throughout the season.

Table 4. Perennial ryegrass cultivar evaluation.

Cultivar	Quality[1] 6/16	7/8	8/18	10/9	Over all dates 1981	Over all dates 1980
Loretta	8.0a[2]	7.0b	7.3NS[3]	8.0abc	7.6ab	5.8abcd
Citation	6.7bc	6.7b	7.3	7.7bc	7.1bc	5.9abc
Manhattan	6.3bcd	6.3b	6.7	7.0c	6.6c	5.5cd
Omega	6.3bcd	7.0b	6.7	8.3ab	7.1bc	5.4d
Birdie	6.0cd	6.3b	6.7	7.3bc	6.6c	5.9abcd
Caravelle	5.3d	5.0c	6.0	5.7d	5.5d	4.4e
Yorktown	7.0abc	7.0b	6.7	7.7bc	7.1bc	5.6bcd
Derby	7.3ab	6.7b	7.7	8.0abc	7.4ab	6.1ab
Pennfine	7.0abc	7.3ab	7.0	8.0abc	7.3abc	6.2a
Regal	6.0 cd	6.7b	6.7	7.0c	6.6c	5.6bcd
CBS-M-16-7-78	6.3bcd	7.3ab	7.3	7.3bc	7.1bc	5.8abcd
M-456	7.0abc	8.0a	7.7	9.0a	7.9a	5.9abc
Blazer	6.7bc	7.0b	6.3	8.3ab	7.1bc	5.6bcd
Fiesta	6.7bc	6.7b	7.3	8.0abc	7.2abc	5.9abc

[1] Quality ratings are made using a scale of 1 through 9, 9 representing the ideal turfgrass quality.

[2] Within a date, means with the same letters are not significantly different at the .05 level.

[3] Means within this date have no statistical significant difference at the 0.5 level.

BENTGRASS BLENDS FOR PUTTING GREEN TURF

D. J. Wehner and J. E. Haley

There are advantages and disadvantages associated with using vegetatively propogated 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 susceptability 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 the severely damaged Toronto greens this summer, it was felt that an evaluation of blends of seeded bentgrass cultivars might be worthwhile. This would be an attempt to see if a quality putting surface could be produced while at the same time increasing the genetic diversity of the stand.

All possible two-way blends of the cultivars Penncross, Penneagle, Seaside, and Emerald were established at the Ornamental Horticulture Research Center in Urbana. Each blend and the four individual components were established in 6 x 10 ft. plots with three replications. There did not appear to be any differences in rate of establishment among the components or blends. These plots will be evaluated for several years to see of any segregation occurs and to evaluate turfgrass quality.

PREEMERGENCE CONTROL OF CRABGRASS

T. W. Fermanian and J. E. Haley

The evaluation of preemergence herbicides for crabgrass (Digitaria sp.) control on established turf is a continuing process. Periodic evaluations are necessary to determine the suitability of new materials for use on turf. The evaluation of preemergence herbicides used for crabgrass control in other crops but not labeled for turf use is also necessary to determine their potential for injurying the turf.

In 1981 two preemergence herbicide trials were conducted at the OHRC at Urbana.

The first experiment (Trial 1) was established on April 1 on a Kentucky bluegrass (Columbia-Touchdown) stand. All plots were overseeded with crabrass seed on three dates, 4-26-80, 4-9-81, and 6-1-81. Plot size was 3 x 5 ft. and replicated three times. Herbicides applied as a liquid were sprayed with a single-nozzle CO_2 sprayer at the rate of 37.5 gpa. Granular materials were distributed by hand.

The herbicides evaluated in this trial were Lasso EC, MON 097, a plant growth regulator (PGR), Dacthal 75W, Tupersan 50W, Balan, Presan EC, and Ronstar 2.5G. Herbicides with a split rate (2+2) were applied twice. The initial applications were followed by a second application six weeks after the first applications. Evaluations of crabgrass control were taken at three months after the initial application date (July 13) and six months after the initial application (October 6). The results are listed in Table 5. An increase in crabgrass populations was observed at three months for both the PGR at 3+3 lb./A and MON 097 at 2 lb./A.. MON 097 at 4 lb./A., Ronstar at 4+2 lb./A., Tupersan at 12 lb./A., Balan at 2 lb./A., Lasso 3+3 lb./A. and Presan at both rates had very good to excellent control at six months. Dacthal at 10 lb./A. had good control at 3 months, however, the crabgrass populations had increased at the six month evaluation. The Kentucky bluegrass turf was not injured by any treatment in Trial 1.

The second experiment (Trial 2) was established on April 15 on a Columbia-Touchdown Kentucky bluegrass stand. Plot size was 3 x 10 ft. The whole area was overseeded twice with crabgrass seed. The first overseeding was preceeded with a vertical mowing of the area. Herbicides used in Trial 2 were mostly granular formulations. All treatments were applied as in Trial 1.

The percent reduction in crabgrass populations two months after the initial applicaions (June 14) as compared to the check plot are listed in Table 6. Both formulations of bensulide (Betamec and Betasan), and Ronstar exhibited excellent weed control. Unlike Trial 1, several herbicides caused turf injury. A rating of phytotoxicity evaluated six (May 28) and eight (June 17) weeks after the initial application is shown in Table 7. Both rates of Devrinol were rated phytotoxic at each date. The use of Devrinol, therefore, is not recommended. Ronstar showed a delayed toxic effect which persisted for several weeks. Ronstar, therefore, should be used with caution.

Table 5. 1981 Preemergence herbicide evaluations. Trial 1.

Herbicide	Formulation	Rate	% reduction in crabgrass population	
		lb.a.i./A.	July 13[1]	October 6
PGR	EC	3	65abc	94a
PGR	EC	5	41abc	83a
PGR	EC	3+3	0d	48b
MON 097	EC	2	0d	80a
MON 097	EC	4	75ab	99a
MON 097	EC	2+2	76ab	83a
Ronstar	G	2	78ab	95a
Ronstar	G	4	69abc	96a
Ronstar	G	4+2	81ab	100a
Tupersan	WP	12	78ab	96a
Tupersan	WP	12+6	76ab	92a
Balan	G	2	90ab	99a
Presan	EC	7.5	97a	99a
Presan	EC	7.5+3.75	98a	100a
Lasso	EC	3	25abc	84a
Lasso	EC	6	43abc	84a
Lasso	EC	3+3	78ab	96a
Dacthal	WP	10	92a	80a
Dacthal	WP	10+5	65abc	88a

[1] Within a date means with the same letter are not significantly different at the .05 level.

Table 6. 1981 Preemergence herbicide evaluations. Trial 2, June 14, 1981.

Herbicide	Formulation	Rate	% reduction in crabgrass population
		lb. a.i/A.	
Dacthal	G	10	22cd[1]
Dacthal	G	10+5	32bcd
Betamec	EC	8	100a
Betamec	EC	8+4	98a
Betasan	G	8	100a
Betasan	G	8+4	100a
Devrinol	G	2	51abc
Devrinol	G	2+1	73ab
Ronstar	G	4	98a

[1]Means with the same letter are not significantly different at the .05 level.

Table 7. 1981 Preemergence herbicide phytotoxicity evaluation. Trial 2.

Herbicide	Formulation	Rate	Phytotoxicity*	
			May 28	June 17
Untreated	--	--	5.7a[1]	5.7a
Dacthal	G	10	5.7a	5.7a
Dacthal	G	10+5	5.0a	5.7a
Betamec	EC	8	5.7a	5.7a
Betamec	EC	8+4	6.0a	6.3a
Betasan	G	8	6.0a	5.7a
Betasan	G	8+4	5.7a	5.7a
Devrinol	G	2	3.0b	3.3b
Devrinol	G	2+1	3.7b	3.7b
Ronstar	G	4	5.0a	3.7b

[1] Within a date means with the same letter are not significantly different at the .05 level.

* Phytotoxicity ratings are made on a scale of 1 through 9, 9 representing no visible phytotoxic effects and 1 representing complete necrosis.

CONTROL OF PLANTAINS AND CLOVER IN TURF WITH POSTEMERGENT HERBICIDES

D. J. Wehner, T. W. Fermanian, J. E. Haley, and A. K. Yust

The high cost of pesticide development has prohibited the introduction of new herbicides which are used only for weed control in turfgrass stands. Manufacturers are evaluating new formulations of standard turfgrass herbicides or seeking data to expand the label of products which have proven efficacious on large scale crops. The purpose of this research was to evaluate the herbicides 2,4-D, MCPP, dicamba, bromoxynil, and Glean for control of broadleaf plantain (Plantago major L.), buckhorn plantain (Plantago lanceolata L.), and white clover (Trifolium repens L.) in a mixed Kentucky bluegrass (Poa pratensis L.)-tall fescue (Festuca arundinacea Schreb.) turfgrass stand. Treatments consisted of sprays containing individual herbicides or combinations of herbicides applied in 28 gallons of water per acre, or herbicide-fertilizer combinations applied in 172 gallons of water per acre.

Weed population ratings (Table 8) taken eight weeks after herbicide application indicated that the best control of broadleaf plantain was afforded by the herbicide 2,4-D alone or in combination with other herbicides. Equally good control was found on plots treated with a combination of bromoxyniol and MCPP. The herbicides Glean and dicamba did not control broadleaf plantain. The results for buckhorn plantain closely paralleled those for broadleaf plantain. The best control of white clover was found on plots treated with the herbicides MCPP and dicamba either alone or in combination with other materials. Neither 2,4-D nor Glean adequately controlled this weed species. Weed control was not affected when fertilizer was combined with herbicides and applied in a large volume of water.

Table 8 . Postemergence control of broadleaf weeds.

Material	Rate lb. a.i./A	Weed Population Buckhorn Plantain	Broadleaf Plantain	White Clover
Dacamine 4D	0.75	8.75a[2]	6.5cde	3.75hi
Dacamine 4D	1.0	8.5ab	7.75abc	4.0ghi
Dacamine 3D	0.75	8.75a	7.5bcd	4.5e-i
Dacamine 3D	1.125	8.75a	8.75ab	4.0ghi
MCPP + 2, 4-D (1.5:1.5)	1.5	8.5ab	7.5bcd	6.75b-e
MCPP + 2, 4-D (1.5:1.5)	1.875	9.0a	8.5ab	7.0a-d
MCPP + 2, 4-D (1.0:2.0)	1.50	8.75a	7.75abc	6.75b-e
MCPP + 2, 4-D (1.0:2.0)	1.875	9.0a	8.75ab	5.5c-i
Trexan	1.065	9.0a	8.5ab	7.75abc
Dacamine 3D + Formolene (1 lb. N/1000 sq. ft.)	1.125	8.75a	7.5bcd	4.25f-i
MCPP + 2, 4-D + Formolene (1.5:1.5)(1 lb. N/1000 sq. ft.)	1.875	8.75a	8.0ab	7.0a-d
MCPP + 2, 4-D + Formolene (1.0:2.0)(1 lb. N/1000 sq. ft.)	1.875	9.0a	8.5ab	6.5b-f
Buctril	1.0	7.75a-e	6.5cde	6.0b-h
Buctril	2.0	7.0cde	7.5bcd	7.5abc
Buctril + Chipco Turf Herb. MCPP	0.5 + 1.0	8.25abc	8.5ab	6.75b-e
Buctril + Chipco Turf Herb. MCPP	1.0 + 1.0	8.5ab	9.0a	7.75abc
Buctril + Chipco Turf Kleen	0.5 + 0.98	8.75a	8.75ab	5.5c-i

Table 8. Postemergence control of broadleaf weeds.

