1987 Illinois Turfgrass Research Report

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Foreword

This report presents the 1987 results of the turfgrass research projects conducted in Illinois. Contributors to the report include scientists from the Departments of Horticulture and Plant Pathology at the University of Illinois and the Department of Crop and Soil Sciences at Southern Illinois University. We hope the information presented in this research report will aid turfgrass managers throughout Illinois when making management decisions.

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

Our new cover was designed by Joan Zagorski, a graphic designer in Agricultural Communications and Extension Education.

Jean Haley

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Dave Wehner

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UNDERSTANDING THE DATA

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

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

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

BENTGRASS BLENDS FOR PUTTING GREEN TURF

J. E. Haley and D. J. Wehner

INTRODUCTION

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

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

MATERIALS AND METHODS

All possible two-way blends of the cultivars Penncross, Penneagle, Seaside, and Emerald were established at the Ornamental Horticulture Research Center in Urbana on 21 August 1981. Each blend and the four individual components were established in 6 x 10 ft plots with three replications. The turf is maintained at a 0.25 inch height of cut and is irrigated as necessary to prevent wilt. During the 1987 growing season the turf was fertilized with 3.0 lb N/1000 sq ft and was on a preventative fungicide program. The area was lightly topdressed 8 times during the growing season with a 8-1-1 sand - soil - peat mixture.

RESULTS

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

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

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

Bentgrass quality was fair to good during the 1987 growing season (Table 1). As in previous years the best quality was observed with Penneagle and blends containing Penneagle. Annual bluegrass infestation was highest in plots of Emerald, Seaside and the Emerald/Seaside blend.

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

Table 1. The evaluation of creeping bentgrass cultivars and blends for the 1987 growing season.[1]

Cultivar/Blend	All Dates[2]	Quality[3] 6/02	Quality[3] 7/09	Quality[3] 9/02	% Annual Bluegrass[4] 6/02
Penneagle	8.4a	7.7a	8.7a	9.0a	0.7b
Penneagle/Emerald	8.1ab	7.7a	8.0ab	8.7ab	1.0b
Penncross/Penneagle	8.0ab	6.7ab	8.7a	8.7ab	0.7b
Penneagle/Seaside	7.6bc	7.0a	7.7a-c	8.0bc	5.0b
Penncross	7.4bc	7.0a	7.7a-c	7.7cd	5.3b
Penncross/Seaside	7.4bc	7.3a	7.0b-d	8.0bc	6.3b
Penncross/Emerald	6.9c	7.0a	6.7cd	7.0de	6.7b
Emerald	6.1d	5.7bc	5.3e	7.3c-e	16.7a
Seaside	6.0d	5.7bc	5.3e	7.0de	18.3a
Seaside/Emerald	6.1d	5.3c	6.3de	6.7e	16.7a
$LSD_{0.05}$	0.7	1.2	1.1	0.9	6.9

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

[2]Values represent the mean of 12 scores obtained from 3 replications and 4 evaluation dates.

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

[4]Percent annual bluegrass refers to the percent of the plot area covered with annual bluegrass plants.

FAIRWAY BENTGRASS MANAGEMENT STUDY

J. E. Haley and D. J. Wehner

INTRODUCTION

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

MATERIALS AND METHODS

The large blocks of each cultivar which were established in 1981 have been split so that half the area is receiving a preventative fungicide program while the other half receives no fungicide. Perpendicular to the fungicide strips are cultivation treatments consisting of vertical mowing, core cultivation, or no cultivation. These treatments were applied in June during the growing seasons of 1982 through 1985. The plots are monitored for turfgrass quality, annual bluegrass infestation, and disease severity. Plots are mowed at 5/8" and given 2.5 lbs nitrogen/1000 sq ft/yr as 18-4-10.

RESULTS

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

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

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

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

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

During 1987 turf quality was poor to fair for all cultivars (Table 1). The best quality was observed with Penneagle and Penncross. Quality was highest in turf treated regularly with fungicides. Highland colonial bentgrass and Emerald creeping bentgrass continued to decline. Plots containing Highland and Emerald contained the greatest percentage of annual bluegrass. Statistically there was no significant difference in annual bluegrass infestation between turf treated with fungicides and turf not treated with fungicides.

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

Treatment	Quality[2] 6/04	8/04	9/02	Percent Annual Bluegrass[3] 6/04
Fungicide	6.3a	6.3a	5.5a	28.3
No Fungicide	4.9b	4.1b	3.5b	16.1
$LSD_{0.05}$	0.6	0.7	1.2	NS
Highland	5.0b	3.9d	3.6de	54.4a
Emerald	5.3b	4.5cd	3.5e	41.7a
Prominent	5.4b	5.1bc	4.3cd	20.1b
Seaside	5.5b	5.2bc	4.6bc	10.8b
Penncross	6.3a	6.0ab	5.2ab	3.7b
Penneagle	6.2a	6.3a	5.7a	2.6b
$LSD_{0.05}$	0.5	0.9	0.7	19.1
Core Cultivation	5.4b	5.2a	4.6a	21.7
Vertical Mowing	5.7a	5.0b	4.3b	23.9
No Cultivation	5.7a	5.3a	4.6a	21.0
$LSD_{0.05}$	0.2	0.2	0.3	NS

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

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

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

USDA NATIONAL PERENNIAL RYEGRASS CULTIVAR EVALUATION AT URBANA

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

INTRODUCTION

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

MATERIALS AND METHODS

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

RESULTS

Little differences were observed in the establishment rate of the 65 ryegrass cultivars. For most cultivars August quality was poor to fair (Table 1). Turf quality improved considerably during September and October. Cultivars that scored poorly on all three rating dates include Delray, Regal and Linn.

In the future the turf will be monitored for quality, density, texture, color, and resistance to pests.

Table 1. The evaluation of perennial ryegrass cultivars during the 1987 growing season.[1]

Cultivar	Quality[2] 8/03	9/11	10/29	Cultivar	Quality 8/03	9/11	10/29
Acrobat (HE 177)	4.7b-e	7.0b-d	6.7b-d	J208	3.7e-g	6.0ef	6.0de
Allaire	4.7b-e	7.0b-d	7.0a-c	KWS-A1-2	4.0d-f	6.0ef	7.0a-c
BAR LP 410	5.0a-d	7.0b-d	6.7b-d	Linn	2.7g	4.3g	4.0g
BAR LP 454	4.3c-f	7.0b-d	6.0de	Manhattan	4.0d-f	6.0ef	6.3c-e
Barry	4.0d-f	7.0b-d	6.7b-d	Manhattan II	5.3a-c	7.7ab	7.0a-c
Belle	5.3a-c	6.7c-e	7.0a-c	MON LP 763	4.0d-f	6.3de	7.3ab
Birdie	5.0a-d	7.0b-d	7.0a-c	NK 80389	3.7e-g	6.0ef	6.3c-e
Brenda	5.7ab	7.7ab	7.0a-c	Omega II	5.0a-d	7.0b-d	6.7b-d
Caliente	5.0a-d	7.0b-d	6.3c-e	Ovation	6.0a	7.7ab	7.0a-c
Citation	5.7ab	7.0b-d	7.0a-c	Palmer	6.0a	7.3a-c	7.3ab
Cowboy	5.3a-c	7.0b-d	6.7b-d	Patriot	4.3c-f	6.7e-c	6.7b-d
DEL 946	5.3a-c	6.3de	6.7b-d	Pavo (WW E 14)	3.7e-g	6.3de	6.0de
Delray	3.7e-g	5.3f	5.0f	Pennant	5.7ab	7.7ab	7.0a-c
Derby	4.7b-e	7.0b-d	7.0a-c	Pennfine	5.5a-c	6.3de	6.7b-d
Diplomat	5.3a-c	7.3a-c	7.0a-c	Pick 233	5.0a-d	6.3de	7.0a-c
Gator	5.7ab	6.7c-e	7.0a-c	Pick 300	5.0a-d	7.0b-d	7.0a-c
Goalie	5.9a-d	6.7c-e	7.0a-c	Pick 600	5.7ab	7.7ab	7.0a-c
ISI-K2	5.0a-d	7.0b-d	7.0a-c	Pick 647	5.3a-c	7.0b-d	7.3ab
ISI-851	4.7b-e	6.7c-e	7.0a-c	Pick 715	5.7ab	7.3a-c	7.0a-c
J207	4.7b-e	7.0b-d	6.3c-e	Prelude	5.7ab	7.0b-d	7.0a-c

(continued)

Table 1. The evaluation of perennial ryegrass cultivars during the 1987 growing season (continued).[1]

	Quality[2]				Quality		
Cultivar	8/03	9/11	10/29	Cultivar	8/03	9/11	10/11
PST-M2E	4.3c-f	7.0b-d	7.3ab	Ronja (WW E 31)	4.0d-f	6.7c-e	6.7b-d
PST-2DD	4.3c-f	6.3de	6.7b-d	Runaway (HE 145)	4.3c-f	6.7c-e	6.7b-d
PST-2HH	5.0a-d	6.7c-e	7.0a-c	Sheriff	4.0d-f	6.3de	6.3c-e
PST-2H7	4.7b-e	7.3a-c	7.3ab	SR 4000	5.0a-d	7.3a-c	7.3ab
PST-2PM	5.0a-d	8.0a	7.7a	SR 4031	4.3c-f	6.7c-e	6.3c-e
PST-250	4.7b-e	6.7c-e	6.7b-d	SR 4100	5.7ab	7.3a-c	7.0a-c
PST-259	4.7b-e	6.7c-e	7.3ab	Sunrye (246)	4.0d-f	6.7c-e	7.0a-c
PSU-222	4.7b-e	6.7c-e	6.7b-d	Tara	5.3a-c	6.7c-e	6.7b-d
PSU-333	4.7b-e	6.7c-e	6.3c-e	Vintage-2DF	4.3c-f	6.0ef	5.7ef
Ranger	5.3a-c	6.7c-e	7.0a-c	Yorktown II	5.3a-c	7.0b-d	7.0a-c
Regal	3.3fg	5.3f	5.7ef				
Regency	5.0a-d	7.0b-d	7.0a-c				
Repell	5.0a-d	7.0b-d	7.0a-c				
Rival	4.7b-e	7.0b-d	7.0a-c				
Rodeo	4.7b-e	7.3a-c	7.3ab				
$LSD_{0.05}$	1.1	1.0	0.8		1.1	1.0	0.8

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

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

THE SUMMER DORMANCY RESPONSE OF KENTUCKY BLUEGRASS (Poa Pratensis L.)

D.L. Martin and D.J. Wehner

INTRODUCTION

Rarely a growing season passes in Illinois without some Kentucky bluegrass (Poa pratensis L.) turfs experiencing "summer dormancy". Summer dormancy is the condition of perennial grasses during the summer months when above ground organs are brown and dead due to severe soil moisture deficit, yet meristematic regions and underground organs remain viable awaiting favorable environmental conditions for growth. The summer dormant condition represents the last stage of the turf's drought resistance mechanism, at the end of which the turf will either be able to regenerate or will die from the severe drought stress imposed. Increasing demands on our finite water resource coupled with the severe drought seen by a large portion of Illinois during late spring of 1987 emphasize the need for a better understanding of this important survival mechanism. The goals of this project are to: i) determine the specific sites of shoot regeneration following an episode of summer dormancy, ii) determine the rate of decline in regeneration potential following prolonged dormancy, iii) evaluate selected cultivars for the presence of the dormancy mechanism and iv) evaluate the feasibility of utilizing tetrazolium chloride (2,3,5-triphenyltetrazolium chloride) for measuring the recovery potential of a dormant turfgrass stand.

MATERIALS AND METHODS

FIELD RESEARCH

Research on the dormancy response is in its first season. A quonset rain shelter was erected for control of rainfall to a "common type" Kentucky bluegrass maintained under 2 lb N/1000 sq ft and mowed at a 2.5 inch cut. Treatments in the field experiment, replicated 3 times and arranged in a randomized complete block design, consisted of a nondrought stressed control and turf subjected to no rainfall or irrigation for 0, 2, 4, and 6 weeks after death of the inner most emerged leaf. After resumption of irrigation, weekly sampling by the grid method was conducted for shoot density per plot and site of shoot regeneration. In addition, live rhizomes were selected for carbohydrate analysis from the plots just prior to rewatering and at 2 week intervals after rewatering.

GROWTH CHAMBER STUDIES

The colorless tetrazolium chloride (2,3,5-triphenyltetrazolium chloride), which is reduced to a carmine red formazan upon exposure to viable tissue, has long been a valuable tool of researchers in assessing the viability of dormant seed, bulbs, corms and tubers of many species of plants. Preliminary research was conducted to determine if the material might be used to asses the viability of crowns and rhizomes from summer dormant Kentucky bluegrass.

RESULTS AND DISCUSSION

FIELD RESEARCH

Analysis of field data is incomplete at present. Results of testing of the quonset rain shelter for its suitability in with standing high winds and controlling rainfall to the study area found the shelter suitable for future drought stress research. Field research will continue during the 1988 growing season.

GROWTH CHAMBER STUDIES

Preliminary work with tetrazolium chloride found complications in using the indicator for determining viability of plants selected from severly drought stressed turf. The complications result from the colorless die not being reduced to the red form (indicating viability) in the same quantities in rhizome tissue held in various depths of dormancy by apical dominance. Modifications of the testing procedure are being considered and a final evaluation has not yet been conducted.

THE EVALUATION OF CHELATED IRON AND NITROGEN SOURCES IN A FERTILIZATION PROGRAM

J. E. Haley and D. J. Wehner

INTRODUCTION

Iron is usually not deficient in the soils of Illinois. Iron, however, can enhance the color (make darker green) of turfgrass plants when applied at a high enough rate. The use of iron can reduce the amount of N needed to maintain acceptable color. With iron, the color remains acceptable but the growth of the plant is not as vigorous as would be found with a larger amount of nitrogen. The drawback in using iron is that the effect on the color is only temporary and can fade before another application can be made. Previous research at the University of Illinois has shown that turf fertilized with 0.5 lb nitrogen/1000 sq ft plus iron gave color equal to turf fertilized with 1.0 pounds of nitrogen/1000 sq ft. The best results with iron were found where chelated iron was applied at the rate of 2.0 pounds of actual iron per acre in combination with a reduced rate of nitrogen. The purpose of this research is to further evaluate the use of chelated iron with Formolene, Fluf, and urea when applied four times during the growing season.

MATERIALS AND METHODS

Fertilizer treatments include nitrogen from Formolene, Fluf, or urea with or without iron. The basic program consists of 4 applications of fertilizer providing 1 lb N/1000 sq ft application. Iron is substituted for 0.5 N/1000 sq ft in round 1 and 2, round 2 and 3, or round 3 only (see Table 1.). Sequestrene 330, the iron source, is applied at the rate of 2.0 lb iron/A. The treatments were applied on 3 May, 2 July, 28 August, and 23 October 1985; 21 May, 15 July, 28 August, and 8 October 1986; and 6 May, 8 July and 24 August 1987. No round 4 treatments were applied during 1987. The spray volume is 3.5 gallons of water/1000 sq ft. The turf was mowed at 1.5 inch and clippings were returned to the plots. Turfgrass color evaluations were made weekly throughout the season.

RESULTS AND DISCUSSION

1985

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

1986

During 1986, the weather was dry during the late spring and early summer with adequate rainfall during mid-summer and dry weather in early fall. Fewer differences between treatments were found during 1986. On many rating dates, the treatments were iron was substituted for a portion of the nitrogen resulted in turf that rated equal or better (darker green) than turf where only N was used. The 1986 data would indicate that it is feasible to substitute iron for a portion of the total N on a routine basis. The exception to this observation seemed to occur with Fluf where slightly lower color ratings occurred with the use of iron in combination with N in comparison to the full rate of N.

1987

Following round 1 applications, turf color was not as good in treatments where iron was substituted for a portion of the nitrogen (Table 1). For 5 - 6 weeks after round 2 fertilization, treatments with the iron substitution had turf color equal to or better than treatments where only nitrogen (from the same formulation) was applied. Four weeks after round 3 applications, turf color was best where no iron was applied all season.

Table 1. The evaluation of iron and nitrogen sources in a fertilization program during 1987.[1]

	lb N/1000 sq ft + oz Fe/1000 sq ft[*]				Color[2]					
Material	Rnd 1	Rnd 2	Rnd 3	Rnd 4	5/14	5/20	5/27	6/03	6/10	6/17
Formolene	1.0+0	1.0+0	1.0+0	1.0+0	8.7a	8.7ab	8.3bc	8.0c	8.3a	8.0a
Formolene+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	8.0b	8.0b	8.0cd	7.0d	7.0b	7.0b
Formolene+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	9.0a	8.7ab	9.0a	8.0c	8.3a	7.3ab
Formolene+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	9.0a	8.7ab	9.0a	8.0c	7.7ab	7.3ab
Fluf	1.0+0	1.0+0	1.0+0	1.0+0	8.7a	8.0b	8.3bc	8.3bc	8.0a	8.0a
Fluf+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	8.0b	8.0b	7.7d	7.0d	7.0b	7.0b
Fluf+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	8.7a	8.0b	8.7ab	8.0c	8.0a	7.7ab
Fluf+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	8.0b	8.0b	8.0cd	8.0c	7.7ab	7.3ab
Urea	1.0+0	1.0+0	1.0+0	1.0+0	9.0a	9.0a	9.0a	8.7ab	8.3a	7.7ab
Urea+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	8.0b	8.0b	8.3bc	7.0d	7.0b	7.3ab
Urea+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	9.0a	9.0a	9.0a	9.0a	8.0a	8.0a
Urea+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	9.0a	9.0a	9.0a	9.0a	8.3a	8.0a
check	-	-	-	-	5.3c	4.3c	4.7e	4.3e	4.3c	4.7a
$LSD_{0.05}$					0.5	0.7	0.6	0.5	0.7	0.7

(continued)

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

[*] Round 1 treatments were applied 6 May, Round 2 treatments were applied 8 July, and Round 3 treatments were applied 24 August. No Round 4 treatments were applied in 1987.