Material	Rate lb. ai./A	Weed Population		
		Buckhorn Plantain	Broadleaf Plantain	White Clover
Buctril + MCPP + Dicamba	0.5 + 0.5 +0.125	7.75a-e	7.5bcd	7.0a-d
Trexan	1.6	9.0a	8.75ab	9.0a
Glean + Surfactant[3]	0.5 oz/A	7.25b-e	4.25fg	4.75d-i
Glean + Surfactant	1.0 oz/A	7.25b-e	5.25ef	6.0b-h
Glean + 2, 4-D + Surfactant	0.125 oz/A + 0.5	8.25abc	6.25de	5.0d-i
Glean + 2, 4-D + Surfactant	0.125 oz/A + 0.75	9.0a	8.5ab	3.5i
Glean + 2, 4-D + Surfactant	0.5 oz/A + 0.5	8.25abc	8.0ab	5.0d-i
Glean + 2, 4-D + Surfactant	0.5 oz/A + 0.75	8.75a	8.25ab	5.0d-i
Glean + 2, 4-D + Surfactant	1.0 oz/A + 0.5	7.75a-e	7.5bcd	6.25b-g
Glean + 2, 4-D + Surfactant	1.0 oz/A + 0.75	8.0a-d	7.75abc	5.5c-i
Dicamba	0.25	6.75de	4.0g	8.25ab
MCPP	1.0	8.25abc	6.25de	6.75b-e
Control		6.5e	4.0g	4.5e-i

[1]Weed population is based on a scale of 1 through 9, 9 representing 0% weeds, 1 representing 100% weeds.

[2]Within a column, means with the same letter are not significantly different at the .05 level.

[3]The surfactant was applied at a rate of 1 pint/100 gallons.

CONTROL OF WHITE GRUBS IN TURFGRASS, 1981

C. W. MacMonegle and R. Randall

Annual white grubs were a serious problem throughout Illinois during 1981. Average counts ranged between 25-35 grubs per square foot, well above the damage threshold of 12-15 grubs per square foot.

Several insecticides were evaluated for control of annual white grubs (larvae of the southern masked chafer) infesting a lawn in Urbana, Illinois, 1981. A single application of each insecticide was applied to an established Kentucky bluegrass lawn with less than 0.5 inch of thatch on July 27, approximately 3 weeks after peak adult flight. Plots were 10 x 20 feet arranged in a randomized complete block design and replicated 3 times. Sprays were applied with a hose-end sprayer and granular formulations were applied using a rotary granular spreader. All treatments were irrigated immediately after application with sufficient water to wet the first 0.5 inch of soil. Post treatment counts of larvae were made on September 8 by examining 10 random 4.25 inch diameter plugs (1 sq. ft.) from each plot. Number of live larvae (grubs) found in a 2 inch zone below the soil line were recorded.

Oftanol (2 lbs. a.i./A), Proxol (8 lbs. a.i./A), diazinon (5 lbs. a.i./A) and the combination of Dursban (2 lbs. a.i./A) and Sevin (4 lbs. a.i./A) gave excellent control of the annual white grub (Table 9).

Table 9 . Annual White Grub Control - 1981, Urbana, Illinois

Treatment	Lbs. a.i./acre[1]	Ave. no. grubs/sq. ft.[*2]
Oftanol 5G	2.0	0.3 a
Proxol 80SP	8.0	3.3 a
Diazinon 14G	5.0	0.7 a
Dursban 4E + Sevin Sprayable (80%)	2.0 4.0	1.0 a
Check	---	31.3 b

[*] Means followed by the same letter not significantly different at 5% level according to Duncan's Multiple Range Test.

[1] Treatment applied July 27, 1981.

[2] Area sampled September 8, 1981.

FIELD TESTING OF FUNGICIDES AND ANTIBIOTICS TO CONTROL THE DECLINE OF TORONTO BENTGRASS

D. J. Wehner

During 1980 and 1981, research was conducted in Illinois to determine the efficacy of antibiotics and standard turfgrass fungicides for controlling the decline of Toronto bentgrass. This disease, which first appeared in the Chicago area in the fall of 1979, has caused such extensive damage that several golf course superintendents have abandoned Toronto and replaced their greens with Penncross or Penneagle.

1980 Studies

Studies during 1980 were conducted at Medinah Country Club and included a broad spectrum of standard turfgrass fungicides (chlorthalonil, Daconil 2787; iprodione, Chipco 26019; benomyl, Tersan 1991; triadimefon, Bayleton; propamocarb, Banol; metalaxyl, Subdue). None of these materials controlled the decline of Toronto bentgrass. The rates used for the trial were chosen from the upper end of the recommended label rates.

In August of 1980, a cooperative research project was initiated and sponsored by the Golf Course Superintendents Association of America, the United States Golf Association, and the Chicago District Golf Foundation. Turfgrass researchers from the University of Illinois were given the task of conducting field trials of pesticides aimed at controlling the decline of Toronto bentgrass

1981 Studies

The experiments conducted by University of Illinois researchers in 1981 concentrated on the use of fungicides and antibiotics for disease control. Several fungicides were tested again in case a fungal organism was responsible for the disease. Antibiotics were included on the premise that the disease organism was not a fungus but rather a bacteria or bacteria-like pathogen. Researchers at Michigan State University (D. Roberts, J. Vargas, and K. Baker) reported evidence in 1980 that bacteria or bacteria-like organisms were found in the water-conducting tissue of infected Toronto bentgrass plants. This evidence combined with the lack of disease control with standard fungicides in 1980 and the failure of several plant pathologists to isolate a fungal pathogen from diseased plants formed the basis for the testing of antibiotics.

The majority of testing by U of I researchers in 1981 was done at Silver Lake Country Club with smaller trials at Medinah Country Club and St. Charles Country Club. In early April, a replicated trial with 21 different treatments was started on the bentgrass nursery at Silver Lake. As sometimes happens, the disease did not occur on the nursery this year.

To increase the chance of getting some useful data, a series of smaller nonreplicated trials were established on two putting greens at Silver Lake, two greens at Medinah, and one at St. Charles. These trial plots consisted of four 60-foot-long sprayed strips, one strip each of chlorthalonil, metalaxyl, tetracycline (Mycoshield), and streptomycin (Agri-Strep) and an untreated check strip. The disease pressure on these greens varied. However, there was an indication that the antibiotic tetracycline showed promise for disease control on three of the five greens treated. The most striking observations were made on May 20, 1981 on the #11 green at Silver Lake. These observations are characterized by the May 20 disease ratings which are presented in Table 10. They indicate a reduction in disease severity with the tetracycline (25% disease on tetracycline plot vs. 50% disease on check plot) but not complete control and no control with chlorthalonil, metalaxyl, or streptomycin.

Based on the results of the nonreplicated trials, a second replicated study was established on June 3, 1981 on two putting greens (#1 and #11) at Silver Lake. This trial concentrated on using tetracycline at several rates in an attempt to get better disease control. Prior to the start of the test, the plots on #1 had an average rating of 36%. The application rates and results for these studies are presented in Table 11. The higher rates tested (3.6 and 4.8 oz/1000 sq. ft.) were effective on #1 where there was minimal disease pressure but they were ineffective on #11 where the disease was more severe prior to the start of the test. This study indicated that low rates may provide preventative control while higher rates would be needed for curative control.

The need for high rates of tetracycline for curative control was clearly demonstrated at St. Charles Country Club in an experiment started on the #16 green on May 28, 1981. Two sets of plots were established by Superintendent Peter Leuzinger. One set of plots was treated with the strips of chlorthalonil, metalaxyl, streptomycin and tetracycline at the rates mentioned in Table 10. The second set of plots was treated with materials supplied to Superintendent Leuzinger by the researchers from Michigan State University. These treatments consisted of a copper based fungicide (Kocide), tetracycline, and streptomycin applied at high rates in a heavy drench treatment. By mid-June, it was apparent that plots receiving high rates of tetracycline (40-60 oz. Mycoshield in 50 gallons water per 1000 sq. ft.) were free of disease while plots receiving low rates of tetracycline showed no improvment.

Further research is needed to refine the tetracycline treatment procedure. Two major questions which need to be answered are: 1. How many sprays are needed to prevent the disease form developing? and, 2. Can this material be used at rates lower than heavy drench treatment which was successful at St. Charles? A third set of plots was established by the author at Silver Lake in an attempt to answer the latter question concerning rates of tetracycline. This study was established on July 9, 1981 and consisted of plots treated with various rates of tetracycline in 5, 10, or 20 gallons of water per 1000 sq. ft. Shortly after establishing the plots, a change in the weather allowed the test area to improve and no useful information was gathered. Additional field work on this disease will be conducted in 1982 with the hope of answering these two major questions.

The author would like to thank the GCSAA, USGA, and Chicago District Golf Foundation for their support of this project. Also, appreciation is expressed to Dudley Smith and Tom Hildreth of Silver Lake C. C., Don Pakkala and Kip Tyler of Medina C. C., and Pete Leuzinger of St. Charles C. C. for their cooperation with the field testing program.

Table 10. Disease ratings from strip plots on #11 green at Silver Lake Country Club. Plots received three sprays from 4/30/81 to 5/20/81.

Treatment	Rate* (formulated product/ 1000 sq. ft.	% Disease 4/30/81	% Disease 5/20/81
Streptomycin (Agri-Strep)	1.9 oz.	30	40
Chlorthalonil (Daconil 2787)	11.0 fl. oz.	30	50
Tetracycline (Mycoshield)	2.4 oz.	30	25
Metalaxyl (Subdue)	4.0 fl. oz.	30	60
Check		30	50

*All treatments applied in 5.3 gallons water per 1000 sq. ft.

Table 11. Disease ratings from replicated trials on #1 and #11 putting greens at Silver Lake Country Club.

Treatment	Rate* (formulated product/ 1000 sq. ft.)	% Disease 6/17/81	
		#1 green	#11 green
Tetracycline	1.2 oz.	20 A B+	40 A
Tetracycline	2.4 oz.	17 BC	28 A
Tetracycline	3.6 oz.	13 BC	21 A
Tetracycline	4.8 oz.	5 C	16 A
Check		33 A	40 A

*All plots except those receiving 4.8 oz. were sprayed on 6/3/81 and 6/10/81. Plots receiving 4.8 oz. rate were sprayed on 6/3/81.