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

Table 1. The evaluation of iron and nitrogen sources in a fertilization program during 1987 (continued).[1]

Material	lb N/1000 sq ft + oz Fe/1000 sq ft[*]				Color[2]					
	Rnd 1	Rnd 2	Rnd 3	Rnd 4	6/26	7/02	7/09	7/15	7/23	8/03
Formolene	1.0+0	1.0+0	1.0+0	1.0+0	6.3a-c	7.0bc	6.0	8.3a	8.0a	8.3a
Formolene+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	5.7c	6.7c	6.0	8.3a	7.7a	7.7ab
Formolene+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	6.3a-c	7.3ab	6.0	8.3a	7.3a	7.7ab
Formolene+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	6.3a-c	7.0bc	6.0	8.0a	7.3a	8.0ab
Fluf	1.0+0	1.0+0	1.0+0	1.0+0	7.0a	7.7a	6.0	8.3a	7.3a	8.0ab
Fluf+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	6.0bc	7.0bc	6.0	8.0a	7.3a	7.3b
Fluf+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	7.0a	7.3ab	6.0	8.3a	7.7a	8.0ab
Fluf+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	6.7ab	7.0bc	6.0	8.3a	8.0a	8.0ab
Urea	1.0+0	1.0+0	1.0+0	1.0+0	6.7ab	7.3ab	6.0	8.0a	7.3a	8.3a
Urea+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	6.3a-c	7.0bc	6.0	8.7a	7.7a	7.7ab
Urea+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	7.0a	7.0bc	6.0	8.0a	7.7a	7.3b
Urea+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	6.7ab	7.0bc	6.0	8.0a	8.0a	8.3a
check	-	-	-	-	4.0d	5.3d	5.0	4.3b	5.0b	4.3c
$LSD_{0.05}$					0.9	0.7	NS	0.7	0.8	0.7

(continued)

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

[*]Round 1 treatments were applied 6 May, Round 2 treatments were applied 8 July and Round 3 treatments were applied 24 August. No Round 4 treatments were applied in 1987.

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

Table 1. The evaluation of iron and nitrogen sources in a fertilization program during 1987 (continued).[1]

	lb N/1000 sq ft + oz Fe/1000 sq ft[w]				Color[z]					
Material	Rnd 1	Rnd 2	Rnd 3	Rnd 4	8/10	8/17	8/24	8/31	9/08	9/14
Formolene	1.0+0	1.0+0	1.0+0	1.0+0	7.3a	7.7a	7.0a	8.0a	9.0a	7.7ab
Formolene+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	6.3b	7.0ab	6.0b	7.0c	8.3ab	7.3a-c
Formolene+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	7.0ab	7.0ab	6.0b	7.0c	8.3ab	6.7cd
Formolene+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	7.3a	7.7a	7.0a	7.7ab	8.3ab	6.7cd
Fluf	1.0+0	1.0+0	1.0+0	1.0+0	7.7a	7.7a	6.7a	7.3bc	8.3ab	8.0a
Fluf+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	7.0ab	6.3bc	6.0b	7.0c	8.3ab	7.3a-c
Fluf+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	7.3a	7.3a	6.0b	7.0c	8.0b	6.7cd
Fluf+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	7.7a	7.7a	7.0a	8.0a	9.0a	7.0bc
Urea	1.0+0	1.0+0	1.0+0	1.0+0	7.3a	7.3a	7.0a	8.0a	9.0a	7.7ab
Urea+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	7.3a	7.3a	6.0b	7.7ab	8.7ab	7.3a-c
Urea+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	7.3a	7.0ab	6.0b	7.7ab	8.7ab	6.7cd
Urea+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	7.7a	7.7a	7.0a	8.0a	9.0a	7.3a-c
check	-	-	-	-	4.7c	5.7c	4.7c	5.0d	5.7c	6.0d
$LSD_{0.05}$					0.7	0.8	0.4	0.5	0.7	0.9

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

[w]Round 1 treatments were applied 6 May, Round 2 treatments were applied 8 July and Round 3 treatments were applied 24 August. No Round 4 treatments were applied in 1987.

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

Table 1. The evaluation of iron and nitrogen sources in a fertilization program during 1987 (continued).[1]

Material	lb N/1000 sq ft + oz Fe/1000 sq ft[*]				Color[2]		
	Rnd 1	Rnd 2	Rnd 3	Rnd 4	9/22	9/29	10/03
Formolene	1.0+0	1.0+0	1.0+0	1.0+0	8.7ab	7.7ab	7.0a
Formolene+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	8.0b	7.3bc	6.0a
Formolene+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	8.0b	7.0c	6.0a
Formolene+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	8.3ab	7.0c	6.3bc
Fluf	1.0+0	1.0+0	1.0+0	1.0+0	9.0a	8.0a	7.0a
Fluf+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	8.0b	7.3bc	6.7ab
Fluf+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	8.0b	7.0c	6.3bc
Fluf+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	8.7ab	7.3bc	6.7ab
Urea	1.0+0	1.0+0	1.0+0	1.0+0	9.0a	8.0a	7.0a
Urea+Iron	0.5+0.7	0.5+0.7	1.0+0	1.0+0	8.7ab	8.0a	6.7ab
Urea+Iron	1.0+0	0.5+0.7	0.5+0.7	1.0+0	8.3ab	7.0c	6.0c
Urea+Iron	1.0+0	1.0+0	0.5+0.7	1.0+0	9.0a	7.0c	6.0c
check	-	-	-	-	6.0c	6.0d	6.0c
$LSD_{0.05}$					0.8	0.5	0.6

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

[*]Round 1 treatments were applied 6 May, Round 2 treatments were applied 8 July and Round 3 treatments were applied 24 August. No Round 4 treatments were applied in 1987.

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

THE EVALUATION OF IRON SOURCES APPLIED TO A KENTUCKY BLUEGRASS DURING JUNE AND JULY

J. E. Haley and D. J. Wehner

INTRODUCTION

Iron can be used to temporarily enhance turf color in place of nitrogen. This is especially useful in the summer months when it is undesirable for the turf to be vigorously growing but a dark green turf is still the ideal. The purpose of this study was to evaluate two forms of iron for use on a Kentucky bluegrass turf.

MATERIAL AND METHODS

Iron was applied as iron sulfate and iron chelate at 0.5 and 1.0 lb iron/A alone and in combination with nitrogen (urea, 45-0-0) at 0.5 lb N/1000 sq ft. Urea was also applied alone at 0.5 and 1.0 lb N/1000 sq ft. Each treatment was replicated 3 times and an untreated check (no iron or urea) was included with each replication. Fertilizers were applied to one set of plots on 15 June 1987 and to a second set of plots on 17 July 1987. Materials were applied with a small plot sprayer at 152.5 gpa. The area was mowed at 1.5 inch and clippings were returned to the plots. Color ratings were taken to evaluate treatment performance.

RESULTS

June applications of iron alone were never as dark green as iron with nitrogen or nitrogen alone (Table 1). Generally iron chelate at 1 lb Fe/A and 0.5 lb N/1000 sq ft provided color as green as nitrogen at 1 lb N/1000 sq ft up to 17 days after treatment. At 24 DAT there was little difference between iron sources and rates combined with 0.5 lb N/1000 sq ft compared with nitrogen applied alone at 0.5 and 1.0 lb N/1000 sq ft. Results from the July applications were similar to results from June treatments (Table 2). Color ratings in July were not as high as in June and differences among treatments faded more quickly.

Table 1. The evaluation of iron sources applied to a Kentucky bluegrass turf on 15 June 1987.[1]

	Iron	Nitrogen[3]	Color[2]					
			6/17	6/26	7/02	7/09	7/15	7/26
Iron Source	lb Fe/A	lb N/1000 sq ft	2 DAT[4]	11 DAT	17 DAT	24 DAT	30 DAT	41 DAT
Iron Sulfate	0.5	0	5.0d	4.0d	5.0d	4.3e	5.0de	5.0d
Iron Sulfate	1.0	0	5.3cd	4.0d	5.0d	4.7de	5.0de	5.0d
Iron Chelate	0.5	0	5.0d	4.3d	4.7d	4.3e	4.7e	5.0d
Iron Chelate	1.0	0	5.3cd	5.0c	6.0c	5.3cd	5.7cd	6.0c
Iron Sulfate	0.5	0.5	5.7bc	7.0b	7.0b	6.3ab	6.7ab	6.3bc
Iron Sulfate	1.0	0.5	6.0b	7.0b	7.3b	6.3ab	6.0bc	6.7ab
Iron Chelate	0.5	0.5	6.7a	7.0b	7.3b	7.0a	7.0a	6.7ab
Iron Chelate	1.0	0.5	7.0a	8.0a	8.0a	7.0a	7.0a	6.7ab
No Iron	0	0.5	6.0b	6.7b	7.0b	6.0bc	6.7ab	6.0c
No Iron	0	1.0	4.3e	8.0a	8.0a	7.0a	7.3a	7.0a
Check	0	0	5.0d	4.0d	5.0d	5.0de	5.0de	5.0d
$LSD_{0.05}$			0.6	0.4	0.5	0.9	0.7	0.6

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

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

[3]The nitrogen source was urea (45-0-0).

[4]DAT refers to days after treatment.

Table 2. The evaluation of iron sources applied to a Kentucky bluegrass turf on 17 July 1987.[1]

	Iron	Nitrogen[3]	Color[2]					
			7/20	7/23	8/03	8/10	8/17	8/24
Iron Source	lb Fe/A	lb N/1000 sq ft	3 DAT[4]	6 DAT	17 DAT	24 DAT	31 DAT	38 DAT
Iron Sulfate	0.5	0	4.3d	5.3cd	4.3de	4.7de	4.0c	5.0c
Iron Sulfate	1.0	0	5.0cd	5.7c	5.0cd	4.7de	4.7c	5.0c
Iron Chelate	0.5	0	5.0cd	5.0cd	4.3de	4.3de	4.7c	5.0c
Iron Chelate	1.0	0	5.7bc	5.7c	5.0cd	5.0d	4.7c	5.0c
Iron Sulfate	0.5	0.5	6.3ab	7.0b	5.7bc	6.0c	5.7b	5.7ab
Iron Sulfate	1.0	0.5	6.7a	8.0a	6.7a	7.0ab	6.0b	6.0a
Iron Chelate	0.5	0.5	7.0a	7.7ab	6.7a	6.3bc	6.0b	6.0a
Iron Chelate	1.0	0.5	7.0a	8.0a	6.7a	7.0ab	6.0b	5.7ab
No Iron	0	0.5	6.3ab	7.0b	6.3ab	6.3bc	5.7b	5.3bc
No Iron	0	1.0	6.3ab	8.0a	7.0a	7.7a	7.0a	6.0a
Check	0	0	4.3d	4.7d	4.0e	4.0e	4.0c	5.0c
$LSD_{0.05}$			0.8	0.7	0.9	0.8	0.9	0.5

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

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

[3]The nitrogen source was urea (45-0-0).

[4]DAT refers to days after treatment.

PREEMERGENCE CONTROL OF CRABGRASS

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

INTRODUCTION

Preemergence herbicides for control of crabgrass have been available to turfgrass managers for many years. Periodically, new herbicides and new turf formulations of field crop herbicides are developed that need to be evaluated for crabgrass control and compared to the existing materials. The purpose of this research was to evaluate the new herbicides Premier, EL 107, Mon 15126, prodiamine, BASF 514 and a new formulation of EL 107 plus Balan for crabgrass control.

MATERIALS AND METHODS

The herbicides evaluated in this research were Dacthal (DCPA, SDS Biotech), Betamec (bensulide, PBI Gordon), Balan (benefin, Elanco), Team (benefin + trifluralin, Elanco), EL 107 (isoxaben, Elanco), EL 107 plus Team, EL 107 plus Balan, Pre M (pendimethalin, LESCO), Ronstar (oxadiazon, Rhone Poulenc), Premier (Ciba Geigy), BASF 514 (quinclorac, BASF Corporation) and Mon 15126 (undisclosed, Monsanto). All treatments were applied on 17 April 1987 to a common Kentucky bluegrass turf. Where a second treatment was required applications were made on 3 June 1987. Liquid herbicides were applied with a small plot sprayer at a spray volume of 40 gpa. Granular materials were applied by hand. Each treatment was replicated 3 times and an untreated check was included with each replication. Plot size was 3 x 10 ft. The turf was mowed at 1.5 inches and irrigated to encourage crabgrass development. Plots were evaluated for percent crabgrass control on two dates. Percent crabgrass control was determined by comparing percent cover with crabgrass of each treated plot and comparing it with percent cover with crabgrass in the untreated check.

RESULTS

Please keep in mind when interpreting the results that there was tremendous crabgrass pressure on our test area as evidenced by the large percentage of crabgrass (90 to 100 percent) in the untreated check plots. A crabgrass control rating of 85% or greater should be considered good to excellent crabgrass control.

Generally, all materials provided good to excellent preemergence control of crabgrass (Table 1). In this evaluation BASF 514 performed poorly. However research from other states indicate that it provides good preemergence control on unirrigated sites.

Table 1. The evaluation of herbicides applied 18 April 1987 for preemergence control of crabgrass in a Kentucky bluegrass turf.[1]

Herbicide	Rate lb ai/A	% Crabgrass Control[2] 6/25	8/03
Premier 1.2EC	1.0	100.0a	94.8ab
Premier 1.2EC	1.5	100.0a	99.3a
Premier 1.2EC	1.75	100.0a	100.0a
Premier 1.2EC	3.0	100.0a	100.0a
Premier 1.2EC	1.0/0.5*	100.0a	99.7a
Team 2G	3.0	100.0a	97.6a
EL 107 75DF + Team 2G	0.5 + 2.0	100.0a	87.3a-d
EL 107 75DF + Team 2G	0.5 + 3.0	100.0a	94.7ab
EL 107:Balan 60DF	3.0	96.1a	78.2cd
EL 107:Balan 60DF	3.6	98.9a	91.5a-c
Mon 15126 3EC	0.25	96.1a	86.6a-d
Mon 15126 3EC	0.375	100.0a	97.6a
Mon 15126 3EC	0.5	100.0a	99.3a
Mon 15126 3EC	0.75	100.0a	100.0a
Mon 15126 3EC	1.0	100.0a	100.0a
BASF 514 50WP	0.5	56.7c	3.3f
BASF 514 50WP	1.0	85.0b	53.0e
Balan 2.5G	2.0/2.0*	98.9a	76.0d
Pendimethalin 60DG	1.5	100.0a	88.0a-d
Pendimethalin 60DG	3.0	100.0a	97.0a
Dacthal 75WP	10.5	100.0a	99.0a
Prodiamine 65WDG	0.5	100.0a	99.0a
Ronstar 2G	3.0	98.9a	89.2a-d
Betamec 4EC	7.5	98.9a	81.8b-d
$LSD_{0.05}$		5.7	14.3

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

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

*The second application was made 03 June 1987.

THE EVALUATION OF PRODIAMINE FOR PREEMERGENCE CONTROL OF CRABGRASS

J. E. Haley and T. W. Fermanian

INTRODUCTION

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

1984 EVALUATION

MATERIALS AND METHODS

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

RESULTS

In 1987 crabgrass control was good to excellent with all spring applications of Dacthal and Prodiamine (Table 1). Crabgrass control was also good to excellent with fall applications of Prodiamine at rates of 0.5, 0.75 and 2.0 lb ai/A. Turf injury, observed in 1985 and 1986, was also visible in 1987 on the turf treated in the fall with 2.0 lb ai/A. A significant reduction in Kentucky bluegrass germination was noted in plots treated in the fall with prodiamine at 2.0 lb ai/A and in spring treated plots of prodiamine at 0.38, 0.75 and 2.0 lb ai/A and Dacthal at 5.25 and 21.0 lb ai/A.

1986 SPRING EVALUATION

MATERIALS AND METHODS

In 1986 a second study was established comparing Prodiamine with several industry standard herbicides.

All treatments were applied on 18 April 1986 (Table 2). Where appropriate, second applications were made on 28 August 1986 for control of winter annuals. Each treatment was replicated 3 times and an untreated check was included with each replication. Materials were applied using a small plot sprayer in a spray volume of 40 gpa. Plot size was 3 x 10 feet.

RESULTS

Herbicides were not reapplied in 1987 but were rated for residual crabgrass control 21 July and 3 August 1987 (Table 2). Crabgrass control was good to excellent with all materials on the July evaluation date. Although, by August, crabgrass control had deteriorated with most treatments, prodiamine treatments still provided as much as 78.3% control. Best control was found with treatments that had 2 prodiamine applications.

1986 FALL APPLIED EVALUATION

MATERIALS AND METHODS

On 24 October 1986 a third prodiamine evaluation was established to further evaluate the application of prodiamine in the fall and split spring-fall applications. Materials were reapplied to some plots 18 April 1987. Treatments and rates are given in Table 3. Herbicides were applied at 40 gpa with a CO_2 back pack sprayer. Each treatment was replicated 3 times and an untreated check was included with each replication.

RESULTS

All rates of prodiamine provided excellent preemergence crabgrass control (Table 3). Single applications of prodiamine at 0.75 and 1.0 lb ai/A resulted in the least control.

1987 SPRING EVALUATION

MATERIALS AND METHODS

A 1987 spring trial was established to evaluate granular formulations and carriers of prodiamine. Two formulations, 0.5G and 1.0G, of each carrier, a synthetic and a clay material, were evaluated. Formulations of each carrier were applied at rates of 0.5 and 0.75 lb ai/A on 18 April 1987. Prodiamine 65DG at 0.5 and 0.75 lb ai/A and pendimethalin 1.78G at 1.5 lb ai/A were also applied. All treatments were replicated 3 times and an untreated check was included with each replication. Granular materials were applied by hand. Prodiamine 65DG was applied with a small plot backpack sprayer at 40 gpa.

RESULTS

There was no difference in preemergence crabgrass control among treatments on the first evaluation date (Table 4). Evaluations made on 3 August show that good to excellent crabgrass control was achieved with most formulations with the exception of pendimethalin 1.78G and Prodiamine 0.5G, both carriers, at 0.5 lb ai/A. With the other formulations crabgrass control ranged from 72 to 98.0 % control.

Table 1. The evaluation of prodiamine, applied in the spring and fall, for control of crabgrass.[1]

Material	Rate lb ai/A	Application Time[4]	% Crabgrass Control[2] 6/25/87	% Crabgrass Control[2] 8/03/87	Germination[3] 10/27/87
Dacthal	5.25	Spring	100.0a	81.7b-d	33.7c-e
Dacthal	10.5	Spring	100.0a	88.3a-d	43.0a-d
Dacthal	21.0	Spring	100.0a	86.7a-d	33.7c-e
Prodiamine	0.25	Spring	91.7ab	80.0cd	47.3a-c
Prodiamine	0.38	Spring	100.0a	93.3a-c	36.3b-e
Prodiamine	0.5	Spring	100.0a	98.3ab	40.7a-e
Prodiamine	0.75	Spring	100.0a	100.0a	35.0c-e
Prodiamine	2.0	Spring	100.0a	100.0a	26.0e
Check	---	Spring			52.0a
Dacthal	5.25	Fall	34.4d	3.7fg	40.7a-e
Dacthal	10.5	Fall	43.1cd	0g	45.7a-d
Dacthal	21.0	Fall	36.1d	0g	50.0ab
Prodiamine	0.25	Fall	64.7bc	17.f0	51.0ab
Prodiamine	0.38	Fall	94.2a	52.8e	50.7ab
Prodiamine	0.5	Fall	95.8a	73.0 d	41.3a-d
Prodiamine	0.75	Fall	100.0 a	92.8a-c	50.7ab
Prodiamine	2.0	Fall	100.0a	100.0a	32.3de
Check	---	Fall			54.3a
$LSD_{0.05}$			27.4	16.9	14.7

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

[2]Percent crabgrass control represents percent cover of the treated plot with crabgrass plants when compared with the percent cover of the untreated check plot.

[3]Germination refers to the number of seedlings that germinated per 40 square centimeters 42 days following planting.

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

Table 2. The evaluation of prodiamine and other preemergence herbicides for control of crabgrass in a Kentucky bluegrass turf from applications made on 18 April 1986[1].

Herbicide	Rate[2] lb ai/A	% Crabgrass Control[3] 7/21/86	8/03/87
Balan 2.5G	2.0 + 3.0	78.8bc	1.7d
Betasan 4E	7.5	88.0ab	11.7cd
Dacthal 75WP	10.5	69.9c	0d
Ronstar 2G	4.0	92.5a	23.3b-d
Pre M 60WDG	3.0	94.1a	10.0cd
Prodiamine 65WDG	0.38	88.9ab	45.0a-c
Prodiamine 65WDG	0.50	87.4ab	45.0a-c
Prodiamine 65WDG	0.75	94.1a	60.0ab
Prodiamine 65WDG	1.0	95.7a	61.7a
Prodiamine 65WDG	0.5 + 0.25	92.4a	50.0ab
Prodiamine 65WDG	0.5 + 0.5	91.7a	73.3a
Prodiamine 65WDG	0.75 + 0.25	92.5a	78.3a
Prodiamine 65WDG	1.0 + 0.25	90.4ab	76.7a
$LSD_{0.05}$		12.1	37.0

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

[2]Second applications were made on 28 August 1986 for control of winter annuals.

[3]Percent crabgrass control represents percent cover of the treated plot with crabgrass plants compared with the percent cover of the untreated check plots. Turf was not retreated in the spring of 1987 and plots were rated for residual crabgrass control.

Table 3. The evaluation of Prodiamine applied to a Kentucky bluegrass turf on 10 Oct 1986.[1]

Material	Rate[2] lb ai/A		% Crabgrass Control[3] 8/03/87
Prodiamine	0.75		95.2b
Prodiamine	1.00		92.9b
Prodiamine	1.25		99.2a
Prodiamine	1.50		100.0a
Prodiamine	1.75		99.7a
Prodiamine	0.75 + 0.75	applied in the spring	100.0a
Prodiamine	1.00 + 0.75	applied in the spring	100.0a
Prodiamine	1.25 + 0.50	applied in the spring	100.0a
Prodiamine	1.50 + 0.25	applied in the spring	100.0a
$LSD_{0.05}$			2.9

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

[2]Applications were made 10 October 1986. Where a second application was applied in the spring the date of application was 18 April 1987.

[3]Percent crabgrass control represents percent cover of the treated plot with crabgrass plants compared with the percent cover of the untreated check plots.

Table 4. The evaluation of granular formulation of prodiamine applied 18 April 1987.[1]

Herbicide	Carrier	Formulation	Rate	% Crabgrass Control[2]	
			lb ai/A	6/25	8/03
Prodiamine		65DG	0.50	100.0	95.1a
Prodiamine		65DG	0.75	100.0	98.0a
Pendimethalin		1.78G	1.5	89.4	68.9b-d
Prodiamine	clay	0.5G	0.5	93.3	73.3a-d
Prodiamine	clay	0.5G	0.75	98.3	85.2a-c
Prodiamine	clay	1.0G	0.5	62.8	60.0cd
Prodiamine	clay	1.0G	0.75	77.8	72.2a-d
Prodiamine	synthetic	0.5G	0.5	91.1	82.2a-c
Prodiamine	synthetic	0.5G	0.75	100.0	95.1a
Prodiamine	synthetic	1.0	0.5	73.3	56.0d
Prodiamine	synthetic	1.0	0.75	91.1	87.2ab
$LSD_{0.05}$				NS	25.9

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

[2]Percent crabgrass control represents percent cover of the treated plot with crabgrass plants compared with the percent cover ofthe untreated check plots.

POSTEMERGENCE CONTROL OF CRABGRASS

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

INTRODUCTION

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

MATERIALS AND METHODS

Treatments included Acclaim (fenoxaprop, Hoescht Roussel Agri-Vet) applied with and without Pre M (pendimethalin, LESCO) at 0.04 and 0.06 lb ai/A on 1 May 1987; 0.06 and 0.08 lb ai/A on 16 May 1987; 0.08 and 0.12 lb ai/A on 3 June 1987, and 0.12 lb ai/A on 16 June 1987; Acclaim applied alone and with Trimec (2,4-D, MCPP and dicamba, PBI Gordon) at 0.12 and 0.18 lb ai/A on 5 June and 7 July 1987. Pre M was applied at 1.5 lb ai/A and Trimec was applied at 4.0 pt product/A. An experimental herbicide from Monsanto, Mon 15126 was applied at 0.5, 0.75, 1.0 1.5 lb ai/A on 5 June and 7 July 1987. Mon 15126 was also applied at 0.5 lb ai/A with Acclaim at 0.18 lb ai/A on 5 June and with Acclaim at 0.25 lb ai/A on 7 July. All Mon 15126 applications were made in a 0.5% v/v solution with the surfactant XM-12. BASF 514 (quinclorac, BASF Corporation) was applied at 0.5 and 1.0 lb ai/A on 5 June. Crabgrass was at the 1-4 leaf stage of growth on 5 June and at the 2-4 tiller stage of growth on 7 July. All treatments were replicated 3 times and an untreated check was included with each replication. Herbicides were applied with a backpack sprayer at a spray volume of 40 gpa. Plots were evaluated for percent crabgrass control on 2 dates. Percent crabgrass control was determined by comparing percent crabgrass cover of each treated plot with percent crabgrass cover of the untreated check plot.

RESULTS

Treatments of Acclaim alone made before 3 June showed significantly less crabgrass control than treatments of Acclaim and Pre M. This would indicate that crabgrass germination was still occurring at this time and any postemergence control should be accompanied by applications of a preemergence herbicide. Crabgrass control was significantly less when Acclaim was applied in a tank mix with Trimec than when it was applied alone. The manufacturer suggests that Acclaim not be applied in tank mixes or within 5 days of dicamba or and phenoxy-type herbicides application. These herbicides reduce the effectiveness of Acclaim. Best crabgrass control was achieved when Acclaim was applied at the 2-4 tiller stage of crabgrass growth.

All applications of Mon 15126 provided excellent crabgrass control on both treatment dates. It was observed that Mon 15126 did not always kill the crabgrass plant but did severely stunt its growth. In a healthy competitive turf this would effectively control most crabgrass invasions.

BASF 514 provided excellent crabgrass control at 1.0 lb ai/A. At the 0.5 lb ai/A control was only fair.

Table 1. The evaluation of herbicides for postemergence control of crabgrass applied to a perennial ryegrass - Kentucky bluegrass turf in 1987.[1]

Material	Application Date	Rate lb ai/A	% Crabgrass Control[2] 6/26	8/03
Acclaim	May 1	0.04	52.8g	27.8j
Acclaim + pendimethalin	May 1	0.04 + 1.5	100.0a	95.6ab
Acclaim	May 1	0.06	61.7e-g	42.8h-j
Acclaim + pendimethalin	May 1	0.06 + 1.5	100.0a	92.3a-d
Acclaim	May 16	0.06	76.1d-f	40.4h-j
Acclaim + pendimethalin	May 16	0.06 + 1.5	98.7ab	89.1a-d
Acclaim	May 16	0.08	80.6 b-e	45.7hi
Acclaim + pendimethalin	May 16	0.08 + 1.5	100.0a	91.5a-d
Acclaim	June 3	0.08	82.8a-d	62.2fg
Acclaim + pendimethalin	June 3	0.08 + 1.5	91.7a-d	69.4ef
Acclaim	June 3	0.12	96.4a-c	77.8c-f
Acclaim + pendimethalin	June 3	0.12 + 1.5	91.7a-d	76.3d-f
Acclaim	June 16	0.12	98.7ab	84.6a-e
Acclaim + pendimethalin	June 16	0.12 + 1.5	98.7ab	93.0a-c
Acclaim	June 5*	0.12	93.7a-d	72.6ef
Acclaim	June 5	0.18	97.0a-c	81.1b-e
Acclaim + Trimec	June 5	0.12 + 4 pt/A	58.9fg	31.1ij
Acclaim + Trimec	June 5	0.18 + 4 pt/A	78.3c-e	45.6hi
Acclaim	July 7*	0.12		94.3ab
Acclaim	July 7	0.18		95.6ab
Acclaim + Trimec	July 7	0.12 + 4 pt/A		36.1h-j
Acclaim + Trimec	July 7	0.18 + 4 pt/A		48.1gh
Mon 15126**	June 5	0.5	100.0a	94.6ab
Mon 15126	June 5	0.75	100.0a	99.3a
Mon 15126	June 5	1.0	100.0a	99.7a
Mon 15126	June 5	1.5	100.0a	100.0a
Mon 15126 + Acclaim	June 5	0.5 + 0.18	100.0a	100.0a
Mon 15126	July 7	0.5		89.6a-d
Mon 15126	July 7	0.75		94.5ab
Mon 15126	July 7	1.0		94.8ab
Mon 15126	July 7	1.5		96.3ab
Mon 15126 + Acclaim	July 7	0.5 + 0.25		99.7a
BASF 514	June 5	0.5	98.7ab	68.9ef
BASF 514	June 5	1.0	100.0a	94.3ab
$LSD_{0.05}$			6.5	16.1

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

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

*On 5 June the crabgrass plants were at the 1-4 leaf stage of growth. On 7 July the crabgrass plants were at the 2-4 tiller stage of growth.

**All Mon 15126 applications were made in a 0.5% v/v solution with surfactant XM-12.

THE EVALUATION OF ACCLAIM FOR PHYTOTOXICITY ON A CREEPING BENTGRASS MAINTAINED AS A PUTTING GREEN

J. E. Haley and D. J. Wehner

INTRODUCTION

The herbicide Acclaim (fenoxaprop, Hoechst Roussel Agri-Vet) has been shown to be an effective postemergence control of crabgrass. Information is needed to determine if there is phytotoxicity associated with the use of this herbicide. The purpose of this study was to evaluate the phytotoxicity of Acclaim on a close cut creeping bentgrass turf.

MATERIALS AND METHODS

Acclaim 1EC was applied to a 'Penneagle' creeping bentgrass turf at 0.04, 0.06, 0.08 and 0.12 lb ai/A on 5 June 87. A second application was made at the same rates and to the same plots on 16 July 1987. The treatments were applied with a small plot sprayer that delivered 40 gallons of water per acre. Plots were observed for phytotoxicity and percent cover with crabgrass. The creeping bentgrass was mowed at 0.25 inches. Plot size was 3 x 10 feet with three replications. An untreated check plot was included with each replication.

RESULTS

Significant phytotoxicity was observed with all rates of Acclaim above 0.04 lb ai/a following the 5 June application and with all rates of Acclaim following the 16 July application (Table 1). No statistical difference was observed in crabgrass control among treatments on 9 July. Crabgrass control was significantly better with a second application of Acclaim, although no difference was observed among the four rates.

Table 1. An evaluation of Acclaim applied to a creeping bentgrass putting green on 5 June and 16 July 1987.[1]

Material	Rate lb ai/A	Phytotoxicity[2] 7/20	Phytotoxicity[2] 8/03	% Crabgrass[3] 7/09	% Crabgrass[3] 8/03
Acclaim	0.04	9.0a	7.7b	21.7	16.7b
Acclaim	0.06	7.7b	6.3c	20.0	13.7b
Acclaim	0.08	7.7b	6.0c	5.7	3.7b
Acclaim	0.12	6.3c	4.3d	5.0	0b
Check	--	9.0a	9.0a	33.3	68.3a
$LSD_{0.05}$		0.7	1.1	NS	19.1

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

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

[3]Percent crabgrass represents percent of the plot covered with crabgrass plants.

THE EVALUATION OF ACCLAIM PHYTOTOXICITY WHEN APPLIED TO A KENTUCKY BLUEGRASS TURF

J. E Haley and D. J. Wehner

INTRODUCTION

Turf injury has occurred on some Kentucky bluegrass cultivars treated with Acclaim (fenoxaprop, Hoechst Roussel Agri-Vet). Cultivars known to have reduced vigor or temporary stunting following Acclaim applications are Glade, Monopoly, Ram I, Touchdown, America, Columbia and Lovegreen. The addition of slow-release nitrogen and/or chelated iron to the spray tank as 'safeners' is recommended to prevent potential turf injury. The purpose of this research was to evaluate several nitrogen sources as safeners to be used in tank mixes with Acclaim.

MATERIALS AND METHODS

Treatments were Acclaim 1EC alone and in tank mixes with Urea 40%/FLUF 60%, Formolene, and Urea. Acclaim 0.5EW, a fenoxaprop formulation more suitable for high volume application, was applied with Urea 40%/FLUF 60%. All Acclaim treatments were applied at a rate of 0.25 lb ai/A. Nitrogen was applied at a rate of 1.0 lb N/1000 sq ft total for each treatment. Each treatment was replicated 3 times and an untreated check was included with each replication. Treatments were applied on 7 July 1987 and on 17 July 1987 to an adjacent location. There was no statistical difference in ratings between the two experimental sites. The spray volume was 152.5 gpa. The turf was Kentucky bluegrass blend of 'Parade', 'Adelphi', 'Glade' and 'Rugby' maintained at 1.5 inch in height and irrigated as needed to prevent wilt. The turf was rated for injury (phytotoxicity) and a rating below 7.0 was considered objectionable.