+Means within a column followed by the same letter are not significantly different at the .05 level of confidence by the Duncan's Multiple Range Test.

STUDIES ON MANAGING LEAF SPOT AND MELTING OUT ON KENTUCKY BLUEGRASS

Contrasts between 1980 and 1981 epidemics

M. C. Hirrel, M. C. Shurtleff, G. L. Fagiolo, and A. D. Fly

Two experiments were conducted to improve and further evaluate fungicide application in a disease management program for Leaf Spot and Melting Out.

Timing Experiment: Success in 1980 in controlling this disease using Chipco 26019, Daconil 2787, and Dyrene, alone or in combination with Acti-dione TGF, was further tested by varying the time between fungicide applications. Rates of application were as follows: Chipco 26019 (2 and 4 oz/1000 sq ft), Daconil 2787 (3 and 6 oz/1000 sq ft), Dyrene (8 and 12 oz/1000 sq ft) and in combination with Acti-dione TGF (0.5 oz/1000 sq ft) using Chipco 26019 at 2 oz/1000 sq ft, Daconil 2787 at 3 oz/1000 sq ft, and Dyrene at 4 oz/1000 sq ft. Applications were made beginning on April 24 and then every 7, 10, or 14 days until May 26.

Fungicide Evaluation Experiment: Twenty-four fungicide treatments applied either alone or in combinations were compared to an untreated check. Bayleton and Acti-dione RZ showed poor control in 1980 but were retested in 1981. Tersan LSR alone and with Chipco 26019 was retested to determine if it would be as effective in controlling the leaf spot phase this year as it was last year. New evaluations were made using Scott's Lawn Disease Preventer as a single granular application in Spring and Fall, and two new formulation from DuPont, DPX 7331 and DPX 3866. Three applications of each fungicide treatment were made at 2 week intervals starting April 25.

Artificial Inoculation: On half of each plot in both experiments were artificially inoculated with an isolate of Dreschlera poae (*Helminthosporium vagans*) obtained from the University of Illinois turf plots. Virulence of this isolate was maintained throughout the winter on bluegrass grown under glass. Inoculation was made 10 and 7 days prior to fungicide application at a concentration of 10,000 conidia/ml covering a 7 sq in area. The uninoculated portion served as a measure of natural infection while the inoculated area would be used to measure the spread of the pathogen from a single focus of infection. Additional N at a rate of 3-4 lb/1000 sq ft was applied following inoculation in order to promote disease development.

Results: To date leaf spot severity has been minimal in both experiments, and the crown rot (melting out) phase failed to develop even when artificially inoculated. Since 1980 was quite favorable for a leaf spot epidemic, an explanation for this year's poor disease development might be found in comparing the weather conditions during Spring green-up for the past two years. The most dramatic difference in spring weather conditions between the two years was the temperature three weeks prior to spray. In 1980 the average high for this period was 50.7°F while this year the average was 64.5°F. During this period there were 8 days with daily highs over 70°F while in 1980 there was only one day when temperatures reached 70°F. From screening studies using 84 bluegrass varieties, we have found that infection is greater when turf is grown at temperatures in the low to mid 60°F range. This strongly suggests that our Urbana isolate is typical of this pathogen in that cool temperatures and wet conditions are required for infection.

A second factor may be related to N fertility levels at or prior to infection. Our N application was probably put on too late to affect infection. However, this year there have been several reports of moderate to severe leaf spot epidemics on home lawns in the Urbana area. In nearly every instance, severe leaf spot epidemics were associated with heavy Fall and Spring N fertilization. Thus, warm weather inhibition of leaf spot may be overcome on turf under high N management.

While thus far no chemical control data has been obtained for Spring, plans have been made to repeat this work in the Fall using heavier N levels to stimulate disease development. This Spring's work cannot be consisered a total failure for we have obtained valuable information on some of the abiotic factors affecting this disease. The development of a useful disease management program must afford the turf grower with a means of evaluating the build-up of a disease situation. In 1980 we showed that melting out severity could be predicted from leaf spot severity. This year we have learned that chemical control may be altered to a less intense program if temperature highs during Spring green-up average greater than 60°F. Thus, the monitoring of environmental parameters in a disease management program can lead to more effective and more economical disease control.

COMPARISON OF MULCHES FOR TURFGRASS ESTABLISHMENT

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

The use of a mulch is an integral part of successful turfgrass establishment. The function of the mulch is to prevent erosion during establishment and to provide a desirable microenvironment for seed germination and growth. Various types of materials have been used for mulching turfgrass seedbeds. These materials have included such things as straw, sawdust, excelsior, wood chips, shredded bark, netting, and cellulose fiber. As new types of mulching materials become available, they must be tested to determine their effectiveness in turfgrass establishment. The purpose of this research was to evaluate the use of chopped paper as a mulch for turfgrass seedbeds.

Methods and Materials

This research was conducted at the Ornamental Horticulture Research Center in Urbana, Illinois. A seedbed was prepared by treating an existing Kentucky bluegrass stand with glyphosate, rototilling the area after the turf had died, and leveling the area with a dragmat. The soil type was a Flanagan silt loam (Aquic Argiudoll) having a pH of 6.2 and 115 and 704 pounds of available phosphorus and potassium per acre, respectively. Prior to seeding, a 12-12-12 fertilizer was applied at the rate of 360 pounds per acre. The area was then seeded with 'Kentucky 31' tall fescue (*Festuca arundinacea*) at a rate of 260 pounds of seed per acre. The seed was applied with a drop spreader to insure uniform coverage and guarantee meaningful seedling counts. Seeding was done on September 25, 1980.

The mulches used and their rates of application are listed in the accompanying table. Except for the straw treatment which was applied by hand, all mulches were applied using a hydro seeder to 20' by 20' plots with three replications of each treatment.

Seedling counts were taken on October 14, 1980 from three randomly selected one square foot areas in each plot. Seedling heights and soil moisture (gravimetric determination) were also measured on October 14, 1980. Turfgrass quality and percent plot cover were rated on November 7, 1980 and quality, color, and density were evaluated on April 20, 1981. All data were subjected to an analysis of variance and means were analyzed by Duncan's multiple range test.

The time period from the date of seeding (9/25/80) until the seedling counts were made (10/14/80) was characterized by dry weather. Irrigation was applied to the test area three times prior to the seedling counts. Rainfall was adequate for good turfgrass growth for the remainder of the test period.

Results and Discusssion

The seedling counts and height measurements given in Table 12 reflect the ability of the mulches to create an ideal enviornment for seed germination and growth. The highest number of seedlings per square foot was found on the plots mulched with straw. There were no significant differences between straw, Conwed wood fiber, Turffiber, Spramulch and the untreated check. There was some variation in seedling counts within plots. This variation probably results in fewer significant differences between treatments.

The tallest seedlings were found on the plots mulched with straw. The seedlings on all other plots were shorter with no significant differences between the remaining treatments. The taller seedlings on the straw plots probably resulted from a combination of more moisture being available for plant growth (32% soil moisture under straw vs. 19-23% soil moisture under the other mulches, see table) and more initial elongation of the primary shoot before exposure to light.

The percentage of the plot covered with tall fescue was rated in November of 1980. The plots which had been mulched with straw were completely covered by that date. There was a lower percentage of cover on the remaining plots but the cover on the plots mulched with Conwed wood fiber, Spramulch at 1800 pounds per acre, Original Hollow wood fiber, and the untreated check was not significantly lower than the straw treatment.

Quality, color, and density ratings were taken in April of 1981 to determine if there were any differences in winter survival or spring green-up due to treatments. The data indicate that there were no significant differences in quality or density due to treatments. The turf on the plots which had been mulched with straw had a lower color rating than turf on the other plots. This was probably due to a restricted nitrogen supply for turf growth during the decomposition of the straw layer.

The results of this research indicate that there was a slight advantage to using straw as the mulching material for turfgrass establishment. This advantage was manifest in the higher percentage of cover found on the straw-mulched plots in November. However, a good mulch must also prevent erosion during seed germination and establishment. The ability of the mulches to prevent erosion was not tested in this research and therefore no conclusions can be drawn concerning this aspect of mulch performance.

Table 12. Seedling counts and heights, turfgrass quality, color, density, and percent cover for plots treated with mulches for turfgrass establishment.

Treatment	Rate (lbs/A)	Seedlings/ft^2 10/14/80	Seedling height (cm) 10/14/80	% Soil moisture 10/14/80	% Cover 11/80	Quality[2] 11/80	Quality[2] 4/20/81	Color[2] 4/20/81	Density[2] 4/20/81
Straw	3800	501 a[1]	6.4 a	32 a	100 a	9.0 a	8.0	5.3 b	8.0
Conwed wood fiber	1500	442 ab	2.6 b	23 b	87 a	7.2 ab	7.0	7.0 a	6.7
Turffiber	1500	392 ab	2.0 b	22 b	80 bc	6.6 b	5.7	7.3 a	5.3
Spramulch	1500	340 abc	2.6 b	19 b	78 bc	5.5 b	5.7	7.0 a	5.3
Spramulch	1800	375 abc	2.0 b	21 b	87 abc	6.8 ab	6.7	7.0 a	6.0
Astro mulch	1500	334 bc	2.8 b	20 b	76 bc	6.2 b	6.0	7.0 a	5.7
Original Hollow wood fiber	1500	327 bc	2.1 b	21 b	91 ab	7.3 ab	7.0	7.0 a	6.7
Soilguard		219 c	2.1 b	21 b	70 c	5.2 b	5.7	7.0 a	4.7
Check		359 abc	2.3 b	20 b	83 abc	7.0 ab	5.3 NS	7.0 a	5.3 NS

[1]Means within each column with a letter in common are not significantly different at the 5% level of confidence.

[2]Quality, color, and density rated on a 1 to 9 scale with 9 = high quality, good color or good density.

MULCHING MOWER TRIAL

J. E. Haley and D. J. Wehner

Public interest in "mulching" mowers has increased in the last few years. More information is needed on the advantages and/or disadvantages of using these mowers compared to conventional rotary mowers. Conventional rotary mowers are typically used with a bagger to catch clippings and therefore avoid the accumulation of leaf debris on the turf's surface with each mowing. The "mulching" mowers by virtue of their closed housing, do not require a bagger. Clippings, held under the housing, are repeatedly chopped and returned to the turf to recycle nitrogen and other nutrients. The primary objective of this study was to determine the long term effects on an improved Kentucky bluegrass turf of a "mulching" mower compared to the influence of a conventional rotary mower with clippings returned intact and with clippings removed. The secondary objectives were to look at the influence of mowing frequency and nitrogen levels on the turf.

The study was initiated on a one year old stand of "Baron" Kentucky bluegrass in April 1979. Plots were arranged in a split plot design with each plot replicated 3 times. Fertility levels were 0, 3 and 6 lb. N/1000 sq. ft./year. The yearly applications were divided into three equal portions and applied in April, June and September. A water soluble source of nitrogen was used. The turf was mowed at 5 cm. of height 1 or 2 times per week or once every 2 weeks (.5 times/week). Weather permitting, mowing was performed the same time each week. Plots were mowed with a Toro 21" Mulcher Deluxe and a Toro 21" Rear Bagger. When removing clippings a bagger attatchment was mounted over an open chute at the rear of the mower. When clippings were returned, the bag was removed and the chute closed. This may differ from other rotary mowers that do not have bags or discharge chutes that close when the bag is not in use. Clippings produced by the conventional mower were larger than those produced by the mulching mower.

Visual quality was evaluated on 17 dates from 1979 through 1981. The evaluations reflect color, density, pest populations and general appearance (Table 13). As expected turf receiving no nitrogen showed reduced quality on all dates. Differences in quality between medium and high fertility levels reflect when nitrogen was applied in relation to when the data was collected. Quality was low when mowing was infrequent at once every two weeks. This is a result of mower scalping and deposits of clipping debris on the turf surface especially during periods of rapid growth. No consistant differences were noted between turf mowed with the mulching mower and the rotary mower/clippings returned. However clipping debris was a problem at high fertility levesl and infrequent mowing when the mulching mower was used. Out of 17 evaluation dates there were 11 dates when there was significant difference in the interaction between mower types and fertility levels (Table 14). Where 6 lb. N/1000 sq. ft./year was applied, returning the clippings with the rotary mower provided better quality than the mulching mower. At 3.0 lb. N/1000 sq. ft./year the differences in quality between methods of returning the clippings was less. With no added nitrogen there were no differences between these two methods. Removing the clippings gave reduced quality on 9 dates.

Visual density evaluations were made on 8 dates from 1980 through 1981 (Table 15). Density increased as nitrogen was added. Frequency did not effect density. As in quality there was no consistant differences between the mulching mower and returning the clipping with the rotary mower. Where clippings were removed density was reduced.

Thatch measurements, evaluated in October 1981 showed an increase in thatch as fertility levels increased. There was no difference in thatch build up among the mowing methods used. It was observed that thatch under turf where clippings were removed was more dense and fibrous than thatch under turf where clippings were returned with the rotary mower or the mulching mower. When looking at the interaction of mowing units and fertility levels there is less thatch buildup with the mulching mower at medium fertility levels than with the rotary mower/clippings returned at medium fertility levels (Table 16). When looking at the interactions of mowing units with mowing frequencies, there is less thatch in plots mowed with the mulching mower at one time per week than in plots mowed one time per week with the rotary/clippings returned. However, in both cases the differences between mowing methods are not large when taken over a three year period.

Weed populations were high where no supplemental nitrogen was provided and especially where clippings were removed due to reduced vigor and density of the turf.

It can be concluded that in this trial best turf quality was obtained under medium to high nitrogen fertility with frequent to weekly mowings. If clippings are to be removed additional nitrogen must be supplied. Some problems were associated with the mulching mower used. Stalling in tall grass and unsightly clipping debris deposited on the turf surface occurred more frequently than with the conventional rotary mower used.

Table 13. Turfgrass quality as a result of fertility level, mowing frequency and mowing unit.

Fertility[1]	Dates[2]
Quality[3] at 0#N < quality at 3#N < quality at 6#N	8
" " 0#N < " " 3#N = " " 6#N	9
Frequency[4]	
Quality[3] at 0.5 times/wk. < quality at 1.0 time/wk. = quality at 2.0 times/wk.	10
" " 1.0 time/wk. < " " 2.0 times/wk.	2
" " 0.5 times/wk. = " " 1.0 time/wk. = " " 2 times/wk.	5
Mowers[5]	
Quality w/rotary w/clip returned < quality w/mulcher mower	4
" rotary w/clip returned > " mulcher mower	5
" rotary w/clip returned = " mulcher mower	8
" rotary w/clip removed < " mulcher mower, rotary w/clip returned	8

[1] Fertility levels are: no nitrogen, 3 lb. N/1000 sq. ft./year and 6 lb. N/1000 sq. ft./year.

[2] 'Dates' refers to the number of dates out of 17 evaluation dates from 1979 through 1981 that the quality statement holds true.

[3] Quality ratings are made on a scale of 1 through 9, 9 representing ideal turf quality.

[4] Mowing frequency was 0.5 times/week (once every two weeks), 1 time/week and 2 times/week.

[5] Mowers used were a conventional rotary mower with clippings returned intact, a conventional rotary with clippings removed, and a mulcher mower.

Table 14. Turfgrass quality as a result of the interaction of mowing unit and fertility level.

		Dates[1]
At 0#N		
Quality[2]	w/rotary/clip returned = quality w/mulcher mower	11
"	rotary/clip removed < " mulcher mower, rotary clip returned	7
At 3#N/1000 sq. ft./year		
Quality	w/rotary/clip returned < quality w/mulcher mower	2
"	rotary/clip returned > " mulcher mower	4
"	rotary/clip returned = " mulcher mower	5
"	rotary/clip removed < " mulcher mower, rotary/clip returned	7
At 6#N/1000 sq. ft./year		
Quality	w/rotary/clip returned < quality w/mulcher mower	3
"	rotary/clip returned > " mulcher mower	8
"	rotary/clip removed < " mulcher mower, rotary/clip returned	5

[1] Of the 17 dates on which quality was evaluated there were 11 dates where there was an interaction between mowing units and fertility levels. 'Dates' refers to the number of dates from 1979 through 1981 where that quality statement holds true.

[2] Quality ratings are made on a scale of 1 through 9, 9 representing ideal turf quality.

Table 15. Turfgrass density as a result of fertility level, mowing frequency and mowing unit.

Fertility[1]	Dates[2]
Density[3] at 0#N < density at 3.0#N < density at 6.0#N	5
" " 0#N < " " 3.0#N = " " 6.0#N	3
Frequency[4]	
Density at 0.5 times/wk. < density at 1.0 time/week = density at 2.0 times/wk.	2
" " 0.5 times/wk. = " " 1.0 time/week = " " 2.0 times/wk.	6
Mowers[5]	
Density w/rotary/clip returned < density w/mulcher mower	1
" " rotary/clip returned > " " mulcher mower	1
" " rotary/clip returned = " " mulcher mower	6
" " rotary/clip removed < " " mulcher mower, rotary/clip returned	8

[1]Fertility levels are: no nitrogen, 3 lb. N/1000 sq. ft./year and 6 lb. N/1000 sq. ft./year.

[2]'Dates' refers to the numbers of dates out of 8 evaluations dates from 1980 through 1981 where the statement holds true.

[3]Density ratings are visual ratings made on a scale of 1 through 9, 9 representing ideal turf density.

[4]Mowing frequency was 0.5 times/week (once every two weeks), 1 time/week and 2 times/week.

[5]Mowers used were a conventional rotary mower with clippings returned intact, a conventional rotary with clippings removed and mulcher mower.

Table 16. Thatch[1] - Interactions

Mowing unit*	Mower x Fertility[2] (cm. thatch) lb. N/1000 sq. ft./year		
	0	3	6
remove	.83e[3]	1.68bcd	2.10a
return	1.44d	1.98ab	1.95ab
mulch	1.42d	1.49cd	1.82abc

Mowing unit	Mower x Frequency[4] (cm. thatch) mowing frequency/week		
	2.0	1.0	0.5
remove	1.46c[3]	1.55bc	1.59bc
return	1.36c	1.94a	2.08a
mulch	1.52bc	1.38c	1.83ab

[1]Thatch measurements were made in cm. visible thatch in October 1981.

[2]Mower x fertility refers to the interaction of mowing units with fertility levels.

[3]Means with the same letter are not significantly different at the .05 level.

[4]Mower x frequency refers to the interactions of mowing units with mowing frequency.

*Mowing units used were a conventional rotary mower with clippings returned intact (return), a conventional rotary with clippings removed (remove), and a mulcher mower (mulch).

FAIRWAY RENOVATION WITH THE USE OF EMBARK AND ROUNDUP

C. Stynchula and D. J. Wehner

Kentucky bluegrass, bentgrass, and Poa annua are the major components of many golf course fairways in the midwest. Establishing improved Kentucky bluegrass varieties in these fairways through overseeding is usually unsuccessful. Large scale overseeding is only feasible in the spring or fall. This is the optimum growing period for the seedling as well as the existing plants resulting in a reduction in stand establishment. If a competetive disadvantage could be imposed on the existing grasses, more successful renovation programs may be accomplished. The purpose of this study is to evaluate the growth regulator mefluidide (Embark) as a tool in fairway renovation. By supressing the growth of the existing turf, it might be possible to increase the success of an overseeding.

Two field studies were initiated on Sept. 15, 1980 and Sept. 28, 1981 on the University of Illinois Golf Course, Savoy, Illinois. Glyphosate (Roundup) and three application rates of mefluidide (Embark) were applied on the seventeenth fairway and driving range. Glyphosate was applied at a rate of 2 lb. ai/A for complete eradication of the exisiting Kentucky bluegrass, bentgrass, and Poa annua stand. Embark was applied at three rates of .125 lb. ai/A, .25 lb. ai/A, and .15 lb. ai/A. This application retarded growth of the existing stand but continued to provide a playable turf surface. In 1980, renovation procedures were initiated a week after the chemical treatments. A time length of two days was allowed before renovation in 1981. Warren's A-31 (1980 study) and Touchdown (1981 study) Kentucky bluegrass were broadcast over the plots at a rate of 1 lb./1000 sq. ft. A steel mat was used to break up soil plugs and to drag seed into the holes. The second method used a Rodger's seeder with slicer blades which are run in one direction over the plots. Bluegrass seed was drilled into the plots on 2" centers at a rate of 1 lb./1000 sq. ft. Preliminary data of germinations showed consistent seedling emergence in all plots. Seedlings in 1980 reached an average height of 3/4" by mid-November. An early ground freeze in 1981 hindered some germination and growth of Touchdown Kentucky bluegrass seedling. Since no growth retardent affect of Embark in the spring existed, A-34 Kentucky bluegrass blended into the stand. This made collection of data on Embark treated plots impossible. However, weed infestation of knotweed and Poa annua was very prominent in plots where Roundup was used.

In a second study conducted in the greenhouse, mefluidide sprayed at .25 lb. ai/A on Kentucky bluegrass seeds inhibited their germination. A delayed germination of 13 days prevailed on Embark treated seeds in comparison to untreated seeds. An additional greenhouse study where Embark at .25 lb. ai/A was sprayed on 4 inch plugs and seeded one day after treatment revealed a quicker growth of seedlings compared to untreated plugs.

Additional studies have been planned to evaluate the feasibility of using mefluidide in renovation. Kentucky bluegrass will be overseeded into mefluidide treated ryegrass and bentgrass stands. Data collection should be easier where species differences will allow easy identification of established bluegrass.