RESULTS

On all 3 evaluation dates, there was significantly more injury on turf treated with Acclaim without safeners than on untreated turf (Table 1). Phytotoxicity evaluations made on 20 July and 3 August indicate that the addition of urea at 1 lb N/1000 sq ft with Acclaim 1EC does not reduce injury and may enhance it. Air temperatures were high and moisture low 10 days prior to the 27 July evaluations. This may have effected the performance of both Acclaim and the safeners. More information is needed to understand the potential for phytotoxicity with Acclaim on Kentucky bluegrass. Currently, the manufacturer suggest to avoid early application to Kentucky bluegrass prior to 15 June and rates of 0.5 lb ai/A should not be applied until after 15 July. Previous studies at the University of Illinois have not detected much injury. However the results of this study indicate that caution should be exercised when using Acclaim.

Table 1. An evaluation of Acclaim applied to a Kentucky bluegrass turf on 7 July and 17 July 1987.[1]

Material[*]	Phytotoxicity[2] 7/20	7/27	8/03
Acclaim	6.8b	6.5b	7.2c
Acclaim plus Urea/FLUF	5.7d	6.2b	7.8bc
Acclaim plus Formolene	6.5bc	6.2b	8.2ab
Acclaim plus Urea	5.8cd	6.8b	7.8bc
Acclaim EW plus Urea/FLUF	6.2b-d	6.7b	8.8a
Check	9.0a	9.0a	9.0a
$LSD_{0.05}$	0.8	1.1	1.0

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

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

[*]All Acclaim treatments were applied at 0.25 lb ai/A and all fertilizers were applied so each treatment receive a total of 1 lb N/1000 sq ft.

THE EVALUATION OF HERBICIDES FOR BROADLEAF WEED CONTROL IN TURF

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

INTRODUCTION

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

MATERIALS AND METHODS

Herbicides were applied 22 May 1987 in a spray volume of 40 gpa (Table 1). Plot size was 3 x 10 feet and each treatment was replicated 3 times. An untreated check was included with each replication. Weed control evaluations were made on a scale of 1-9, where 9 = a large, healthy weed population and 1 = no weeds present.

RESULTS

Excellent control of white clover was observed with all materials at all rates with the exception of XRM-3724 + Breakthru and with Turflon II (Table 2). All materials provided excellent control of dandelions with the exception of XRM-3724 + XRM-3972, XRM-3724 + Breakthru at 0.38 + 0.062 lb ai/A, BASF 514, and Turflon II. Plantain control was fair to poor with most of the XRM-3724 + XRM-3972 combinations, XRM-3724 + Breakthru combinations, and BASF 514.

Table 1. Herbicides evaluated for postemergence control of white clover, dandelions and broadleaf and buckhorn plantain during the 1987 growing season.

Herbicide	Active Ingredients	Manufacturer
XRM-3724	triclopyr amine	Dow Chemical
XRM-3972	clopyralid amine	Dow Chemical
Banvel	dicamba	Velsicol
Breakthru	chlorflurenol	The Andersons
BASF 514	quinclorac	BASF
EH 680	2,4-D, 2,4-DP, dicamba	PBI/Gordon Corporation
EH 883	MCPA, MCPP, dicamba	PBI/Gordon Corporation
EH 884	MCPA, MCPP, dicamba	PBI/Gordon Corporation
EH 888	MCPA, MCPP	PBI/Gordon Corporation
EH 992	2,4-D, MCPP, dicamba	PBI/Gordon Corporation
Trimec	2,4-D, MCPP, dicamba	PBI/Gordon Corporation
D-free Trimec	MCPA, MCPP, dicamba	PBI/Gordon Corporation
Turflon D	2,4-D, triclopyr	Dow Chemical
Turflon II Amine	2,4-D, triclopyr	Dow Chemical
Weedone DPC	2,4-D, 2,4-DP	Union Carbide
Weedone DPC Amine	2,4-D, 2,4-DP	Union Carbide

Table 2. Postemergence control of white clover, dandelion and plantain 41 days following herbicide application on 22 May 1987.[1]

Herbicide	Rate lb ai/A	Weed Control[2] Clover 7/02	Dandelion 7/02	Plantain 7/02
XRM-3724 + XRM-3972	0.38 + 0.062	1.0c	3.7c	5.7bc
XRM-3724 + XRM-3972	0.38 + 0.125	1.0c	2.0c-f	3.0de
XRM-3724 + XRM-3972	0.38 + 0.25	1.0c	1.0f	2.7d-f
XRM-3724 + XRM-3972	0.5 + 0.062	1.0c	1.7d-f	4.0cd
XRM-3724 + XRM-3972	0.5 + 0.125	1.0c	1.7d-f	2.0ef
XRM-3724 + XRM-3972	0.5 + 0.25	1.0c	1.3ef	2.0ef
XRM-3724 + XRM-3972 + dicamba	0.5 + 0.3 + 0.1	1.0c	1.0f	2.3d-f
XRM-3724 + XRM-3972 + dicamba	0.25 + 0.125 + 0.1	1.0c	1.0f	5.3bc
XRM-3724 + Breakthru	0.125 + 0.125	3.0b	6.0b	6.0b
XRM-3724 + Breakthru + dicamba	0.125 + 0.125 + 0.1	1.3c	2.0c-f	6.3b
XRM-3724 + Breakthru + dicamba	0.125 + 0.125 + 0.125	1.0c	2.3c-f	4.0cd
XRM-3724 + XRM-3972 + Breakthru	0.125 + 0.125 + 0.125	1.0c	2.0c-f	1.7ef
BASF 514	0.5	1.7c	2.3c-f	6.7b
BASF 514	1.0	1.0c	3.3cd	5.7bc
	pt product/A			
EH 680	3.0	1.0c	1.0f	1.0f
EH 883	3.0	1.0c	1.0f	1.0f
EH 884	3.0	1.3c	1.0f	2.0ef
EH 888	4.0	1.0c	1.0f	1.7ef
EH 992	4.0	1.3c	1.3ef	1.3ef
Trimec	3.0	1.0c	2.0c-f	2.0ef
Trimec	4.0	1.3c	1.3ef	2.3d-f
Turflon D	3.0	2.0bc	1.3ef	1.3ef
Turflon II	3.0	3.0b	3.0c-e	1.7ef
Weedone DPC	3.0	1.7c	1.0f	1.3ef
Weedone DPC	4.0	1.0c	1.0f	1.0f
Weedone DPC Amine	4.0	1.0c	2.3c-f	1.0f
Weedone DPC Amine	6.0	1.0c	1.0f	1.7ef
Check	---	9.0a	9.0a	9.0a
$LSD_{0.05}$		1.3	1.7	1.8

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

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

POSTEMERGENT CONTROL OF BUCKHORN PLANTAIN

T. W. Fermanian, R. Kane, and J. C. Fech

INTRODUCTION

Buckhorn plantain (Plantago lanceolata) is a common pest of Illinois turfs. It is generally controlled through timely applications of postemergent herbicides, moderate fertilization and irrigation. On some sites buckhorn plantain can be a persistent hard to control weed. The objective of this study was to evaluate the ability of several common herbicides and herbicide combinations to control buckhorn plantain at one of these sites.

Chicago Golf Club in Wheaton, IL has had persistent problems with controlling buckhorn plantain. Several attempts to control buckhorn plantain growing in roughs have been only partially successful.

MATERIALS AND METHODS

A field study was established at the Chicago Golf Club in a rough turf on 22 October 1986. At the time of application, buckhorn plantain was present on the plots in populations ranging from 30% to 60% coverage. All treatments were applied at 40 GPA with a small plot sprayer at 40 PSI. The experiment was arranged as a randomized complete block design with four replications in plots of 3 X 10 feet. All the herbicides selected are commercially available and labeled for use on turf.

RESULTS

All plots were evaluated on 10 May 1987 (28 WAT) and 27 May 1987 (30 WAT) for the percent of the plot covered with buckhorn plantain. Statistical analysis of the results showed a mixed response (Table 1). Escort, both EH 791 treatments, the sequential Turflon D treatments and the sequential Riverdale treatments had fewer buckhorn plantain plants than the untreated check plots 28 WAT. Two weeks later only the Escort and the sequential Turflon D treatments still had smaller buckhorn plantain populations. Additionally, plots treated with sequential applications of Turflon D still displayed an increase in buckhorn plantain populations, but still significantly less than the check plots.

While the results of this study can only be considered as preliminary information, either Escort or the sequential Turflon D treatments at the tested rates, provided partial control of buckhorn plantain.

Table 1. The evaluation of postemergence herbicides for the control of buckhorn plantain applied at the Chicago Golf Club 22 October 1987.

Herbicide[2]	Commercial Rate	% Buckhorn Plantain[1] 5/10/87	5/27/87
Escort 50WDG metsulfuron methyl	1.0 oz cf/A	3	4
EH 791 2.43 lb/gal 2,4-D 1.21 lb/gal MCPP 0.24 lb/gal dicamba	3.0 pt cf/A	14	33
EH 791	3.0 + 2.0* pt cf/A	16	33
Turflon D 2.0 lb/gal 2,4-D 1.0 lb/gal triclopyr	4.0 pt cf/A	24	39
Turflon D	4.0 + 3.0 pt cf/A	8	15
Riverdale Triamine 1.3 lb/gal 2,4-D 1.3 lb/gal 2,4-DP 1.3 lb/gal MCPP	4.0 pt cf/A	25	54
Riverdale Triamine	4.0 + 3.0 pt cf/A	4	21
Check	---	43	45
$LSD_{0.05}$		23	29

[1]All values represent the mean of 3 replications. Values represent the percentage of each plot covered with buckhorn plantain.

[2]All treatments were mixed with 1.0% v/v of the surfactant XM-12.

*All second applications were made on 27 October 1987, 7 days after the initial application.

THE EVALUATION OF BROADLEAF WEED FORMULATIONS ON TWO APPLICATION DATES

J. E. Haley and D. J. Wehner

INTRODUCTION

The efficacy of postemergence broadleaf weed herbicides depends on many factors. Among these are herbicide formulations and timing of herbicide application. The purpose of this study was to determine the effect of application timing on the efficacy of new formulations of several broadleaf weed herbicides applied to a turf infested with white clover (Trifolium repens L.) and buckhorn and broadleaf plantains (Plantago lanceolata L. and Plantago major L.).

MATERIALS AND METHODS

The herbicides , Turflon II Amine (Dow Chemical Co.), D-free Trimec, Trimec (PBI Gordon) and Weedone DPC Amine (2,4-D + 2,4-DP, Union Carbide) were applied at the rates indicated in Table 1 on 10 July and 9 September 1987, to a mixed stand of Kentucky bluegrass and tall fescue located on the Agronomy South Farm at the University of Illinois. A new set of plots was used for each application date. The plots were mowed as needed to a height of 2" and did not receive supplemental irrigation. Treatments were applied with a small plot sprayer that delivered 40 gallons of spray per acre to 3 x 10 feet plots. Each treatment was replicated 3 times and an untreated check was included with each replication.

Weed control ratings were given on a 1 to 9 scale with 9 = no control of the weed species and 1 = no weeds present.

RESULTS

All herbicide treatments provided excellent control of white clover following the July application (Table 1). White clover control was only fair following the September application. This may be do to drouth stress on both the weeds and the turf during September.

Plantain control was excellent following the July application. Like the white clover control, plantain control was not as good in September. Turflon II at 2.0 lb ai/A was the least effective of all the herbicides and rates tested.

Table 1. The evaluation of herbicides for the postemergence control of broadleaf weeds during the 1987 growing season.[1]

		White Clover Control[2]		Plantain Control[2]	
		Application Date		Application Date	
	Rate	7/10	9/09	7/10	9/09
Material	pt cf/A[*]	17 DAT[**]	15 DAT	17 DAT	15 DAT
Turflon II Amine	2.0	1.0b	3.0b	1.3c	6.3b
Turflon II Amine	2.5	1.3b	2.7b	1.0c	4.7c
Turflon II Amine	3.0	1.0b	3.0b	2.0b	4.0c
Trimec	3.0	1.0b	3.0b	1.3c	4.0c
D-free Trimec	3.0	1.3b	3.0b	1.0c	5.0bc
Weedone DPC Amine	4.0	1.3b	4.3b	1.3c	4.7c
Check	9.0a	9.0a	9.0a	9.0a	9.0a
$LSD_{0.05}$		0.7	2.1	0.5	1.4

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

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

[*]Rates are given as pints of commercial product (formulation) per acre.

[**]Refers to days after treatment.

THE PHYTOTOXICITY OF PROGRASS ON AN IMMATURE KENTUCKY BLUEGRASS AND CREEPING BENTGRASS TURF

J. E. Haley and D. J. Wehner

INTRODUCTION

Prograss (ethofumesate, Nor Am Chemical Company) has exhibited both pre and postemergence control of annual bluegrass (Poa annua) in established perennial ryegrass, Kentucky bluegrass and fairway-height creeping bentgrass turf. More information is needed about its potential for use in renovation programs where annual bluegrass easily invades seedling Kentucky bluegrass and creeping bentgrass turf. The purpose of this study was to evaluate any Prograss injury to seedling Kentucky bluegrass and creeping bentgrass.

MATERIALS AND METHODS

Turf was established 28 August 1986 at 2 locations. Site 1 was primarily perennial ryegrass before renovation and site 2 was primarily annual bluegrass prior to renovation. At both locations a 30 x 36 feet area was treated with Roundup (glyphosate, Monsanto), vertical mowed and raked before seeding. A Kentucky bluegrass blend was seeded in one half the area at 2 lb seed/1000 sq ft and 'Penneagle' creeping bentgrass was seeded in the other half at 1 lb seed/1000 sq ft. Prograss treatments consisted of 0.75 lb ai/A applied 4 weeks after seeding (WAS) on 19 September, with a second application 8 WAS on 24 October; 0.75 lb ai/A applied 6 WAS on 10 October, with a second application 10 WAS on 8 November; and 1.5 lb ai/A 6 WAS, with a second application 10 WAS. Each treatment was replicated 3 times at each site and for each species. An untreated check plot was included with each replication.

RESULTS

No differences were observed between sites so all reported data includes results from both locations. In November 1986, the greatest injury was observed on turf treated 6 and 10 weeks after seeding (Table 1). Only a slight reduction in quality was observed on creeping bentgrass treated 4 and 6 weeks after seeding. Phytotoxicity ratings were slightly higher with the higher rate of Prograss. All treatments significantly reduced the percentage of annual bluegrass. The percent of the turf present that was annual bluegrass on 5 May 1987 was highest in the untreated check and in the plots treated at 4 and 8 weeks. Kentucky bluegrass plots treated with 1.5 lb ethofumesate/A, 6 and 10 weeks after seeding had very little turf cover of any kind. This may be a result of serious injury to the desirable Kentucky bluegrass or may be a result of excellent annual bluegrass control in a highly infested area. The study will be reevaluated in the spring of 1988.

Table 1. The evaluation of Prograss applied for the control of annual bluegrass in seedling turf established and maintained as a golf coarse fairway.[1]

Treatment	Rate lb ai/A	Application Weeks After Seeding[4]	Phytotoxicity[2] 11/07/86		% Annual Bluegrass[3] 5/05/87	
			Bent	Blue	Bent	Blue
Prograss	0.75	4 + 8	8.2b	7.0b	3.8b	50.0b
Prograss	0.75	6 + 10	6.3c	5.8bc	0.7c	19.2c
Prograss	1.5	6 + 10	5.7d	5.0d	0c	0.5d
Check	-	-	9.0a	9.0a	13.8a	78.3a
$LSD_{0.05}$			0.4	0.5	1.7	8.4

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

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

[3]Percent annual bluegrass refers to the percent of turf present that is annual bluegrass. It does not refer to the total area of the plot that is covered with annual bluegrass.

[4]The turf was established 28 August 1986. Treatments were applied 19 September 1986 (4 week), 10 October 1986 (6 week), 24 October 1986 (8 week) and 8 November 1986 (10 week).

THE EVALUATION OF PACLOBUTRAZOL FOR ANNUAL BLUEGRASS SUPPRESSION IN A GOLF COURSE FAIRWAY

J. E. Haley and T. W. Fermanian

INTRODUCTION

Annual bluegrass (Poa pratensis) is often a major component of golf course turf. It competes well with creeping bentgrass (Agrostis palustris) when irrigation is frequent, nitrogen levels are high, and mowing heights are low. Even when mowing heights are 0.25 inches or less, annual bluegrass is able to produce vast quantities of seed. On a golf course annual bluegrass is considered an undesirable turf. It is susceptible to winter damage and is difficult to maintain as a quality turf during stressful summer months. The purpose of this study was to evaluate the growth regulator paclobutrazol as a Poa annua suppressor on annual bluegrass turf maintained as a golf course fairway.

MATERIALS AND METHODS

The rates of paclobutrazol (2 lb/gal flowable) were 0.35, 0.45 and 0.55 lb ai/A (Table 1). These were applied to an annual bluegrass turf on 21 April 1987; 21 April and 10 June 1987; and 21 April, 10 June and 11 September 1987. Additional treatments included paclobutrazol at 0.5 lb ai/A applied 11 September 1987; and 11 September 1987 and April 1988. Plot size was 3 x 10 feet and each treatment was replicated 3 times. An untreated check was included with each replication. Materials were applied with a CO_2 backpack sprayer at a spray volume of 40 gpa. The turf was mowed at 0.25 inch in height and was irrigated daily to prevent stress. Plots were evaluated for phytotoxicity and percent decrease of annual bluegrass.