FAIRWAY BENTGRASS MANAGEMENT STUDY

D. J. Wehner and J. E. Haley

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 reduce 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.

The large blocks of each cultivar will be split and half the area will receive a preventative fungicide program while the other half will not receive any fungicide. Perpendicular to the fungicide strips will be cultivation treatments consisting of vertical mowing, core aerification, or no cultivation. The plots will be monitored for turfgrass quality, thatch buildup and disease severity.

THE EFFECTS OF SAND TOPDRESSING ON A CREEPING BENTGRASS PUTTING GREEN

R. E. Burns and T. W. Fermanian

In recent years, interest has greatly increased in a pure sand topdressing program developed by Dr. John Madison and his associates at the University of California. This involves the application of 100% sand to the surface of the turfgrass stand on a routine basis throughout the year.

Agreement can usually be found on the value of topdressing; however, opinions often vary as to what constitutes a good top-dressing program.

The purpose of this study is to examine the effects of pure sand and modified high sand mixes as topdressing materials on the degradation of thatch and its influence on other soil properties.

The study uses a split plot design with three replications per treatment. the main treatments consist of three application intervals and a check. They include:

1) biweekly applications, no cultivation
   2 cu. ft. material/1000 sq. ft.

2) monthly applications
   vertical mowing in April, May, Sept., Oct.
   4. cu. ft. material/1000 sq. ft.

3) bimonthly application
   vertical mowing in April, Oct.
   4 cu. ft./1000 sq. ft.

The subplots consist of 6 materials. They are a fine sand, a medium sand, a 9:1 sand-soil mix, an 8:1:1 sand-soil-peat mix, milorganite and a 9:1 sand-soil mix with a wetting agent.

According to Madison, sand for topdressing and green construction should have a minimum of 75% of the particles in two adjacent size ranges. The following sands were chosen:

The fine sand is a washed blend sand with the following particle size analysis:

Very coarse	0.7%
Coarse	1.3%
Medium	59.8%
Fine	34.3%
Very fine	3.4%
Silt and clay	0.5%

The medium sand is a washed mason sand with the following particle size analysis:

Very coarse	3.9%
Coarse	14.3%
Medium	75.3%
Fine	6.5%
Very fine	0.0%
Silt and clay	0.0%

The first treatments were applied July 13, 1981 to a Washington creeping bentgrass turf mowed at 1/4 inch. All of the mixes were blended with the medium sand. The milorganite plots receive a total of 6 lbs. N/1000 sq. ft./year corresponding to the application intervals. The remaining plots receive a total of 6 lbs. N/1000 sq. ft./year. from another source. The wetting agent is applied at a rate equal to 32 oz./1000 sq. ft./year.

Initial readings taken included thatch depth, bulk density of the soil immediately under the thatch, and infiltration rates. Initial thatch samples consisted of 3 plugs taken at random from each plot with a 2 x 2 inch plugger. Thatch thickness was measured using a millimeter scale on compressed and uncompressed plugs. Bulk density readings were obtained using the core method. Infiltration rates were taken from each plot using a variation of a double-ring infiltrometer. Visual ratings of turf quality were taken before the initial application and will be taken monthly. They will be based on color, texture, density, uniformity, hydrophobic dry spot development and disease incidence.

This study, being designed to measure thatch decomposition, is a long term study. Therefore, at this time, there is no data to report concerning any change in the thatch layer. Visual observations have shown a difference in quality between the topdressed plots and the check plots. Again, it is too soon to differentiate between treatments.

Concerning fall color, all treatments had much higher ratings than the check. The biweekly and monthly treatments also had considerably better color than the bimonthly treatment. All ratings for topdressing materials were within a small range with the 9:1 sand-soil mix plus wetting agent at the top and the milorganite at the bottom.

Treatments will be applied in 1982 and the plots will be monitored throughout the growing season.

IRON FERTILIZATION OF KENTUCKY BLUEGRASS

A. Yust and D. Wehner

Introduction

Kentucky bluegrass is the major turfgrass species used in Illinois. The quality of a Kentucky bluegrass turf can be judged by its color, density, uniformity, texture, and smoothness. The most noticeable characteristic is color with dark green being desireable. Nitrogen fertilizers can be used to produce a dark green color, but high rates of nitrogen can also cause certain problems. More frequent mowing, increased disease incidence, and reduced stress tolerance are associated with high nitrogen levels. Foliar application of iron fertilizers can also be used to enhance color (Beard, 1973). Nitrogen fertilization will still be necessary; however, reduced rates of nitrogen could be utilized resulting in fewer problems with excessive growth, disease, and other stresses.

Most Illinois soils contain sufficient qualities of available iron for turfgrass growth, but there are certain instances where soil iron is limited and iron-related chlorosis can result. Soil factors which cause iron to be unavailable include high pH, high levels of phosphorus or HCO_3 an imbalance of metallic ions or a combination of high pH, high lime, high moisture, and cool temperature.

Iron is important in the plant for a number of functions. Iron is directly involved in photosynthesis, respiration and nitrogen metabolism. Iron is also necessary for chlorphyll synthesis but is not an integral part of the chlorophyll molecule. Chlorophyll content and green color have been related in numerous studies.

Iron sulfate and iron chelate are the two main iron fertilizers used to correct plant chlorosis due to iron deficiencies. Iron fertilizers are most commonly applied in solutions directly to the foliage of the plant. Soil applications of iron fertilizers are generally less effective than foliar applications. Iron sulfate is cheaper but iron chelates are able to maintain iron in a plant available form longer and can usually be applied at lower rates of actual iron than iron sulfate to correct iron chlorosis symptoms. (Tilsdale and Nelson, 1975).

Iron Fertilization

Iron sulfate and iron chelate at rates of 0,1,2 and 4 pounds of actual iron per acre were combined with nitrogen at rates of 0,0.5 and 1.0 pounds per 1000 square feet and applied to a mature Touchdown-Columbia Kentucky bluegrass stand at the Ornamental Horticulture Research center. Foliar applications of the fertilizer treatments were made to the individual 30 square feet plots with a CO_2 sprayer. Visual color ratings and chlorophyll determinations were made weekly until color differences no longer exsisted.

The first application of treatments was made on July 26, 1980. Color ratings for plots receiving the application of two pounds per acre iron rate are given in Table 17. Color differences after one day were due to iron. After one day all plots receiving iron were darker green than plots receiving nitrogen alone or the check. After seven and fourteen days, color differences due to the iron were still noticable. Plots receiving iron and 0.5 pounds of nitrogen were greener than plots receiving 0.5 pounds of nitrogen only and as green as the plots treated with one pound of nitrogen only. There were no differences in color ratings taken 21 days after treatment.

The second application of treatments was made on October 2, 1980. Color ratings for plots treated with the two pound iron rate as presented in Table 18. As was the case after the July 26 treatment, color differences after one day were due to iron. Color differences due to the iron lasted for 65 days after the October 2 treatment as compared to only 14 days after the July 26 treatment. This difference was related to the plant growth and growing conditions of the specific time of year. Considerably less plant growth occurred after the October 2 treatments as compared to plant growth after the July 26 treatments. Thus, the effect of the iron was manifest longer.

Iron application made on October 2, 1980 did not enhance 1981 spring green up of the treated plots. Plots receiving nitrogen in October of 1980 were green before plots receiving no nitrogen in the spring of 1981.

Four applications of treatments were made in 1981. Color enhancement due to iron was noticable 24 hours after each application. Color differences due to iron lasted on week after the April 21 application, two weeks after the June 17 and August 18 applications and for two months after the October 3 treatment.

Iron Toxicity

Iron sulfate and iron chelate at rates of 0, 1, 2, 4, 8, 10, 16, 32 and 64 pounds of actual iron per acre were applied to a mature Touchdown-Columbia Kentucky bluegrass stand at the Ornamental Horticulture Research Center on September 6, 1981. Foliar applications were made to the individual 30 square feet plots using a CO_2 backpack sprayer. Visual injury ratings were taken on September 7, 13, and 20 (Table 19).

One day after application, only those plots treated with 16, 32 and 64 pounds of iron per acre showed injury to the turf. Increasing damage in the form of blackening and thinning of the turf occurred as the rate of iron increased from 16 to 64 pounds (Table 19). There was no difference in injury to the plots due to the iron fertilizer source.

Injury ratings taken one week following application of the treatments show that there is no noticable damage to plots receiving 16 pounds of iron per acre (Table 19). Furthermore, there was a reduction in noticable damage due to the 32 and 64 pound rates of iron. After 2 weeks, there was no visual damage on any of the plots treated with iron. Good growing conditions and several rainfalls during the two weeks following the application of these treatments contributed to the plots quick recovery from injury.

Literature cited:

Beard, J. B. Turfgrass Science and Culture 1973.

Tilsdale, S. L. and W. L. Nelson. Soil Fertility and Fertilizers 1975.

Table 17. Color Ratings (7-26-80 application).

Treatment	Days from application 1	7	14	21
2FeS[1]	6.7[4] d[5]	6.7 cde	7.7 ef	8.7 a
2FeC[2]	7.3 bcd	7.7 bcd	8.0 bcd	8.0 ab
2FeS + .5N[3]	7.0 cd	8.3 ab	8.7 ab	8.3 a
2FeC + .5N	9.0 a	8.7 ab	9.0 a	8.3 a
2FeS + 1N	7.0 cd	8.7 ab	9.0 a	8.7 a
2FeC + 1N	7.7 bc	9.0 a	9.0 a	9.0 a
.5N	5.3 e	7.0 cde	7.3 de	8.0 ab
1N	5.3 e	8.0 abc	8.3 abc	8.3 a
Check	5.0 e	6.3 e	6.3 f	8.0 ab

1) 2FeS = Iron Sulfate at 2 lbs. of iron per acre.

2) 2FeC = Iron Chelate at 2 lbs. of iron per acre.

3) N = nitrogen rate in lbs. per 1,000 sqare feet.

4) Color ratings are made on a scale of 1 through 9, 9 representing a dark green color and 1 representing a light green color.

5) Within a date, means with the same letter are not significantly different.

Table 18. Color ratings (10-2-80 application).

Treatment	Days from application					
	1	7	14	21	28	65
2FeS[1]	7.7[4]abc[5]	7.0def	6.0e	6.3ef	6.3de	5.0f
2FeC[2]	7.7abc	7.7b-e	7.3bcd	7.3cde	7.3bcd	6.7bcd
2FeS + .5N[3]	7.7abc	7.7b-e	7.3bcd	7.7bcd	7.7bcd	6.7bcd
2FeC + .5N	7.7abc	8.3abc	8.0abc	8.0bcd	8.0bcd	6.7bcd
2FeS + 1N	7.3bcd	7.7b-e	7.3bcd	7.0def	7.3bcd	7.3abc
2FeC + 1N	8.3ab	9.0a	8.7a	8.3abc	8.7a	8.0a
.5N	6.0e	6.3fg	6.3de	7.0def	7.0cd	6.0de
1N	6.3de	7.3cde	6.7de	7.0def	7.0cd	7.3abc
Check	5.7e	6.0g	6.0e	6.0f	6.0e	5.0f

1) 2FeS = Iron Sulfate at 2 lbx. of iron per acre.

2) 2FeC = Iron chelate at 2 lbs of iron per acre.

3) N = nitrogen rate in lbs. per 1,000 square feet.

4) Color ratings are made on a scale of 1 through 9, 9 representing a dark green color and 1 representing a light yellow color.

5) Within a date, means with the same letter are not significantly different.

Table 19. Injury ratings.

Treatment	Days from application 1	7
16 lbs. FeS[1]	8.3[3]c[4]	0b
16 lbs FeC[2]	10.0c	0b
32 lbs. FeS	25.0b	6.7a
32 lbs. FeC	25.0b	6.7a
64 lbs. FeS	56.7a	8.3a
64 lbs. FeC	61.7a	10.0a

1) FeS = Iron Sulfate

2) FeC = Iron Chelate

3) Percent injury is the mean of 3 replications.

4) Within a date, means with the same letter are not sigificantly different.

LIQUID NITROGEN FERTILIZATION FOR HOME LAWNS

B. G. Spangenberg, T. W. Fermanian, D. J. Wehner

Nitrogen is generally considered the most important nutrient for turfgrass. Actively growing turfgrass responds quickly to available nitrogen with improved color and increased growth rate. There are many fertilizer sources available which supply nitrogen to turf, the majority of which are applied as dry materials. However, liquid application offers such advantages as reduced labor, reduced mixing and loading time, and increased accuracy with liquid metering. there are several available nitrogen materials which can be applied as solutions to turf, some of which are relatively new. With the rapid growth of the home lawn care industry in recent years, an evaluation of these types of materials is needed. Research on these materials usually conducted by private businesses, is not generally available to others. Liquid sources could prove to be a vital part of a total lawn care program. The purpose of this study is to evaluate the performances of liquid nitrogen sources relative to each other and to granular sources in a home lawn use situation.

This study was initiated May 1st, 1981 on an established stand of Columbia-Touchdown Kentucky bluegrass. Each treatment is replicated three times as a 3 x 10 feet plot in a randomized comlete block design. Liquid materials are applied with a CO_2 backpack sprayer, with a spray volume of 4 gal/1000 sq ft, using a 8010 LP nozzle. Granulars are applied by hand. A schedule similar to that of a home lawn care company has been set up, with four applications in 1981 on May 1st, June 18th, August 6th, and October 9th. A similar schedule is planned for 1982.

Nitrogen sources which are applied as liquids included FLUF, Formolene, UAN, Folian (12-4-4 and 12-4-6), Nitroform, and urea. Granular sources used in this study include SCU, urea, ammonium sulfate, ammonium nitrate, urea with inhibitor, and ammonium sulfate with inhibitor. Urea is added to some of the liquid sources to provide a soluble source of nitrogen for the turf until the controlled-release source begins to become available to the plant. In addition, chelated iron is added to some mixtures rather than urea to provide a quick green-up response without the possible detrimental effects, such as disease problems, which accompany high nitrogen rates. There are a total of twenty-five different treatments in addition to the check. Nitrogen rates are one pound of actual nitrogen per one thousand square feet per application, except for SCU, which is two pounds per one thousand square feet in two applications. Lower nitrogen rates are used when mixed with chelated iron.

Color, quality, growth rate, and fertilizer efficiency are the main parameters being monitored in this study. Color and quality are visual ratings taken weekly. Growth rate is measured approximately every two weeks as fresh clipping weights. Fertilizer efficiency will be determined from total nitrogen found in oven-dried clippings using the Kjeldahl method. Other data recorded includes phytoxicity, disease occurence, and thatch buildup. Weather data is also being recorded daily throughout the study. All data is subjected to statistical analysis.

The poor performance of all the Folian treatments in this first year of study was very surprising. Due to the consistent lack of response, paralleling the check in most cases, it is likely that faulty materials are the cause. This problem will be looked into before next season. However, Folian data has been excluded from this season's table summaries.

As expected, urea added as a soluble nitrogen source to controlled release materials such as Nitroform and FLUF did give a better initial color response within 1 week than the controlled release material alone. Likewise, chelated iron gave similar results, showing a more rapid improved response within 24 hours. These results are reflected in the accompanying table (Table 20). Recommendations cannot be made based on one season's data, however, several trends should be noted for future evaluation. SCU consistently was near the top or at the top of color and growth rate ratings. Materials such as FLUF and Nitroform, which have long residual effects, showed a gradual increase in response over the entire season. Formolene showed a moderate initial response. One thing to note about the 1981 season; frequent rainfall in mid and late summer may have aided the quick, positive response of some materials, since there were days when even the check plots appeared acceptable.

Some dollar spot occured principally in August and was found primarily on the check plots. Phytotoxicity occured on the UAN treatments following all applications. Although not severe, it was noticable. The liquid urea treatments showed some tip burn following the October application.

Table 20. Color response[1] of Kentucky bluegrass to various fertilizer treatments. Application dates — May 1, June 18, August 6, and October 9.

Treatments	6/17	6/20	6/25	7/2	7/8	7/22	8/13	8/20	9/30	10/21
Ammonium Nitrate[2]	6.3bc	5.0ef	9.0a	8.7a	9.0a	9.0a	9.0a	8.7ab	7.7ab	7.7abc
Ammonium Sulfate[2]	7.0b	5.3def	8.7ab	8.7a	9.0a	8.7ab	9.0a	8.7ab	7.0bcd	7.3bcd
Amm. Sulfate w/inhibitor[2]	6.0cd	5.0ef	8.3abc	8.7a	9.0a	8.7ab	8.3bc	8.7ab	7.0bcd	6.7de
FLUF[2]	5.7cde	6.0bcd	6.7fgh	6.0de	7.0bcde	7.3def	8.7ab	7.7cde	7.7ab	8.3ab
FLUF/Iron[6]	5.7cde	6.7ab	7.0efg	7.0bcd	6.7cdef	6.7efg	8.0cd	7.3de	6.7bcd	7.7abc
FLUF/Iron[4]	6.0cd	6.7ab	7.0efg	6.3cde	6.7cdef	7.0def	7.7d	7.0ef	6.3cde	7.0dc
FLUF/Urea[3]	6.0cd	5.0ef	8.0bcd	8.0ab	7.7bc	8.0bcd	9.0a	8.0bcd	7.3bc	8.3ab
FLUF/Urea[8]	6.0cd	5.0ef	7.3def	7.0bcd	7.3bcd	7.7cde	8.3bc	7.7cde	6.7bcd	7.7abc
Formolene[2]	6.0cd	5.7cde	7.3def	7.3bc	7.3bcd	7.3def	8.7ab	8.0bcd	7.0bcd	7.3bcd
Formolene/Iron[6]	5.7cde	7.0a	7.7cde	7.0bcd	7.7bc	6.7efg	8.3bc	8.0bcd	7.3bc	8.3ab
Formolene/Urea[3]	6.0cd	5.3def	8.0bcd	7.3bc	8.0ab	7.3def	8.7ab	8.0bcd	7.0bcd	8.0ab
Formolene w/WIN[2]	5.7cde	5.7cde	6.3gh	6.7cd	6.3def	7.0def	8.0cd	7.0ef	6.3cde	7.0cd
Nitroform[2]	5.7cde	6.0bcd	6.0hi	6.0ed	6.7cdef	7.7cde	8.7ab	7.3de	7.3bc	8.3ab
Nitroform/Urea[9]	5.7cde	5.0ef	7.3def	7.0bcd	7.3bcd	8.0bcd	8.3bc	6.3fg	6.3cde	8.3ab
Nitroform/Urea[5]	5.7cde	5.3def	7.0efg	6.3cde	7.3bcd	7.3def	8.7ab	7.7cde	7.0bcd	8.7a
SCU[7]	8.0a	7.0a	8.3abc	7.3bc	8.0ab	8.0bcd	9.0a	9.0a	8.7a	8.3ab
Urea (granular)[2]	6.3bc	5.7cde	9.0a	9.0a	9.0a	9.0a	9.0a	8.3abc	7.0bcd	8.0ab
Urea (liquid)[2]	5.7cde	5.0ef	8.0bcd	7.3bc	7.7bc	8.0bcd	9.0a	7.7cde	7.0bcd	8.7a
Urea/Iron[6]	5.7cde	7.0a	8.0bcd	7.3bc	7.7bc	7.0def	8.3bc	7.3de	6.7bcd	8.0ab
Urea/Iron[4]	5.3de	7.0a	7.3def	7.3bc	7.7bc	7.3def	8.0cd	7.7cde	7.3bc	7.7abc
Urea w/inhibitor[2]	6.3bc	5.3def	9.0a	8.3a	8.7a	8.3abc	9.0a	8.3abc	7.0bcd	8.3ab

Table 20. Color response[1] of Kentucky bluegrass to various fertilizer treatments. Application dates — May 1, June 18, August 6, and October 9.

Treatment	6/17	6/20	6/25	7/2	7/8	7/22	8/13	8/20	9/30	10/21
UAN[2]	6.0cd	4.7f	7.7cde	7.3bc	8.0ab	7.3def	8.0cd	7.7cde	6.7bcd	7.7abc
Check	5.7cde	5.3def	6.0hi	4.7f	5.3g	6.0gh	6.7e	5.3h	6.0de	5.7f

Within a date, means with the same letter are not significantly different at the 0.5 level.

1) Color ratings are made on a scale of 1 through 9, 9 representing ideal turf color.

2) 1.0 lb. N/1000 sq. ft. all 4 treatments.

3) 0.5 lb. N/1000 sq. ft. from each source all 4 treatments.

4) 0.5 lb. N/1000 sq. ft., 0.75 oz. Fe/M 1000 sq. ft. - June, Aug. and 1.0 lb. N/1000 sq. ft. only - May, Oct.

5) 0.5 lb. N/1000 sq. ft. from each - June, Aug.; 0.5 lb. N/1000 sq. ft. from urea in May, and 1.0 lb./1000 sq. ft. from Nitroform, 0.5 lb N/1000 sq. ft. from Urea in Oct.

6) 0.5 lb. N/1000 sq. ft., 0.75 oz. Fe/1000 sq. ft. - May, June; 1.0 lb. N/1000 sq. ft. - Aug., Oct.

7) 2.0 lb N/1000 sq. ft. - May, Aug.

8) 0.75 lb. N/1000 sq. ft. FLUF, .25 lb. N/1000 sq. ft. urea all 4 treatments.

9) 0.5 lb. N/1000 sq. ft. urea in May; 1.5 lb. N/1000 sq. ft. Nitroform, 0.25 lb. N/1000 sq. ft. urea in June; and 1.25 lb. N/1000 sq. ft. Nitroform, 0.50 lb. N/1000 sq. ft. urea in Oct.