RESULTS

All rates of paclobutrazol caused initial phytotoxicity to the annual bluegrass following application (Table 1). The turf recovered before the next treatments were made and injury only reoccurred if paclobutrazol was reapplied to the plot. There was little difference in injury among the rates. Phytotoxicity was greatest following the June application.

Percent decrease of plot cover with annual bluegrass[1] was highest when paclobutrazol was applied in September. The later in the season

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[1]Percent decrease of plot cover with annual bluegrass = [(percent annual bluegrass cover per plot on 28 April 1987 - percent cover on the evaluation date)/percent cover on 28 April] x 100.

paclobutrazol was applied the better the annual bluegrass control. An 82.6% decrease was observed when 0.5 lb ai/A was applied in September only and a 74.3% decrease was observed when 0.35 lb ai/A was applied in April, June and September (annual total of 1.05 lb ai/A). This would suggest that timing of application is more critical than rate.

No differences in seedhead production were observed between treated and untreated plots. Seedheads on turf treated with paclobutrazol tended to be on shorter stalks, therefore, they were not removed with mowing.

Table 1. The evaluation of paclobutrazol (Mon 7325) on a Poa annua turf maintained under golf coarse fairway conditions.[1]

Mon 7325 Rate lb ai/A	Annual Rate lb ai/A	When Applied[4]	Phytotoxicity[2] 5/21	6/29	9/24	Percent Decrease of Annual Bluegrass[3] 9/24	10/13
0.35	0.35	A	5.3b-d	7.3a	8.7a	38.2c-e	33.1c-e
0.35	0.70	A J	5.7bc	4.3bc	9.0a	50.0a-d	54.2bc
0.35	1.05	A J S	6.0b	5.0b	7.7b	37.6c-e	74.3ab
0.45	0.45	A	5.3b-d	7.7a	9.0a	21.4e	15.7e
0.45	0.90	A J	5.0c-e	3.7bc	9.0a	47.1b-d	49.8c
0.45	1.35	A J S	5.0c-e	4.0bc	7.7b	65.0a	73.6ab
0.55	0.55	A	4.3e	7.0a	9.0a	32.7de	27.4de
0.55	1.10	A J	4.3e	3.0c	9.0a	50.2a-d	44.4cd
0.55	1.65	A J S	4.7de	3.0c	7.0bc	65.0a	79.3a
0.50	0.50	S	7.0a	6.7a	6.3c	61.7a-c	82.6a
0.50	1.00	S A*	7.0a	6.7a	7.0bc	63.3ab	76.8a
check	--	---	7.0a	7.3a	9.0a	38.9b-e	36.7c-e
$LSD_{0.05}$			0.7	1.5	0.9	24.5	22.2

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

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

[3]Percent decrease of annual bluegrass was determined by calculating the percent decrease of annual bluegrass plot cover from 28 April to 24 Sept and 28 April to 13 Oct.

[4]A = 21 April 1987 application, J = 10 June 1987 application and S = 11 September 1987 application.

*This April application will be made in the spring of 1988.

THE EVALUATION OF POAST APPLIED TO TALL FESCUE FOR SEEDHEAD SUPPRESSION

J. E. Haley and T. W. Fermanian

INTRODUCTION

Poast (sethoxydim, BASF Corporation) is a herbicide that selectively controls nearly all annual and perennial grass weeds in broadleaf crops. When applied at low rates to tall fescue (Festuca arundinacea)it has been shown to suppress seedhead development with some discoloration of the tall fescue. The purpose of this research was to evaluate seedhead suppression, phytotoxicity and growth retardant effects of Poast on tall fescue established on roadsides and right of ways.

MATERIALS AND METHODS

Poast treatments included rates of 0.0125, 0.025, 0.05, 0.1, 0.2, 0.0125 plus 0.0125, 0.0125 plus 0.025, 0.025 plus 0.125, and 0.025 plus 0.25 lb ai/A. All treatments were applied in a solution with a crop oil (provided by BASF) at a rate of 1 qt/A. An additional treatment of Poast at 0.05 lb ai/A without crop oil was included. All treatments were applied on 1 May 1987. If a treatment received a second herbicide application this was made on 4 June 1987. All treatments were replicated 3 times and an untreated check was included with each replication. Herbicides were applied with CO_2 backpack sprayer at 40 gpa. Plot size was 3 x 10 ft. Turf was unmowed following application and no irrigation was provided.

RESULTS

Turf quality was unacceptable at rates of 0.1 and 0.2 lb ai/A (Table 1). Turf quality was significantly lower, 26 days after application, at the 0.05 lb ai/A rate when the herbicide was applied with the crop oil compared with the same rate without the crop oil. Seedhead production was significantly reduced with all Poast treatments. The greatest seedhead suppression was found at rates of 0.025 lb ai/A and higher. At 0.05 lb ai/A seedhead production was significantly higher without crop oil than with crop oil. Seedhead production was not effected by additional treatments applied on 4 June. Some turf growth retardation was seen at rates of 0.05 lb ai/A and higher. Without crop oil no growth retardation was observed at the 0.05 lb ai/A.

Table 1. The evaluation of Poast applied to an unmowed tall fescue turf.[1]

Material	Rate lb ai/A	Quality[2] 5/27	Quality[2] 7/02	Percent Seedheads[3] 5/27	Height[4] 5/28	Height[4] 7/02
Poast + crop oil	0.0125*	8.7a	6.7ab	76.7b	18.2ab	18.7
Poast + crop oil	0.025	8.3a	7.0a	8.3d	16.4a-c	21.7
Poast + crop oil	0.05	6.0b	7.0a	1.7d	14.3cd	22.5
Poast no crop oil	0.05	8.7a	6.7ab	56.7c	18.9a	22.1
Poast + crop oil	0.1	4.0c	6.0b	0.3d	11.6d	21.6
Poast + crop oil	0.2	3.0d	5.0c	0 d	11.5d	19.8
Poast + crop oil	0.0125/0.0125	9.0a	7.0a	56.7c	17.9ab	22.3
Poast + crop oil	0.0125/0.025	9.0a	7.0a	71.7b	18.3ab	22.2
Poast + crop oil	0.025/0.0125	8.7a	7.0a	8.3d	15.4bc	18.7
Poast + crop oil	0.025/0.025	8.7a	6.3ab	5.3d	17.5a-c	22.2
Check	--	9.0a	7.0a	100.0a	19.3a	22.4
$LSD_{0.05}$		0.8	0.9	13.4	3.4	NS

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

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

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

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

*The first application was made 1 May 1987. Where a second application was made treatments were applied 4 June 1987.

AN EXPERT SYSTEM FOR PLANNING TURFGRASS ESTABLISHMENT

H. Liu and T. W. Fermanian

INTRODUCTION

This is one in a series of reports on the study of expert systems for planning turfgrass establishment. The first one was reported in the 1986 Illinois Turfgrass Research Report. This study mainly focuses on the two different systems and the field evaluation study of TURFPLAN built by using AURORA, a new version of AgAssistant. There will be a third report next year focusing on the evaluation study of the expert system, called TURFPLAN designed on a main-frame computer.

The establishment of a turf is one of the more complex practices in turfgrass management. It involves knowledge of turfgrass species, soil science, and turfgrass establishment procedures. In order to have a rapid, successful turfgrass establishment, it is very important to control soil conditions, grass selection, planting methods, pest control and post-plant care. In most cases, advice from turf experts is not available for people who are going to build a new turf. This may result in inappropriate turfgrass establishment practices. Many problems in turfgrass maintenance are directly related to mistakes made during establishment, such as severe weed problems, poor drainage, unfavorable site conditions, improper turfgrass species or cultivars and post-planting care.

Knowledge-based computer systems, commonly referred to as expert systems, have great potential to functionally perform like an expert. Expert systems are sophisticated computer programs which have the ability to solve problems in a narrowly defined area or domain. For turfgrass management, expert systems may offer a great opportunity for transferring new methods and techniques to turf professionals or anyone needing information about turfgrass management. An expert system for turfgrass establishment may present a consultation environment for providing advice to people who need assistance in building a new turf. The hypothesis of this study is that TURFPLAN can substitute for expert advice for establishing a turf when there is a lack of human experts.

MATERIALS AND METHODS

Using AURORA as a building tool

The computer system designed for microcomputers is TURFPLAN an expert system built by using AURORA, an expert system building tool. Like many other expert system builders, the basic components of the expert system implemented in AURORA consist of a knowledge base with an inference engine, and an advisory system. The development process of TURFPLAN involved five steps: identification, conceptualization, formalization implementation and test. The first four steps mainly included the collection of turf establishment knowledge. The accumulated expertise about turf establishment was transferred into rule-based knowledge by direct editing and learning of rules by examples. The last step included the testing and evaluation of TURFPLAN. The evaluation study was carried out by a field turf establishment study.

Field evaluation study of TURFPLAN

Two field experiments initiated on May 13, 1987 were designed based on two different kinds of soils, Flanagan silt loam and mixed clay loam. The two experiments were separated and each of them consisted of three recommendations for establishing turfs provided by an expert, non-experts, and TURFPLAN, the expert system. Each recommendation presented values for the same seven parameters: previous weed control, basic fertilizers, soil pH amendment, tillage, seed mixture or blends (species and cultivars), mulch requirement, and postplanting weed control

Each experiment consisted of two maintenance levels, low and medium, and a RCB arrangement of 6 x 10 feet plots with eight replications. The data collected weekly were percent of plot covered with turfgrass, density of turf (numbers of seedlings per square decimeter), and quality of turf (1 to 9 scale in which 9 is the best quality).

RESULTS

Field evaluation data were collected weekly starting at the second week after seeding (Tables 1 and 2). The data from the non-expert systems' recommendations for the two soils were observed to be higher than expected. A reason may be that annual and perennial ryegrasses were recommended by non-experts. Annual and perennial ryegrasses usually have a higher germination and establishment performance than the other species. This evaluation study will be carried out at least two more years before final conclusions are drawn. However, from the initial data, turfgrass quality, density and coverage, it can be concluded that the recommedations from TURFPLAN match the expert recommendations.

Building TURFPLAN by using ESDE

In order to further confirm the hypothesis of this research a second expert system building tool was used. The second expert system building tool, Expert System Development Environment (ESDE), has been used since July, 1987. ESDE is implemented on an IBM mainframe computer on the University of Illinois campus. The ESDE TURFPLAN was built with the same expertise as the AURORA TURFPLAN but the size of the knowledge base is much bigger. Up to now, 155 rules and 56 parameters have been implemented into the system. The building process is similar to the first one but ESDE can accumulate a larger knowledge base and has an inference engine with forward and backward chaining paradigms.

A future evaluation has been designed to further evaluate ESDE TURFPLAN. Two groups of human experts will participate in the evaluation study. The first group of experts will be presented a number of turf establishment situations that require their expert design and recommendations. ESDE TURFPLAN will provide the same number of designs through a consultative process. For each situation, there will be one design from ESDE TURFPLAN and one from each expert. A second group of experts will evaluate the designs from both the first group of experts and TURFPLAN. The results of this study will be reported in the 1988 Illinois Turfgrass Research Report.

The final conclusion of this study, however, can only be made after both evaluation studies for TURFPLAN are completed.

Table 1. Flanagan silt loam.[1]

Recommendations	N*	% Cover with turf	Seedlings decimeter^2	Quality**
TURFPLAN	80	27.4	19.5a	2.8a
Expert	80	24.6	13.4b	2.4b
Non-expert	80	26.4	16.0b	2.5ab
$LSD_{0.05}$		NS	2.9	0.38

Table 2. Mixed clay loam.[1]

Recommendations	N*	% Cover with turf	Seedlings decimeter^2	Quality**
TURFPLAN	80	22.4ab	16.9a	2.4a
Expert	80	20.2b	13.0b	2.2ab
Non-expert	80	24.2a	16.9a	2.0b
$LSD_{0.05}$		3.7	3.4	0.34

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

*Values represent the total data collected for each recommendation.

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

Pithomyces chartarum - A NEW FUNGUS OF BLUEGRASS

H. T. Wilkinson and M. C. Shurtleff

In July and August of 1985, 1986, and 1987 we received a number of telephone calls and specimens of Kentucky bluegrass from residents in Illinois, Indiana and Wisconsin. After mowing, the equipment and the operators themselves were covered with sooty black fungus. Concern was raised as to the nature of this condition and if the grass was being attacked by stripe and/or flag smut. Leaf smut diseases, however, are prevalent during the cool months of spring and autumn when the grass is growing rapidly and not during hot summer weather. The Kentucky bluegrass plants examined in July and August showed no symptoms of the leaf smut disease on their leaf blades or after staining the grass tissue and examination under a microscope. The root growth and leaf color of the grass plants were not visibly affected by the presence of the fungus.

Blends of Kentucky bluegrass from 50 sod farms were examined. What apparently was the same black fungus was found on seven farms. All seven Kentucky bluegrass sods were less than 18 months old, had considerable amounts of dead leaf tissue, and the clippings were routinely returned to the sod.

Samples were collected from the affected sod farms and the same fungus was consistently isolated from all locations, grown on culture medium in the laboratory, and later positively identified as *Pithomyces chartarum*. This is the first report of this fungus growing in bluegrass sod in the United States. The fungus was found only on senescent or dead leaves and clippings. We consider it to be a saprophyte and not a parasite; thus not damaging to grass.

The dark brown spores (conidia) of the *Pithomyces* fungus were recovered from the dead or dying grass blades and clippings in astronomical numbers. These spores are broadly ellipsoidal with both transverse and longitudinal septa. Research in our laboratory has shown that the growth, development and spore production of *Pithomyces* is favored by high temperatures (85 to 95 F; 29 to 35 C), high humidity (85-95%), and abundant water as irrigation or rain fall.

It appears that all Kentucky bluegrass can be affected as the fungus was found in a variety of blends on the sod farms. The fungus was growing on the following cultivars: Adelphi, A-34 (Bensun), Baron, Bargena F, Glad, Julia, Merit, Nassau, Newport, Parade, Park, Rugby, Ram I, and Victa.

An examination of the scientific literature turned up reports of *Pithomyces chartarum* dead plant material in the United States in the states of Alaska, Maryland, Oregon, and Texas but no reports of it growing on Kentucky bluegrass. The fungus has only been reported on orchardgrass in Oregon and pasture grasses in Texas and southern Africa. *Pithomyces chartarum* has, however, been isolated from perennial ryegrass in Europe, Australia, and New

Zealand. In New Zealand it has also been found on prairie grass and several other less common grasses. The same is true of southern Africa.

The sexual stage of teleomorph of Pithomyces chartarum has recently been shown to be an Ascomycete; a species of Leptosphaerulina. The fungus produces ascospores which are similar to the conidia of Pithomyces but are smooth and nearly transparent (hyaline) to light brown. To date, the sexual stage has been found only in South Africa; but may well be undetected in the United States where Pithomyces chartarum has been found. The Leptosphaerulina stage may explain the ability of the fungus to survive the cold winter months and then to produce a flush of Pithomyces conidia when the weather becomes warm to hot and wet.

Since Pithomyces chartarum is known to produce sporidesmin (a mycotoxin), and possibly other toxic compounds, bluegrass clippings covered with a sooty black fungus should not be fed to poultry or livestock, especially young or breeding animals. Otherwise, turfgrass managers have nothing to worry about.

Conditions that support rapid growth of turfgrass, lush canopies, and high relative humidity will promote growth of this fungus. Reducing the amount of nitrogen fertilizer applied plus maintaining a proper mowing height and schedule will reduce fungal growth.

Don't be surprised if you see Pithomyces growing on dead or dying Kentucky bluegrass and possibly other turfgrass leaves during hot and muggy weather following irrigation or rain fall. Now you will know what it is you have.

PREEMERGENT CONTROL OF CRABGRASS

Annamarie Pennucci

INTRODUCTION

Turf managers throughout the Midwest annually confront several major weeds, including large and smooth crabgrass (Digitaria sp.). Despite the development of an extensive array of preemergent herbicides, crabgrass control is rarely satisfactory. Crabgrass pressure ranges from severe to worse with an extended season of germination. In the transition zone the first appearance of crabgrass may be in late March and germination can continue until the first frost of fall. Intermittant summer rains work havoc in areas where control had been good to excellent. Current efforts to control crabgrass include expanded seasons of herbicide application, increased rate and frequency of application and the evolution of new compounds. Trials were established at the Horticultural Research Farm at S.I.U. to test the effectiveness of new and established crabgrass control compounds.

MATERIALS AND METHODS

Fourteen crabgrass herbicides were applied to a monostand of tall fescue (Festuca arundinacea) on April 4, 1987. Four replicate plots, sized 6x10', were treated once with a variety of rates of compounds. In two cases, repeat applications at a lesser rate were made 10 days later (see Table 1). Control was determined as percent plot area covered with either large or smooth crabgrass and data was taken monthly. All herbicides were applied in 75 gallons of water per acre with a backpack CO_2 sprayer. The area is a utility turf receiving 2.0 lbs. N/1000 sq ft/year and supplemental irrigation is not provided.