NITROGEN FERTILIZER MATERIALS AND PROGRAM EVALUATION

J. E. Haley and T. W. Fermanian

Good turfgrass growth depends on an adequate supply of all the essential elements as well as on environmental and cultural factors. Nitrogen is the essential element that receives the most attention in turfgrass fertilization programs. The turf manager regulates the plant's growth by adding or withholding nitrogen while maintaining adequate supplies of other elements.

A good number of nitrogen-containing fertilizers are presently available on the market for turfgrass fertilization: water-soluble and slow-release. These materials vary considerably in their chemical and physical properties. Slow-release products such as ureaformaldehyde (UF) and milorganite (natural organic) have been available for years. Others, such as isobuylidene diurea (IBDU) and methylene ureas, are newer while sulfur-coated ureas are just now becoming important in the industry. Since slow-release nitrogen sources are important components of commercial turf fertilizers, it is important that performance of existing products versus new products are constantly monitored. Safety, efficiency, initial plant response, residual response, and cost among other factors are key considerations in developing and utilizing fertilizers and instituting fertilization programs.

The primary objective of this trial is to evaluate several slow-release nitrogen sources on an improved Kentucky bluegrass turf over a period of several years.

The study was initiated on a one year old stand of "Baron" Kentucky bluegrass. Treatments consist of 14 nitrogen carriers or combinations of carriers applied at 1 lb. N/1000 sq. ft. in May, June, September and October (Program I); 2 lb. N/1000 sq. ft. applied in May and September (Program II); and 4 lb. N/1000 sq. ft. applied in May (Program III). A control plot, receiving no nitrogen, is included in each program. Each treatment is replicated three times with plots 5 x 6 feet in a split plot design. Mowing is performed 2 or 3 times weekly at 1.5 inches. Clippings are returned intact to the plots. Irrigation is performed as needed to prevent wilt. Fertilizer materials and programs are evaluated on a basis of general turfgrass quality with periodic ratings of turf color and visual density. During the 1981 growing season excessive rainfall and moderate temperatures provided excellent growing conditions for the turf resulting in high quality throughout the summer months with little differences among the treatments.

Turf fertilized under Program I exhibited the best spring quality while Program III provided poor to fair spring quality. It should be noted that Hercules UF showed consistant spring quality over all three programs. Later in the season there was no significant differences among the three programs. Turf quality throughout the season was good to excellent except in the control plots. Turf fertilized with Milorganite and Hercules UF provided lower quality ratings than turf fertilized with other nitrogen carriers. However the ratings were still within acceptable levels. Except for turfgrass in the control plots, turf density was high. Materials that received an average density rating of 8.0 or greater (9 = excellent) were Lakeshore Fairway 28-3-9, Urea, O.M. Scott-SCU, Tennessee Valley Authority - SCU and Lakeshore's SCU. Turf responded to all nitrogen carriers with good to excellent June color (7.0 or greater) with the exception of Swift's IBDU, Hercules UF and the control. Weed populations were significantly higher in plots receiving no nitrogen. Although statistically there was no significant differences in the interactions between the fertilizers and fertilization programs used the scores for quality, density and color of this interaction are listed for your convenience (Tables 21-24).

Table 21. Nitrogen sources, rates, and application frequencies.

Fertilizer	Analysis	Program Application Dates I (1 lb N/M)	II (2 lb N/M)	III (4 lb N/M)
1. Scotts 1.9/1 Methylene Urea	39-0-0	April, May, Aug., Sept.	April, Aug.	April
2. Hercules UF	38-0-0	" " "	" "	"
3. Milorganite	6-2-0	" " "	" "	"
4. Swifts IBDU Coarse	31-0-0	" " "	" "	"
5. Canadian Industries Limited - SCU	32-0-0	" " "	" "	"
6. Lakeshore SCU	36-0-0	" " "	" "	"
7. Lakeshore Fairway	28-3-9	" " "	" "	"
8. Scotts - SCU	38-0-0	" " "	" "	"
9. Urea	45-0-0	" " "	" "	"
10. Tennessee Valley Authority - SCU	36-0-0	" " "	" "	"
11. IBDU, TVA-SCU, Urea 24%, 57%, 19%	______	" " "	" "	"
12. IBDU, CIL-SCU, Urea 37%, 43%, 20%	______	" " "	" "	"
13. IBDU, TVA-SCU, Urea 39%, 40%, 20%	______	" " "	" "	"
14. IBDU, CIL-SCU, Urea 22%, 60%, 18%	______	" " "	" "	"

Table 22. Evaluation of nitrogen sources, rates and application frequencies.

Program I (1 lb. N/1000 sq. ft. in May, June, Sept., Oct.)

Fertilizer	Quality[1] 5/12	6/1	6/17	7/10	8/17	Overall dates	Density[2] 6/3	Color[3] 6/3
Scott's 1.9/1 Methylene Urea	7.3	7.3	7.3	8.0	8.3	7.7	7.3	7.0
Hercules UF	6.7	6.3	6.7	6.3	8.0	6.8	7.3	5.3
Milorganite	7.0	6.7	7.0	6.7	8.7	7.2	7.3	6.7
Swifts IBDU	7.0	7.0	7.3	7.7	9.0	7.6	8.0	5.7
CIL-SCU	7.3	7.3	8.0	8.3	8.3	7.9	8.0	7.0
Lakeshore-SCU	8.0	8.0	9.0	9.0	9.0	8.6	8.0	7.3
Lakeshore Fairway	8.0	8.0	8.3	8.7	9.0	8.4	9.0	7.0
Scott's SCU	7.7	8.0	8.7	8.0	8.0	8.1	8.3	7.0
Urea	7.7	7.7	7.7	8.3	8.0	7.9	9.0	7.0
TVA-SCU	7.3	7.7	8.3	9.0	8.3	8.1	8.3	7.0
IBDU 24%, TVA-SCU 57%, Urea 19%	7.7	7.3	8.0	8.3	8.7	8.0	8.0	7.0
IBDU 37%, CIL-SCU 43%, Urea 20%	7.3	7.7	7.7	7.7	8.3	7.7	8.0	7.0
IBDU 39%, TVA-SCU 40%, Urea 20%	7.7	7.7	7.7	8.3	8.3	7.9	8.0	7.0
IBDU 22%, CIL SCU 60%, Urea 18%	7.7	7.3	7.7	8.3	8.0	7.8	8.0	7.0
Control	4.0	3.7	3.7	4.0	4.7	4.0	4.7	3.7

[1] Quality ratings are made on a scale of 1 through 9, 9 representing ideal turf quality.

[2] Density ratings are made on a scale of 1 through 9, 9 representing ideal turf density.

[3] Color ratings are made on a scale of 1 through 9, 9 representing ideal turf density.

Table 23. Evaluation of nitrogen sources, rates and application frequencies.

Program II (2 lb. N/1000 sq. ft. in May, Sept.)

Fertilizer	Quality[1] 5/12	6/1	6/17	7/10	8/17	Overall dates	Density[2] 6/3	Color[3] 6/3
Scott's 1.9/1 Methylene Urea	7.0	7.7	7.3	7.0	8.0	7.4	7.7	8.0
Hercules UF	6.3	6.0	7.0	6.0	8.0	6.7	7.3	6.0
Milorganite	6.3	5.7	7.0	6.3	7.7	6.6	7.3	7.0
Swifts IBDU	7.3	7.0	7.3	8.0	8.3	7.6	7.7	6.0
CIL-SCU	7.3	6.7	8.0	8.0	8.3	7.7	8.0	8.0
Lakeshore-SCU	7.3	8.0	9.0	8.0	8.3	8.1	8.3	7.3
Lakeshore-Fairway	7.3	8.3	8.0	7.7	8.7	8.0	9.0	8.0
Scott's SCU	7.3	8.3	9.0	8.0	8.0	8.1	9.0	8.0
Urea	6.7	8.3	8.7	8.0	8.0	7.9	8.7	8.0
TVA-SCU	7.3	7.3	8.7	8.3	8.3	8.0	8.7	7.0
IBDU 24%, TVA-SCU 57%, Urea 19%	7.3	7.7	8.3	8.7	8.7	8.1	8.3	7.7
IBDU 37%, TVA-SCU 43%, Urea 20%	7.0	7.7	8.0	7.3	8.0	7.6	8.0	7.7
IBDU 39%, TVA-SCU 40%, Urea 20%	7.3	7.0	7.7	7.7	8.0	7.5	8.0	7.7
IBDU 22%, CIL-SCU 60%, Urea 18%	7.0	7.3	8.3	7.0	8.0	7.5	7.7	8.3
Control	4.0	3.7	3.7	3.7	3.7	3.7	4.7	3.7

[1]Quality ratings are made on a scale of 1 through 9, 9 representing ideal turf quality.

[2]Density ratings are made on a scale of 1 through 9, 9 representing ideal turf density.

[3]Color ratings are made on a scale of 1 through 9, 9 representing ideal turf color.

Table 24. Evaluation of nitrogen sources, rates and application frequencies.

Program III (4 lb. N/1000 sq. ft. in May)

Fertilizer	Quality[1] 5/12	6/1	6/17	7/10	8/17	Overall dates	Density[2] 6/3	Color[3] 6/3
Scott's 1.9/1 Methylene Urea	5.7	7.3	8.0	8.3	8.3	7.5	7.7	9.0
Hercules UF	6.7	6.3	7.0	7.0	7.7	6.9	7.3	6.7
Milorganite	5.0	6.0	8.0	7.7	8.3	7.0	6.7	8.0
Swifts IBDU	6.3	5.7	7.0	7.7	8.0	6.9	6.3	6.7
CIL-SCU	5.3	7.7	8.0	7.0	7.7	7.1	7.7	9.0
Lakeshore-SCU	6.3	8.0	9.0	8.7	8.3	8.1	8.0	8.3
Lakeshore-Fairway	6.0	8.7	8.7	8.7	8.0	8.0	8.0	9.0
Scott's SCU	6.0	9.0	9.0	8.3	8.0	7.1	8.0	8.7
Urea	6.0	8.3	9.0	8.3	7.7	7.9	8.0	9.0
TVA-SCU	6.3	8.0	9.0	8.7	8.0	8.0	8.0	8.7
IBDU 24%, TVA-SCU 57% Urea 19%	5.7	8.0	8.7	8.7	8.0	7.8	7.3	8.7
IBDU 37%, CIL-SCU 43% Urea 20%	5.3	8.0	8.7	8.7	8.3	7.8	7.7	9.0
IBDU 39%, TVA-SCU 40%, Urea 20%	6.0	8.0	8.3	8.7	7.3	7.7	7.7	8.7
IBDU 22%, CIL-SCU 60%, Urea 18%	6.3	8.0	9.0	8.3	8.0	7.9	8.0	9.0
Control	4.0	3.7	3.7	4.0	4.7	4.0	5.0	3.7

[1] Quality ratings are made on a scale of 1 through 9, 9 representing ideal turf quality.