RESULTS AND DISCUSSION

Many of the compounds tested here yielded good to excellent control of crabgrass for the first 2 months of the trial. Several of the longer residual materials provided good control for 3 months while only two compounds were able to control crabgrass for longer than 3 months. The important industry standards Tupersan and Dacthal were effective preemergent controls for April and May only. Light intermittant rains during the latter part of May served to release a second crop of crabgrass seedlings and these two compounds were ineffective in rendering control. Similarly Ronstar and pendimethalin provided excellent control for April, May and June, but the heavy rainfall events of late June served to re-establish a large population of crabgrass plants. The residual effects of these compounds was simply not strong enough to provide season long control. Breakthrough of crabgrass germination occurred in July for bensulide and the lower rates of Premier. Higher rates of Premier, 3.0 lbs/A and a split application of 1.5+1.0 lbs/A provided excellent control for 4 months with the split application proving good to excellent season long control. Prodiamine at 1.0 lbs/A also provided good to excellent season-long control of crabgrass.

Generally the breakthrough in crabgrass germination followed major rainfall events in June; however, several compounds were able to provide the necessary residual activity to withstand both added germination pressure and changes in meterology. The newer compounds Premier and prodiamine show promise for extensive use in the southern transition zone where crabgrass pressure is severe and extended seasons of growth offer additional and nearly continual opportunity for crabgrass germination and development.

Table 1. Preemergent Herbicide for Control of Crabgrass and Tall Fescue - 1987.

Herbicide	Rate lbs/A	April[a]	May	June	July	August	September	October
		% Crabgrass Date in Months						
Premier	1.0	0.0	0.0	0.0	16.9	46.6	60.6	76.5
Premier	1.5	0.0	0.0	0.0	16.6	40.1	52.3	69.5
Premier	1.75	0.0	0.0	0.0	12.8	38.2	46.9	64.5
Premier	3.0	0.0	0.0	0.0	0.0	0.0	16.2	26.5
Premier	1.0+0.5	0.0	0.0	0.0	0.0	2.0	8.2	13.5
Pendimethalin	1.5	0.0	0.0	6.8	36.9	54.8	79.2	90.3
Pendimethalin	1.5+1.0	0.0	0.0	0.0	21.6	48.9	62.1	78.0
Tapersan	12.0	0.0	0.0	16.9	40.2	68.8	90.6	94.3
Dacthal	10.5	0.0	0.0	14.8	36.6	58.8	76.9	88.3
Acclaim	0.08	0.0	0.0	2.0	19.6	60.6	82.6	90.3
Acclaim	0.18	0.0	0.0	0.0	16.7	48.6	78.2	87.0
Ronstar	3.0	0.0	0.0	2.6	28.8	56.6	72.9	86.0
Prodiamine	1.0	0.0	0.0	0.0	0.0	0.0	4.6	8.5
Bensulide	10.0	0.0	0.0	0.0	16.8	62.6	88.8	94.5
Control	--	10.9	14.6	62.6	90.0	94.2	96.0	93.0

DORMANT SEASON CRABGRASS CONTROL

Annamarie Pennucci

INTRODUCTION

Crabgrass pressure in the "Crabgrass and Goosegrass Heartland" ranges from moderately severe to severely severe! Efforts to control crabgrass (Digitaria sp.) usually are ineffective and only short seasons of control are usually achieved. Crabgrass germination occurs in mid-March to early April and can continue until the first frost in fall. While pre-emergent materials may be effective for as long as 3 months, this only covers approximately half of the crabgrass season. Post-emergent materials appear similarly limited in duration and frequent midsummer applications are necessary to provide "crab-free" turf of the highest quality. Thus turfgrass managers are continually searching for new compounds with extended periods of control to counter this phenomenal pressure.

MATERIALS AND METHODS

Two rates of prodiamine and Regalstar and one rate each of bensulide and pendimethalin were applied as single fall treatments or as split fall and spring or spring only treatments. Applications were made to utility tall fescue (Festuca arundinacea Schreb.) plots measuring 3 x 30' on November 16, 1986 and April 16, 1987, respectively. Granular materials were applied with a drop spreader, flowables with a backpack CO_2 sprayer delivering 60 psi and 66 GPA. Data were taken as percent crabgrass one, two, three, four and five months after application. Phytotoxicity was generally not a problem and the data are not presented here. Plots were maintained as a low-fertility utility turf receiving 2 lbs. N per 1000 square feet per year and supplemental irrigation was provided only under extreme drought stress conditions. The area was mown twice weekly at 4 inches.

RESULTS AND DISCUSSION

Applications of prodiamine made in the fall show great promise in reducing crabgrass pressure and may provide the busy turf or lawn care manager with an alternative season of application. Higher rates of prodiamine were more successful at preventing crabgrass germination and the control so achieved was of longer duration (Table 1). Fall applications of bensulide, pendimethalin or Regalstar were ineffective and crabgrass pressure exceeded 40% by the end of the test.

Split applications of prodiamine were the most effective in controlling crabgrass of those tested here. One half pound applied in the fall followed by one half pound applied in the spring rendered nearly complete crabgrass control. Spring alone application of prodiamine was not as effective as either the fall alone or the fall/spring applications. Split applications of the other materials tested were more effective than single fall applications but their efficacy could not approach that of prodiamine in either fall or fall/spring treatments.

Duration of control was greater with prodiamine than with other compounds tested here and again, the split application gave season-long control where other compounds had failed to give adequate crabgrass control by mid-season. Early season control afforded by pendimethalin was excellent but its duration was limited to 2 - 2 1/2 months. The major rains received in late June provided more than adequate moisture for resumed crabgrass germination and subsequent plot ratings reflect this additional pressure. Split applications of bensulide were able to reduce crabgrass pressure to less than 28% of the plot while fall alone applications were completely ineffective. While similar reductions could be noted with Regalstar the magnitude of control was sufficiently limited to question its suitability for fall or fall/spring applications.

Of the compounds tested here only prodiamine provided season long control when a fall/spring application was made. Prodiamine at rates as high as 1.0 lbs. (label suggested rate) or higher may offer turf managers an option of application season in their attempt to control crabgrass. The long duration of control afforded by its use may provide added flexibility in crabgrass control scheduling. Data presented here suggest that, to be effective in the 'Crabgtrass Belt', compounds need to be of sufficient duration to withdstand a protracted period of germination and sufficiently residual to withstand major meteorologic changes during the course of a season.

Table 1. Effects of Fall, Fall and Spring and Spring Applications of Selected Herbicides on Crabgrass Pressure in a Utility Tall Fescue Sward, (1986 and 1987).

			% Crabgrass				
			Months After Treatment (Date)				
Treatment	Rate	Season	1 (May)	2 (June)	3 (July)	4 (Aug)	5 (Sept)
prodiamine	0.5	fall	0.0	3.6	9.2	12.4	15.6
prodiamine	1.0	fall	0.0	0.0	6.0	8.4	11.3
prodiamine	0.5 + 0.5	fall & spring	0.0	0.0	0.0	3.2	6.6
prodiamine	1.0	spring	0.0	12.2	22.4	28.6	30.0
bensulide	10.0	fall	2.6	18.8	30.3	36.4	48.3
bensulide	10.0 + 7.5	fall & spring	0.0	16.6	18.8	22.4	26.6
pendimethalin	2.8	fall	4.3	18.6	31.9	40.3	41.3
pendimethalin	1.8 + 2.0	fall & spring	0.0	0.0	8.2	16.4	25.0
Reglastar	150 actual	fall	12.4	22.8	40.6	48.2	59.0
Regalstar	200 actual	fall	6.9	18.4	30.0	42.2	49.6
Regalstar	150 + 150	fall & spring	16.8	36.3	50.4	59.6	72.0
Control	--	--	86.6	92.0	90.0	90.0	93.0

PREEMERGENT AND POSTEMERGENT CONTROL OF CRABGRASS

Annamarie Pennucci

INTRODUCTION

In the never-ending attempt to minimize weed pressure in the transition zone, turf managers continually seek new compounds, rates and dates of application of herbicides for crabgrass control. Often inexpensive and appropriate compounds proved short-lived and unable to withstand changes in rainfall patterns. The residual effectiveness of many crabgrass controls are subject to photodecomposition, microbial degradation, retention in the organic or thatch layers and eventaully prove inadequate. Demands for ever-increasingly "better" turf are aggravated by the inability of compounds to provide adequate crabgrass control. Trials were established in Southern Illinois to test the efficacy of several products, alone, repeated and applied at various rates. Products were tested for efficacy as preemergent, postemergent or pre+post emergent activity.

MATERIALS AND METHODS

Seven crabgrass herbicides were applied to a year old stand of zoysiagrass mxied with crabgrass. The area had been seeded to Zoysia japonica cv 'Korean Common' zoysia under various cover treatments the year previously, and the resulting stands were generally half zoysia and half crabgrass. Long plots, 6x18', were designed to take into consideration the species differences across plots. Compounds were applied to entire plots as preemergents and where appropriate, as repeat application preemergents. The plots were then split lengthwise and half treated as postemergent and where appropriate, repeat postemergent. Initial treatments were made April 1, with repeat preemergent applied April 15, postemergents applied April 29 and repeat postemergents applied May 13, 1987. The area was maintained as a low fertility lawn receiving 1.5 lbs N/1000/year and supplemental irrigation was not provided. Herbicides were applied in 72 gallons of water per acre, and Daconil (chlorothalonil) at 6.0oz/1000 ft^2 was applied as needed to counter dollar spot and brown patch pressures.

RESULTS

All of the compounds applied in this test provided excellent control of crabgrass were visible in late May in plots treated with oxadiazon, simazine, and dacthal. Repeat applications were apparently tied to maximize exposure of compound to germinating crabgrass seeds as the true preemergent materials were as effective as those with postemergent activity. Less than 10% of plots treated with pendimethalin were covered with crabgrass in late June, but subsequent rains facilitated further crabgrass germination and plots so treated developed large populations of crabgrass in a relatively short period of time. By August, fully half of the pendimethalin plots were crabgrass and this continued to develop as the season progressed until the half plot that began the season as crabgrass was once again crabgrass and showed little or no encroachment by zoysiagrass into the weed half plot. The same situation was observed with Poast, simazine and dacthal where initial herbicidal activity was of 2 months duration, following which crabgrass germination was renewed by rainfall and plots reverted to predominantly crabgrass.

Of interest is the effectiveness of Acclaim applied as pre and postemergent material. Little or no crabgrass was visible in Acclaim treated plots until July. The combination of pre and postemergent application timings appeared very effective with this compound. Perhaps crabgrass germination has already begun when the first applications were made and the not-yet-visible crabgrass plants were acutely sensitive to Acclaim. Repeat application would serve to treat those plants escaping initial chemical effects. No reduction in effectiveness was evident when Acclaim was tank-mixed with Dursban or Daconil.

Applications of Premier at 1.0 and 1.5 lb/A rates restricted crabgrass invasion to less than 20% in July yet crabgrass occupied nearly 40% of those same plots in August with continued encroachment evident in September (60%) and October (70%). Rates of Premier greater than 1.5 lb/A were far more effective and of greater residual. The 3.0 lb/A rate gave season long control of crabgrass with some early postemergent burn down visible. Crabgrass so treated was bright orange in 24 hours, light brown in 48 hours, dark brown in 72 hours and no longer visible 5 days after treatment. The rapid death of small 2-4 leaf crabgrass resulting from this preemergent material will serve to broaden the "window of application". Higher rates of the material would probably not be needed in regions north of the transition zone but they provided both excellent initial control and more than adequate residual control. The split application was both the most effective initially and rendered greater residual than did high rates of Premier. Again, the four time postemergent split application was probably not needed, while the two-time pre and repeat as postemergent treatments were most effective.

Of the materials tested here, Premier yielded the only crabgrass free plots at the conclusion of the trial. Prodiamine was also most effective when repeat applications were made. These two materials offer the turf manager the opportunity to both control crabgrass during germination but to sharply limit its encroachment for an entire season. In contrast, the effectiveness of established preemergent materials will need to be combined with effective postemergent materials in the transition zone if turf managers are to develop turf swards free of the crabgrass and goosegrass stimulated late in the season by rains in June and July.

Table 1. Pre- and Postemergent Control of Crabgrass in Zoysiagrass - 1987.[a]

Herbicide	Rate lbs/A	% Crabgrass Date in Months 4/15[b]	5/1	5/14	5/29	6/26	7/24	8/21	9/25	10/23
Premier	0.0	0.0	0.0	0.0	0.0	0.0	18.2	42.4	59.3	72.4
Premier	1.5	0.0	0.0	0.0	0.0	0.0	16.8	40.4	54.6	66.3
Premier	1.75	0.0	0.0	0.0	0.0	0.0	10.8	30.1	38.6	56.2
Premier	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.2	22.3
Premier	1.0+1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2
Pendimethalin	1.5	0.0	0.0	0.0	0.2	7.2	33.6	56.2	86.6	92.4
Pendimethalin	1.5+1.0	0.0	0.0	0.0	0.0	4.3	19.8	44.2	70.3	88.4
Acclaim	0.18	0.0	0.0	0.0	0.0	2.6	8.6	18.3	29.6	54.8
Acclaim + Dursban	0.18+2	0.0	0.0	0.0	0.0	3.3	7.8	16.6	24.5	48.8
Acclaim + Daconil	0.18+8oz	0.0	0.0	0.0	0.0	2.9	9.2	16.6	26.6	56.6
Prodiamine	1.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	12.8	16.3
Oxadiazon	4.0	0.0	0.0	0.0	2.0	6.6	22.8	46.6	66.9	88.6
Simazine	3.0	0.0	0.0	0.0	4.6	12.6	36.6	52.4	83.3	92.1
Poast	1pt	0.0	0.0	0.0	0.0	9.2	21.6	39.4	62.3	80.6
Dacthal	10.5	0.0	0.0	0.0	4.9	10.2	31.1	49.8	70.6	90.4
Dacthal	10.5+10.5	0.0	0.0	0.0	0.0	2.4	12.6	33.9	66.6	80.0
Control	--	6.2	16.6	36.8	66.6	89.6	95.4	94.6	98.8	99.9

[a]Split applications made two weeks after initial treatment date; postemergent repeat application made 4 weeks after initial treatment with the split postemergent made 6 weeks after initial treatment.

[b]Preemergent data only on 4/15, preemergent split data on 5/1, pre, pre-split + post data on 5/14, pre, pre-split, post + post-split data on 5/29 and monthly thereafter.

TURFGRASS SEEDLING SENSITIVITIES TO HERBICIDES

Annamarie Pennucci

INTRODUCTION

The establishment of turfgrass from seed in the transition zone is best accomplished in the early fall, preferably by mid-September. Excessive temperatures and high humidity greatly complicate August and September seedings and annual weedy grass encroachment poses an enormous problem. Alternatively, successful establishment is often sharply curtailed by early fall frosts, for example, the first serious frost of 1987 occurred October 3-5. One and two week old seedlings of most turfgrasses are very susceptible to frost injury and young stands subject to frost are often severely thinned. It would be of great advantage to establish turfgrasses earlier in August or possibly earlier still in the spring of the year. Spring seedlings in the transition zone usually result in near monostands of crabgrass or goosegrass but the problem can be nearly as severe in August. The preemergent herbicide siduron (Tupersan) is commonly applied during seeding but has proven to be short lived in the transition zone. The majority of other preemergent and postemergent herbicides are too harsh and their use on seedling turf will result in substantial seedling mortality. However, researchers are continually testing new compounds at various rates for use of some or all of the important turfgrasses. Trials were established at the Horticultural Research Farm, Carbondale, Illinois to test the efficacy and hazard of using fenoxyprop (Acclaim), Premier, and prodiamine on seedling turf. Compounds were applied at a variety of rates and dates relative to seeding date, thus comprising both preemergent and postemergent treatments to Kentucky bluegrass, tall fescue, perennial ryegrass, creeping bentgrass and zoysiagrass.

MATERIALS AND METHODS

Preemergent Application:

An area of clay loam soil whose sod was removed in 1986 was rototilled and rolled with a Brillion roller in July 1987 prior to chemical application. The area was hand raked, and on August 3, 1987, the control and simultaneous seeding was done by hand shaking seed into plots and then raking and rolling the plots lightly. The grasses used in this test were Kentucky bluegrass (*Poa pratensis*) cv Georgetown; tall fescue (*Festuca arundinacea*) cv Falcon; perennial ryegrass (*Lolium perenne*) cv Fiesta II; creeping bentgrass (*Agrostis palustris*) cv Penncross and zoysiagrass (*Zoysia japonica*) cv Korean Common. Herbicides were then applied to all treatment plots and the area lightly watered to provide ample moisture for seed germination. Additional seedings were made one and two weeks after chemical application to determine the postapplication tolerances of each grass to both compounds. The area was rated for percent germination weekly, for color and density biweekly; however the data reported here are the numbers of plants per square inch, one, two and three months after seeding.

Postemergent Application:

A similar area of clay loam that had lain fallow since August of 1986 was rototilled and rolled with a Brillion roller in July of 1987. The area was hand raked and on August 3, 1987, was seeded to the same grasses as used in the preemergent study. The area was rolled lightly and irrigated daily to insure adequate seed germination. Beginning at the 1-3 leaf stage for each grass; (i.e., 21 days after seeding for Kentucky bluegarss, 14 days after seeding for tall fescue, 10 days after seeding for perennial ryegrass and creeping bentgrass and 28 days after seeding for zoysiagrass) the appropriate plots were treated with various rates of Acclaim, prodiamine and Premier. A similar rates series of Acclaim was applied to each to the grasses at the 4+ leaf (pretillering) stage. Percent germination, color and stand density were taken initially and biweekly, respectively, however the data presented here are number of plants per square inch one, two and three months after herbicide application. An estimate of percent stand loss following treatment is also provided.

RESULTS

Preemergent Application

Applications of Acclaim or prodiamine made at the time of seeding prevented the germination of nearly all of the grasses used in this study, Table 1. Little or no recovery due to later germination was observed two or three months later. Both compounds applied during the excessive heat and humidity of August were lethal to germination of any of these grasses. Applications of Acclaim made one week after seeding were nearly as toxic and fewer than 4 plants per square inch of Kentucky bluegrass or tall fescue were visible in September. Slight recovery due to delayed germination was evident in October and November, however plant number never exceeded 7 plants per square inch. Applications of prodiamine made one week after seeding also completely prevented seed germination in all these grasses. Applications of Acclaim made two weeks after seeding were slightly less toxic to germinating turfgrasses. Within one month, nearly 10 plants per square inch were visible in Kentucky bluegrass, tall fescue and perennial ryegrass plots. Germination of creeping bentgrass and zoysia were still sharply curtailed by Acclaim applied two weeks before seeding. Slight recovery of Kentucky bluegrass, tall fescue and perennial ryegrass were noted two and three months after seeding and final stand counts averaged 10-14 plants per square inch. Only a very few plants of Kentucky bluegrass, tall fescue and perennial ryegrass developed in plots treated with prodiamine and seeded two weeks later. Both bentgrass and zoysia appeared very sensitive to prodiamine-induced suppression of germination. However, those Kentucky bluegrass and tall fescue plants that did germinate produced very few roots which were stunted and thickened in appearance. These roots rapidly turned brown and in time, additional thinning in these plots was observed. By November, very few plants survived in any of the prodiamine plots. In contrast, tall fescue plots treated with Acclaim two weeks after seeding had 66% the density of controls, while perennial ryegrass had 77% and Kentucky bluegrass had 54% the density seen in control (untreated plots). While the application of Acclaim slowed establishment of Kentucky bluegrass, it provided excellent control of crabgrass and goosegrass and the resulting stands of tall fescue and perennial ryegrass were well within the variability normally seen in field conditions. With time, the depression in Kentucky bluegrass density was much less evident, primarily due to spread of rhizomes and tillers. Thus, Acclaim can be successfully used two weeks prior to expected seeding when Kentucky bluegrass, tall fescue or perennial ryegrass are to be sown. The suppression in bentgrass germination would suggest that seeding be delayed for more than the 14 days used in this trial. It must be noted that the seeding attempted here was done in early-mid August when environmental conditions were entirely too hot. Between the excessive heat and humidity and the tremendous volume of water required for germination under those stresses, conditions for germination were poor. Overhead irrigation was responsible for washing some of the seed and also for sealing the soil surface, adding to the difficulties of germination. The bentgrass and zoysia appeared especially subject to seed loss due to irrigation and the data here remain suspect. It is entirely possible that utilizing a misting irrigation sprinkler could alleviate the majority of these problems. Similarly, plots already seeded were randomized along with those yet to be seeded and irrigation was provided to all simultaneously. Thus some sealing of the soil surface resulted in those plots yet to be seeded. A Mat-Away was used to loosen that surface prior to seeding one and two weeks after herbicide treatment and while this appeared beneficial to the Kentucky bluegrass, tall fescue and perennial ryegrass, it was only marginally effective in the bentgrass and zoysiagrass plots. The bentgrass and zoysia portions of the data should be read with caution as this needs to be repeated in isolated plots not subject to the added influences of mis-timed and excessive irrigation.

Postemergent Application

The effects of Acclaim applied to turfgrasses at the 1-3 leaf stage was dependent both on rate and species, Table 2. Generally the lower rate of Acclaim resulted in much less loss of stand than did the higher rates. The loss in stand density for Acclaim at 0.06 lbs/A averaged 20 to 80 percent depending on the grass while higher rates resulted in a loss of between 45 and 100 percent of the stand, Table 3. Of the species tested here, tall fescue and perennial ryegrass were much more tolerant of Acclaim than the other grasses. The best density was achieved with these two grasses at the lower rate while a 50% loss was sustained at the middle rate and a 70% loss at the highest rate. Little change in stand density was seen in October and November. While some increase in the numbers of plants per square inch occurred over time, the increase was paralleled by further stand development in the control plots. Kentucky bluegrass was more sensitive to Acclaim than either tall fescue or perennial ryegrass and that sensitivity increased with dosage. Creeping bentgrass appeared intermediate in sensitivity between tall fescue and Kentucky bluegrass at the low rate but stand reductions of 89% occurred at the high rate. Acclaim at any of these rates proved lethal to zoysiagrass at the 1-3 leaf stage. Premier applied at the same stage was very inhibitory to seedlings of zoysiagrass, creeping bentgrass and Kentucky bluegrass while one third reductions in stand density accompanied its use on tall fescue and perennial ryegrass. Increasing the rate of Premier increased the stand mortality. The loss in stand accompanying the use of prodiamine was very minor for these grasses in September. No loss in stand density was seen with tall fescue or perennial ryegrass while a one third loss in density followed its use on Kentucky bluegrass, creeping bentgrass and zoysia. Increasing rate did not effect the tall fescue or perennial ryegrass but a 40% loss followed its use on Kentucky bluegrass and 67% losses were reported for creeping bentgrass and zoysia. Data taken in October and November records the substantial loss in stand density for both prodiamine rates for all grasses. Three months after treatment fully three quarters of all the plots were barren and nearly all of the creeping bentgrass and zoysia had been lost. Prodiamine treatment resulted in a marked thickening and stunting of both seminal and primary roots. This stunting was rapidly followed by discoloration, browning of the stele and finally death of the root tissue. Small tufted plants were short-lived and of a dark, nearly purple coloration. The loss in stand was visible at the end of September but was accentuated in later months as control plots increased in density. Conversely, plots treated with Premier showed some recovery in number of plants with time. By October the loss in stand density for tall fescue and perennial ryegrass was less than 30% while that of creeping bentgrass was about 50% and Kentucky bluegrass remained unchanged. Further increases in plant number were reported in November where perennial ryegrass stands were within 20% of controls at the low rate and within 30% at the high rate. Kentucky bluegrass, creeping bentgrass and zoysia remained sensitive to Premier at both rates for the duration of the trial.

It is interesting to note that the visual estimates of plot density do not compare well with the actual plant counts. Acclaim at 0.06 lbs/A at the 1-3 leaf stage resulted in a 47% less in Kentucky bluegrass plant number yet visual estimates of 8.2 were recorded three months after treatment. Conversely tall fescue at 30% and perennial ryegrass at 16% reduction in plant number had visually estimated densities of 8.8 and 8.6 respectively. Little or no difference in plot density was apparent when estimates were made as a visual "guess". Acceptable density from visual estimates was recorded for Kentucky bluegrass at the lower two rates and for tall fescue and perennial ryegrass at all three rates when applications of Acclaim were made at the 1-3 leaf stages. Later applications resulted in acceptable estimates of density for all of these grasses at all Acclaim rates. Acceptable density for creeping bentgrass was apparent only at the low rate when applied at either the 1-3 leaf or 4+ leaf stages. Density of zoysia plots was unacceptable at any rate or stage of treatment with Acclaim. Reductions in density in Premier plots as visually estimated were acceptable only for tall fescue and perennial ryegrass at the low levels and plots appeared thinner than would have been expected from plant counts alone. Conversely the plant densities in plots treated with prodiamine would suggest nearly to completely barren plots yet most of the visual estimates of density ranged from 3.0 to 5.6 with Kentucky bluegrass appearing denser than tall fescue or ryegrass despite fewer actual plants. The marked differences between plant count and apparent density probably results from rhizomatous, stoloniferous and tillering growth subsequent to treatment. Finally, plots appeared denser and of better quality than would be expected from plant counts alone and the numerical values for plant density do not adequately reflect "turf quality". However, the reductions in plant number indicate an intolerance towards these herbicides by these grasses. That intolerance can be moderated by reductions in rate and a delay in application date. Recovery from herbicide injury occurs with continued growth of those plants surviving the initial exposure.

CONCLUSIONS

Acclaim and prodiamine should not be applied at the time of seeding or applied over top of seed. Excellent control of crabgrass and goosegrass will be afforded by these compounds, however seeding turfgrases should be delayed until 14 days after herbicide application is made to bare or somewhat weedy soils. Under the excessively hot and humid conditions encountered in this test, a further delay in seeding date for creeping bentgrass and zoysia would be suggested. Delays of 14 or more days probably will required additional soil preparation to avoid the sealing action of rain or irrigation. Soil disturbance may aid turfgrass seed germination but may also bring another crop of weed seeds to the surface, further compounding herbicide injury with weed breakthrough. Lower rates than 0.06 lbs/A may be less lethal to bentgrass and zoysia but may prove insufficient in the control of crabgrass or goosegrass. At this writing and under the conditions of this test, Acclaim and prodimaine cannot be recommended for use in bentgrass or zoysiagrass seedling turf unless seeding can be further delayed. If spring seeding is attempted and conditions are far more favorable for bentgrass growth, perhaps 14 days will be sufficient. In the transitions zone, however, early August seeding bentgrass cannot be effectively accomplished when these compounds are included as pre-seeding herbicide treatments.

Applications of Acclaim made after seeding turfgrasses will render successful control of crabgrass and goosegrass without severe reduction of the turfgrass sward if the rate used is 0.12 lbs/A or less and the plant has at least 4 leaves. Younger plants are more susceptible to herbicide injury than older plants but injury wil always increase with increased rates of application. Tall fescue and perennial ryegrass were much less susceptible to injury than Kentucky bluegrass but Acclaim can be used successfully with all three of these grasses. Creeping bentgrass is subject to still greater injury but the very lowest rates could be used with grass at the 4+ leaf stage. The delay required before herbicide application may compromise the control of invasive weeds afforded by Acclaim yet weed development should not have progressed to the point where control would not be effective (crabgrass with 5 or more tillers). The reductions in bentgrass population suggest that this herbicide should be used with extreme caution and that August seeding in the transition zone places such stress on the plant that additional herbicide injury will severely compromise establishment efforts. The use of this herbicide in more favorable conditions at lower rates, while not tested here, would possibly offer turfgrass managers and additional herbicide for establishment purposes.

The new experimental herbicide Premier has potential for use in establishment of tall fescue and perennial ryegrass and possibly creeping bentgrass under cooler conditions, but appears too harsh for use with Kentucky bluegrass or zoysiagrass. The gradual loss of the root system following prodiamine use would indicate that its use be restricted to fully mature (one year old or older) turf. None of grasses here were able to successfully overcome these root restrictions and severe loss in stand accompanied its use in this test.

Thus, we can recommend Acclaim at low rates applied either two weeks before or two-four weeks after seeding to control annual grassy weeds in the establishment of tall fescue, perennial ryegrass or Kentucky bluegrass during early to mid-August. Still lower rates and seeding at a more favorable time of year may provide turf managers with an additional herbicide for the establishment of bentgrass. None of the compounds, rates or application dates employed in this test could be recommended for herbicidal treatments during the establishment of zoysiagrass.

Table 1. Effects of Preemergent applied Acclaim and Prodiamine on Seedling Establishment - 1987

			# seedlings per square inch — species by date														
			One Month[b]					Two Months					Three Months				
Herbicide	Rate	Growth[b] Stage	KBG[c]	TF	PR	CB	ZJ	KBG	TF	PR	CB	ZJ	KBG	TF	PR	CB	ZJ
Acclaim	0.25	SAT	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4	0.0	0.0	0.0	1.4	0.8	0.0	0.0
Acclaim	0.25	S-1	2.4	3.2	0.8	0.0	0.0	6.2	4.4	2.1	0.0	0.0	7.0	5.1	4.2	0.0	0.0
Acclaim	0.25	S-2	8.4	9.6	10.2	2.6	0.0	12.2	10.4	14.4	4.2	0.0	14.2	10.8	14.0	6.6	0.0
Prodiamine	1.5	SAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prodiamine	1.5	S-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prodiamine	1.5	S-2	0.8	2.4	1.3	0.0	0.0	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control	--	--	16.2	12.8	14.2	26.6	3.2	22.2	17.0	18.0	42.2	12.2	26.2	16.2	18.0	66.4	16.2
Expected Control[d]	--	--						30.0	16.0	16.0	84.4	62.0	30.0	16.0	16.0	84.4	62.0

[a]Data taken one, two and three months after seeding.
[b]SAT = seeded at treatment, S-1 = seeded 1 week after treatment, S-2 = seeded 2 weeks after treatment.
[c]KBG=Kentucky bluegrass cv Georgetown, TF=tall fescue cv Falcon, PR=perennial ryegrass cv Fiesta II, CB=creeping bentgrass cv Penncross, ZJ=Zoysiagrass cv Korean Common.
[d]Assuming 100% germination.

Table 2. Effects of Postemergent applied Acclaim and Prodiamine on Seedling Establishment - 1987

			# seedlings per square inch — species by date														
			One Month[a]					Two Months					Three Months				
Herbicide	Rate	Growth[b] Stage	KBG[c]	TF	PR	CB	ZJ	KBG	TF	PR	CB	ZJ	KBG	TF	PR	CB	ZJ
Acclaim	0.06	1-3	7.2	9.8	10.8	16.2	0.6	14.6	12.2	14.2	20.2	1.0	15.2	12.0	15.0	18.6	1.0
Acclaim	0.08	1-3	4.6	7.2	6.8	12.4	0.0	10.2	12.0	11.6	18.6	0.6	12.4	12.0	14.8	18.0	0.6
Acclaim	0.12	1-3	2.1	4.6	3.8	3.2	0.0	9.6	7.8	10.2	14.4	0.0	10.6	8.6	12.0	16.0	0.0
Acclaim	0.08	4+	12.6	10.6	11.8	14.4	1.0	14.8	16.6	14.4	16.6	1.2	18.6	19.4	18.8	18.8	0.8
Acclaim	0.12	4+	10.4	9.8	9.0	4.6	0.4	12.6	12.4	12.6	12.2	0.6	14.4	16.6	15.9	14.4	0.0
Acclaim	0.18	4+	4.2	3.9	4.6	2.2	0.0	6.2	5.2	6.0	2.6	0.0	6.9	6.6	7.2	3.0	0.0
Prodiamine	1.0	1-3	12.6	14.0	14.8	20.2	2.0	6.8	9.6	12.4	12.2	0.6	4.2	3.6	4.8	2.6	0.0
Prodiamine	1.5	1-3	10.2	12.9	13.0	9.8	1.0	2.8	4.6	8.2	2.4	0.0	3.0	2.4	3.0	2.2	0.0
Premier	1.0	1-3	4.3	8.2	7.9	6.2	0.0	6.6	12.2	13.2	16.6	1.0	3.2	12.2	14.6	20.3	1.0
Premier	1.5	1-3	3.6	4.2	4.6	2.3	0.0	4.2	9.6	10.8	9.8	0.7	5.2	10.9	12.6	10.2	0.0
Control	--	--	18.2	13.0	14.6	30.1	3.2	26.6	14.9	17.2	36.6	6.2	28.8	17.2	18.0	40.8	10.2
Expected Control[d]	--	--						30.0	16.0	16.0	84.0	62.0	30.0	16.0	16.0	84.0	62.0

[a]Data taken one, two and three months after seeding.

[b]Numbers of leaves at treatment date, actual date varied between species, ± 4-10 days.

[c]KBG=Kentucky bluegrass cv Georgetown, TF=tall fescue cv Falcon, PR=perennial ryegrass cv Fiesta II, CB=creeping bentgrass cv Penncross, ZJ=Zoysiagrass cv Korean Common.

[d]Assuming 100% germination.

Table 3. Reduction in Stand Density Following Postemergent Applied Acclaim and Prodiamine to Seedlings - 1987

			% loss in stand density species by date															Visual estimate of density at 3 months[a]				
			One Month[a]					Two Months					Three Months					Species				
Herbicide	Rate	Growth Stage	KBG[c]	TF	PR	CB	ZJ	KBG	TF	PR	CB	ZJ	KBG	TF	PR	RB	ZJ	KBG	TF	PR	CB	ZJ
Acclaim	0.06	1-3	60	25	26	46	81	45	18	17	44	84	47	30	16	54	90	8.2	8.8	8.6	7.2	1.2
Acclaim	0.08	1-3	74	45	53	58	100	61	19	32	49	90	56	30	17	55	94	7.6	8.0	7.9	6.0	1.0
Acclaim	0.12	1-3	88	65	74	89	100	64	48	40	60	100	63	50	33	60	100	6.8	7.2	7.0	5.4	0.0
Acclaim	0.08	4+	30	18	19	52	67	44	+11	16	55	80	35	+12	+4	64	92	8.0	9.0	9.0	7.0	0.8
Acclaim	0.12	4+	42	25	38	85	87	53	16	26	66	90	50	3	11	65	100	7.7	8.3	8.8	5.8	0.0
Acclaim	0.18	4+	77	70	68	93	100	76	60	65	93	100	76	61	60	93	100	6.6	7.8	8.0	3.6	0.0
Prodiamine	1.0	1-3	30	+7	0	32	37	74	35	72	66	90	85	79	73	94	100	5.6	4.2	4.0	3.8	0.0
Prodiamine	1.5	1-3	44	0	11	67	67	89	69	52	93	100	89	86	83	95	100	4.0	3.0	3.2	2.6	0.0
Premier	1.0	1-3	76	37	46	79	100	75	30	23	54	84	75	18	18	50	90	5.0	7.6	7.8	6.2	1.8
Premier	1.5	1-3	80	67	68	92	100	84	35	37	73	88	82	36	30	75	100	4.8	5.0	6.2	4.8	0.0
Control	--	--	--	--	--	--	--	18.2	13.0	14.6	30.1	3.2	26.6	14.9	17.2	48.6	6.2	28.8	17.2	18:0	72.4	10.2

[a]Visual estimate on scale of 0-10, where 0 = completely bare and 10 = dense lush turf.
[b]Data taken one, two and three months after seeding.
[c]KBG=Kentucky bluegrass cv Georgetown, TF=tall fescue cv Falcon, PR=perennial ryegrass cv Fiesta II, CB=creeping bentgrass cv Penncross, ZJ=Zoysiagrass cv Korean Common.