[2] Density ratings are made on a scale of 1 through 9, 9 representing ideal turf density.

[3] Color ratings are made on a scale of 1 through 9, 9 representing ideal turf color.

ILLINOIS WEATHER DATA FOR 1981
WEATHER DATA FOR URBANA STATION

DATE 1981	TEMPERATURE AIR MAX	AIR MIN	SOIL 4" MAX	SOIL 4" MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN
04-01	84	49	56	48	0	98	28
04-02	66	32	55	48	0	72	32
04-03	78	56	54	48	0	56	22
04-04	76	63	57	53	0.9	100	70
04-05	66	35	58	51	0	100	60
04-06	48	28	53	46	0	94	48
04-07	56	34	54	48	0	96	34
04-08	71	48	53	48	0	89	38
04-09	63	43	54	54	0.11	98	74
04-10	64	45	60	53	0.53	98	32
04-11	77	59	57	53	0.9	100	86
04-12	64	55	62	56	0.55	98	98
04-13	69	54	62	56	0	98	78
04-14	74	47	61	58	0.54	100	80
04-15	57	33	62	54	0	98	43
04-16	57	38	63	53	0	90	42
04-17	65	45	56	54	0.05	98	64
04-18	77	46	64	56	0	88	54
04-19	67	45	64	57	0.35	100	46
04-20	54	35	58	54	0.27	100	98
04-21	57	31	58	51	0	100	56
04-22	58	37	59	52	0.19	100	42
04-23	64	48	54	46	0	100	92
04-24	61	39	63	53	0	100	50
04-25	59	32	57	56	0	100	50
04-26	75	50	62	55	0	92	44
04-27	82	54	64	59	0	98	42
04-28	84	53	70	60	0	98	48
04-29	82	47	68	62	0.62	100	50
04-30	59	46	60	57	0.01	100	60
05-01	64	46	63	58	0.11	100	68
05-02	59	34	60	55	0.07	100	70
05-03	72	41	65	54	0	98	34
05-04	77	48	65	60	0	100	44
05-05	74	59	65	60	0	100	52
05-06	63	37	62	55	0.65	100	88
05-07	57	35	60	53	0	86	68
05-08	62	39	62	53	0	90	44
05-09	68	39	62	56	0	98	42
05-10	68	39	61	56	1.2	100	78
05-11	45	37	57	52	0.49	100	10
05-12	48	32	53	49	0	100	70
05-13	59	41	58	49	0	100	46
05-14	58	48	56	54	0.61	100	92
05-15	58	42	57	53	0.83	100	84
05-16	64	43	66	53	0	100	48
05-17	69	52	66	53	0	84	60
05-18	66	39	62	57	1.14	100	46
05-19	48	40	57	52	0.06	100	68
05-20	65	41	59	52	0	64	40
05-21	71	53	64	54	0	58	32
05-22	76	49	69	58	0	100	38
05-23	76	58	68	60	0.06	100	44

ILLINOIS WEATHER DATA FOR 1981
WEATHER DATA FOR URBANA STATION

DATE 1981	TEMPERATURE AIR MAX	TEMPERATURE AIR MIN	SOIL 4" MAX	SOIL 4" MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN
05-24	78	61	69	63	0.04	100	60
05-25	77	47	70	65	0.1	100	64
05-26	78	58	70	65	0	100	52
05-27	70	55	67	64	0	100	66
05-28	72	50	70	64	0	100	56
05-29	80	59	74	64	0	100	48
05-30	84	64	74	68	0.05	100	58
05-31	72	47	74	63	0	74	44
06-02	72	58	68	65	0.1	100	72
06-03	81	64	73	67	0.19	100	62
06-04	81	58	75	68	0	95	55
06-05	84	67	79	70	0.01	100	50
06-06	85	66	77	72	0	100	40
06-07	85	54	77	70	0	94	30
06-08	85	68	79	71	0	98	30
06-09	91	58	79	72	0.12	100	54
06-10	86	61	79	71	0.05	100	36
06-11	80	56	77	70	0	100	40
06-12	76	60	72	70	0.03	100	50
06-13	81	65	74	70	0.8	100	80
06-14	84	67	76	73	0.28	100	82
06-15	90	75	82	78	0	95	65
06-16	89	60	78	73	0.74	100	62
06-17	71	53	72	65	0.02	95	48
06-18	77	52	75	65	0	100	34
06-19	83	52	75	65	0	100	34
06-20	79	58	71	68	0	100	48
06-21	83	63	74	68	0.2	100	50
06-22	78	63	71	69	1.08	100	70
06-23	80	56	74	68	0	100	40
06-24	81	62	78	67	0.26	100	35
06-25	89	67	76	70	0.06	100	55
06-26	81	57	80	75	0	95	40
06-27	78	54	78	70	0	86	38
06-28	83	65	78	70	0	72	32
06-29	85	63	74	70	0	98	40
06-30	90	66	77	70	0	100	38
07-01	81	62	74	71	0	100	63
07-02	81	64	76	71	0	100	70
07-03	83	60	79	71	0	100	52
07-04	85	64	78	72	0.09	100	46
07-05	77	69	74	71	1.35	100	90
07-06	78	62	73	71	0	100	76
07-07	88	68	.	.	0	100	60
07-08	89	70	81	73	0	98	54
07-09	89	70	81	75	0	100	56
07-10	89	64	82	75	0.03	100	56
07-11	84	59	82	74	0	90	34
07-12	89	63	82	78	0	100	36
07-13	92	71	81	77	0	100	54
07-14	93	71	87	80	0	100	65
07-15	85	64	83	76	0.45	100	52
07-16	83	62	77	75	0.31	100	68

ILLINOIS WEATHER DATA FOR 1981
WEATHER DATA FOR URBANA STATION

DATE 1981	TEMPERATURE AIR MAX	TEMPERATURE AIR MIN	SOIL 4" MAX	SOIL 4" MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN
07-17	73	62	77	73	0	100	80
07-18	85	65	80	72	0	100	80
07-19	86	67	80	75	1.95	100	54
07-20	83	64	77	75	0.43	100	10
07-21	87	62	79	75	0	100	60
07-22	78	62	.	.	.	.	.
07-23	79	64	.	.	.	.	.
07-24	76	55	78	72	0	100	46
07-25	82	60	77	71	0	100	54
07-26	85	66	76	74	1.26	100	64
07-27	76	55	75	71	0.77	100	80
07-28	79	55	74	71	0.55	100	82
07-29	72	51	74	71	0	100	82
07-30	77	49	72	67	0	100	50
07-31	76	51	73	67	0	100	36
08-01	80	55	77	75	0	100	40
08-02	82	58	75	70	0	100	50
08-03	84	63	75	72	0.18	100	54
08-04	83	62	76	72	0	100	64
08-05	88	65	78	72	0	100	56
08-06	80	65	75	72	1.43	100	94
08-07	83	63	77	68	0	100	63
08-08	83	65	80	74	0	95	60
08-09	83	62	76	72	0	95	50
08-10	81	52	75	67	1.74	100	54
08-11	75	55	71	69	0	100	66
08-12	79	54	73	69	0	100	44
08-13	79	53	73	69	0	100	53
08-14	82	69	72	69	0	100	56
08-15	80	68	78	75	0.5	95	65
08-16	85	65	78	74	0	95	65
08-17	81	51	73	67	0	100	52
08-18	72	48	70	66	0	100	42
08-19	73	50	70	65	0	100	42
08-20	77	50	70	65	0	100	38
08-21	79	52	70	64	0	100	38
08-22	80	55	71	67	0	100	40
08-23	79	59	78	72	0	100	45
08-24	81	59	73	69	0	100	46
08-25	86	62	74	70	0	100	52
08-26	85	61	75	71	0.13	100	54
08-27	82	61	73	71	0.32	100	38
08-28	79	60	73	70	1.62	100	70
08-29	80	60	71	69	0	100	74
08-30	82	65	75	72	0	95	80
08-31	84	60	74	72	0.1	100	72
09-01	86	63	77	75	0.02	100	60
09-02	78	60	74	71	0.02	100	60
09-03	77	58	73	69	0.01	100	82
09-04	68	59	71	69	0	100	10
09-05	76	50	71	67	0	100	48
09-06	76	53	70	67	0	100	54
09-07	79	57	71	67	0	100	58

ILLINOIS WEATHER DATA FOR 1981
WEATHER DATA FOR URBANA STATION

DATE 1981	TEMPERATURE AIR MAX	AIR MIN	SOIL 4" MAX	SOIL 4" MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN
09-08	73	53	69	65	0	100	40
09-09	74	45	72	66	0	100	38
09-10	75	53	70	65	0	100	40
09-11	83	59	70	65	0	100	44
09-12	82	59	70	66	0	100	46
09-13	83	61	72	68	0	100	48
09-14	86	63	72	68	0	100	50
09-15	81	57	72	68	0.06	100	56
09-16	74	54	70	66	0	100	40
09-17	66	43	68	61	0.07	100	42
09-18	58	43	62	59	0.14	100	41
09-19	64	44	62	58	0	100	40
09-20	74	49	62	58	0	100	36
09-21	78	49	66	67	0	100	40
09-22	81	48	65	61	0	100	34
09-23	65	41	63	58	0	100	40
09-24	67	46	62	58	0	100	28
09-25	74	47	62	58	0	96	32
09-26	80	59	62	60	0	100	42
09-27	84	51	67	62	2.11	100	36
09-28	72	44	65	60	0	94	22
09-29	64	44	62	58	0.72	100	68
09-30	64	49	58	56	0	100	48
10-01	85	55	62	57	0	92	52
10-02	66	36	63	56	0	98	40
10-03	55	33	57	53	0	100	40
10-04	61	44	57	53	0.03	86	26
10-05	69	56	56	54	0	100	56
10-06	82	53	62	56	0.78	100	60
10-07	63	41	63	56	0	92	46
10-08	60	36	58	54	0	100	36
10-09	60	39	57	54	0	94	38
10-10	66	44	57	54	0.01	100	32
10-11	62	43	57	54	0	100	52
10-12	66	48	57	54	0	96	40
10-13	68	45	57	54	0	100	40
10-14	73	50	57	55	0.05	100	50
10-15	58	53	57	56	0.08	100	84
10-16	64	40	60	57	0.01	100	84
10-17	64	49	56	55	0.23	100	48
10-18	66	43	58	54	0.47	100	78
10-19	48	31	56	50	0.01	100	46
10-20	52	33	50	46	0	94	30
10-21	70	48	52	49	0	94	40
10-22	66	40	54	50	0.47	100	66
10-23	48	29	52	47	0.09	100	62
10-24	36	19	54	45	0	100	42
10-25	47	30	44	42	0	92	36
10-26	50	31	46	42	0	100	51
10-27	47	43	47	46	0.22	100	86
10-28	59	36	48	45	0	100	30
10-29	62	42	54	45	0	100	40
10-30	67	44	50	47	0	100	46
10-31	72	50	53	49	0	100	54