FERTILIZER AND HERBICIDE INTERACTIONS AFFECT LARGE BROWN PATCH SEVERITY

Annamarie Pennucci

Introduction

Varying fertility date and rate are frequently employed cultural practices to reduce the apparent severity of some diseases. Generally the high temperature-high humidity diseases of turfgrass are most favored by conditions of high to excess nitrogen fertility. Both Pythium and large brown patch disease are markedly more severe where grass has been fertilized heavily in early spring or frequently during the course of the spring and early summer. Investigations were undertaken here to determine the upper and lower fertility regimes for tall fescue at which either the greatest disease or plant health occurred.

Similarly, the interactions of herbicides with some plant pathogens have been well documented. In particular, the use of postemergent crabgrass herbicides and broad leaf weed control agents are known to stimulate leaf spot diseases to levels greater than those encountered in untreated turf. Crabgrass herbicides are an essential part of managing turfgrass in the Heartland and interactions with other organisms are suspected. Trials were established at Southern Illinois University to test the frequency and severity of brown patch disease occurrence on tall fescue treated with a variety of post emergent crabgrass control agents.

MATERIALS AND METHODS

Fertilizer plots were established in a mature stand of tall fescue (Festuca arundinacea) mown at 2.5 inches. Three fertility regimes were instituted on May 30 and June 30 to coincide with early and maximum disease pressure. Urea was applied at three rates; 1.5, 2.5 and 4.0 lbs. N/1000 ft^2/year as a four time split with the latter two applications made in August and September. Fertilizer was applied by hand to plots measuring 150x7 feet and fungicides were applied to split blocks running perpendicular to the fertility trial. Percent plot area infected with brown patch was taken periodically throughout the summer. The area was irrigated on an every-other day basis to simulate conditions conducive to brown patch development.

Selected postemergent herbicides were applied to a mature stand of tall fescue (Festuca arundinacea) as late postemergent on June 15 and very late post emergents on June 30 and August 1, 1987. Fungicides were applied to split blocks on a 14 day preventative schedule beginning June 15 and continuing for the duration of the summer. Disease was recorded as percent plot area on a 14 day schedule until disease was undetectable due either to disease recession or crabgrass pressure. Plots were also rated for percent dollar spot disease on the invasive crabgrass late in the summer. Fungicides were applied in 2 gallons of water per 1000 square feet and herbicides in 66 gallons per acre; both were applied with a backpack CO_2 sprayer delivering 60 psi.

RESULTS

High levels of N fertilizer resulted in appreciably more disease on all dates than did the other fertilizer treatments, Table 1. The low N treatment resulted in more disease than did the middle treatment. Generally the reduction in fertility suggested for brown patch management has been a reduction of 50% or more. For tall fescue, this will probably be too severe a reduction and some moderate amount of fertility will be required to maintain plant resistance to disease. Similarly, applied fungicides were far more effective when moderate amounts of N were available to the plant (Table 2). Both high and low fertility levels compromised the ability of fungicides to adequately counter disease. Fungicides were generally more effective in the early part of the season and by mid-August levels of disease were generally unacceptable for all fungicides at all N treatment levels. Of the fungicides employed in this test, Vorlan + Fungo or Apache (MF 654) showed the greatest reduction in disease severity although they were unable to completely prevent brown patch. Applications made in advance of June 15 might be necessary to more nearly prevent disease. Recovery of tall fescue at the end of the season was greatest on plots receiving the middle treatment of N and appropriate fungicides. At no time did either the low or high N treatments recover to the extent of the middle N treatment. Many of the newer fungicides tested here show promise as brown patch control agents, particularly if they were to be tank-mixed with a rapid acting preventative such as Daconil, Dyrene or Mancozeb.

The application of late postemergent herbicides exacerbated brown patch disease in all instances (Table 3). Initial disease levels in late June were only marginally increased for Acclaim, Premier and Daconate while these initial levels were far more severe for Prodiamine, TurfCal and Prograss. Continued development following the second application resulted in still more severe disease development. A slight reduction was noted once the effect of the herbicides wore off but disease pressure resumed at high levels following the early August application. Disease pressure was greatest in the 3-5 day period immediately following herbicide application, indicating some temporary slowing of grass growth or some direct effect on fungal development. Despite this surge of disease, the additional pressure was short-lived and disease levels subsided within a week of treatment (2-3 mowings).

Several of the fungicides employed here effectively reduced disease despite herbicide application (Table 4). The contact materials Daconil and Vorlan were the most effective and disease levels were less than 25% of the plot area during the disease surge seen following herbicide application. Daconil was more effective early in the season while Fungo, Tersan 1991 and Chipco were all moderately successful in containing disease. The systemics Bayleton and Banner afforded no control of brown patch and disease levels generally exceeded those of controls. While these compounds afforded excellent control of dollar spot on both the tall fescue and invasive crabgrass, the exacerbation of brown patch poses a serious restriction on their continued use for control of this disease.

CONCLUSION

Brown patch disease is a serious disease of tall fescue in the transition zone and its management is of paramount importance to sports and amenity turfgrass managers alike. Adequate fertility will be an essential part of any disease control program and the work reported here indicates that levels of N slightly greater than previously thought will be necessary to restrict disease development. Excessive or restrictive levels of N will only further weaken the plant or its resistance mechanisms such that disease will worsen. Late postemergent herbicides will similarly exacerbate disease development but only for a short period. This information will be valuable to those managing estate quality tall fescue but serves to indicate the potential for disease development on golf greens where late season herbicide use is necessary. For those who topdress in June, the application of posteemergent herbicides to control contaminating crabgrass may serve to increase disease pressure in a grass already weakened by cultural practices and environmental stress. Carefully timing these operations to immediately follow recent preventative and appropriate fungicide applications should, in most instances, limit further disease progress.

Table 1. Severity of Large Brown Patch Disease as Affected by Fertilizer Rate

Fertilizer	Rate/ 1000/yr	% Disease by Date				
		7/1	7/15	8/1	8/15	9/1
Low	1.5	62.6	58.6	66.7	76.2	74.6
Medium	2.5	42.6	38.7	45.6	32.2	28.7
High	4.0	96.6	94.8	99.9	99.9	89.8
Control	0.0	88.6	92.5	96.6	94.2	88.6

Table 2. Fungicides Mitigate Brown Patch Severity Under Various Fertility Regimes

		% Disease by Date														
		Fertility treatment: Low, Medium, High														
		7/1			7/15			8/1			8/15			9/1		
Fungicide	Rate B /1000	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
Vorlan + Fungo	2+2	42.6	16.6	56.6	31.6	8.6	62.6	28.2	8.0	48.6	36.2	9.2	40.4	26.2	8.0	36.0
Spotless	2	38.8	20.4	60.2	30.2	12.2	60.4	28.2	10.0	52.2	38.8	12.4	50.2	32.6	10.2	42.6
SDS 66518	2	38.8	32.6	66.6	34.3	14.2	76.4	29.0	16.6	60.6	44.4	20.2	58.6	38.0	16.2	46.4
DPX	2	36.6	28.4	52.2	30.2	14.6	72.6	28.2	18.2	54.4	38.6	20.2	48.8	36.6	12.6	42.6
Apache	2	28.8	14.2	44.6	18.6	6.2	52.6	16.6	8.0	32.2	28.0	8.0	34.4	18.2	6.2	22.8
Rhizolex	2	38.8	22.6	62.6	29.6	12.4	66.6	29.2	14.4	56.6	39.0	18.6	48.8	30.1	12.2	36.6
SDS 66333	1	37.6	22.2	60.0	28.8	10.2	72.6	26.6	10.2	50.2	34.4	14.2	48.6	28.0	10.6	38.2
Control	-	62.6	42.6	96.6	58.6	38.7	94.8	66.7	45.6	99.9	76.2	32.2	99.9	74.6	28.7	89.8

Table 3. Postemergent Crabgrass Herbcides Exacerbate Brown Patch Severity

% Brown Patch

		Date					
Herbicide[a]	Rate lb/A	6/18	7/3	7/18	8/4	8/12	8/30[b]
Acclaim	0.18	46.6	66.8	36.6	76.8	22.4	22.6
Prodiamine	1.0	58.8	70.6	32.4	78.8	24.4	28.4
Premier	1.0	48.2	74.4	30.6	76.6	20.6	26.8
TurfCal	2 qt	60.2	80.6	42.2	80.6	36.6	2.4
Prograss	1.0	56.4	79.6	30.8	76.2	22.1	30.2
Daconate[c]	1.0 oz	42.2	56.6	26.6	64.2	18.6	28.8
Control	--	42.4	34.4	32.6	30.2	23.6	24.6

[a] Application dates 7/1 and 8/1.

[b] Crabgrass so severe that brown patch was undetectable, disease rating here for dollar spot on the crabgrass.

[c] Leaf spot disease generally worse on Daconate treated grass, data not presented.

Table 4. Fungicides Mitigate Herbicidal Effects on Brown Patch Severity - Data for 2 dates only[a]

Herbicide	Rate	% Disease, Fungicide Used: 7/3								8/4							
		By	Bn	T	C	--	V	F	D[b]	By	Bn	T	C	--	V	F	D
Acclaim	0.18	72.2	70.4	36.6	32.4	66.8	32.6	28.4	26.2	86.6	88.4	38.6	36.6	76.8	38.6	40.2	38.3
Prodiamine	1.0	70.6	74.4	26.6	32.2	70.6	30.2	30.4	26.4	82.4	80.6	36.6	40.2	78.8	36.6	43.3	36.6
Premier	12.0	68.8	70.2	26.4	30.4	74.4	28.6	29.3	22.4	78.6	82.2	32.3	38.8	76.6	34.4	38.8	28.4
TurfCal	2.0 qt.	86.6	80.1	34.6	36.6	80.6	40.4	36.6	38.8	96.6	97.6	36.6	42.6	80.6	42.6	46.6	26.6
Prograss	1.0	78.8	80.2	30.4	36.4	79.6	28.8	29.4	20.4	86.4	88.8	38.2	36.6	76.2	36.6	35.6	22.4
Daconate	2.0	62.6	60.4	22.6	20.2	56.6	16.6	22.6	26.6	72.4	78.6	28.6	29.8	64.2	28.2	32.2	26.6
Control	--	54.4	56.2	14.6	16.4	34.4	12.2	16.6	10.4	68.6	62.4	22.6	20.4	30.2	26.6	24.4	18.4

[a]Data taken 2 days after herbicide/fungicide application to coincide with maximum disease pressure.

[b]By = Bayleton 0.5 03/1000, Bn = Banner 0.5, T = Tersan 1991 2.0, C = Chipco 26019 2.0, C = Chipco 26019 2.0, -- = Control, V = Vorlan 2.0, F = Fungo 2.0, D = Daconil 2787F 6.0.

LEAFSPOT DISEASES OF TURF AND THEIR CONTROL

Annamarie Pennucci

INTRODUCTION

Leafspot diseases continue to plague both amenity and utility managed turfgrass swards of varying compositions. Typically in the southern midwest, we expect leafspot diseases to occur during the late winter and early spring months. Leafspot diseases are generally more severe on Kentucky bluegrass (*Poa pratensis* L.) yet specific species of *Drechslera* incite disease on each of the other major turfgrasses grown in the United States. In southern Illinois, leafspot and melting out diseases occur on tall fescue (*Festuca arundinacea* Shreb.) from late winter throughout the summer months. While of varying severity, these diseases result in a marked suppression of turf vigor and recuperative potential and result in a concommitant decline in turf appearance. The relative importance of these diseases as midsummer stresses has largely gone unrecognized and few attempts at their control have been reported. As the season of leafspot occurrence overlaps that of one other major disease of tall fescue, namely large brown patch, trials were established at the Horticultural Research Farm at Southern Illinois University to determine the causal agent(s), the season of occurrence, and the relative severity of leafspot diseases on a mixed stand of Kentucky bluegrass and tall fescue. Evaluations of fourteen fungicides for control of these diseases were made simultaneously.

MATERIALS AND METHODS

Trials were established in a roadway subject to heavy vehicle traffic, compaction and severe drought stress. No attempt was made to provide additional water and the area received 1.5 lb. N/1000/year as a split application, one pound in November and one half pound in April. The area was mown at 3 inches once a week in the spring and once every other week in the summer. Fourteen fungicidal treatments were imposed on four replicate 6 x 20' plots on June 1 and repeated on a two week schedule for the remainder of the summer and through the month of September. Identification of causal organisms were made bimonthly from May 1 to October 1. Estimates of disease severity were made concommitantly.

RESULTS

Three organisms were responsible for inciting the leaf spot diseases in the mixed sward. Generally *Drechslera poae* (formerly *Helminthosporium vagans*) caused leafspot and melting out of Kentucky bluegrass in May and June and caused leafspot of tall fescue in May, June, July and September (Table 1). *Bipolaris sorokiniana* incited severe outbreaks of both leafspot and melting out of both grasses in June, July, August and early September. Isolations made in June revealed the presence of Dreschslera dictyoides (formerly Helminthosporium dictyoides) on tall fescue but isolation was infrequent and symptoms of net blotch were never evident. Under these circumstances, it appears that D. dictyoides was relatively unimportant and the majority of disease resulted from D. poae and B. sorokiniana.

The severity of these diseases changed over time. Typically, D. poae was far more severe in early spring and late summer when temperatures ranged from low 70 to high 80, and adequate moisture occurred as rainfall. In the dry summer months, B. sorokiniana was far more severe. Mid-day temperatures averaged low to high 90's and little or no rainfall occurred. Severity was estimated on a scale of 1-10 and is reported in Table 1. It was interesting to note that both organisms occurred on both grasses and time of year was more important than host. Perhaps some of difficulty in controlling "summer" leaf spot diseases of tall fescue have been their mis-identification as D. dictyoidies. Severe epidemics of leafspot incited by B. sorokiniana have been reported on bentgrasses (Agrostis palustris, A. tenuis and A. canina) and annual bluegrass (P. annua) but it has long been suspected of contributing to summer decline of Kentucky bluegrass turf as well.

Fungicides applied to control leafspot diseases were generally far more effective in spring and fall (Table 2). Summer applications resulted in a 50% reduction in leaf spot severity, however, turf appearance and density were still far below expected levels. The compounds used in this test were more effective against D. poae in the cool months than they were against B. sorokiniana in the summer months. It is not possible to determine the importance of wear and drought stress from these trials, although disease pressure was far more severe in the trials than on surrounding turf not subject to these stresses. Fungicide efficacy declined with increasing temperature and increasing stress but most probably reflects a change in causal organisms as well. None of the compounds tested here gave adequate long term control when applied during July and August. Once disease pressure was severe, none of these compounds were effective in reducing disease to acceptable levels. Shortened intervals between applications and alterations between compounds would probably result in improved efficacy.

Partial plots of some fungicides but not all replicates were subject to leakage by an overground irrigation system. Leakage occurred from improper fittings at 20 foot intervals. Water was thus available to partial plots approximately every 4 days in the last two weeks of July and weekly during August. Rapid regrowth of both turf species was evident within one week. Subsequent water availability occasioned a rapid increase in growth rate, an increase in turf density and a rapid loss in disease. New leaves developed only pinpoint lesions in July and continued growth in August and September was nearly completely free of leaf and crown lesions. In those plots treated with both fungicides, and water, regrowth was more rapid and appeared completely disease free. Fungicide treated plots recovered density at nearly twice the rate of control plots with additional water and in all instances, the provision of additional water improved turf density and appearance months before those matching plots subject to continued drought stress (Table 3). The relative importance of proper water management as a leafspot disease control strategy cannot be underestimated. Fungicide efficacy will be greatly improved in those turfs receiving adequate moisture and a reevaluation of disease development needs to be made in both drought stressed and properly irrigated turfs. At this writing, leafspot diseases rank as a severe problem in bluegrass/tall fescue swards and the fungicides currently available are inadequate when applied on fourteen day intervals after disease pressure is evident. Preventative applications of appropriate contact fungicides accompanied by adequate water offer the turf manager an alternative method of leafspot disease control.

Table 1. Causal Organisms of Leafspot Diseases Isolated from a Mixed Kentucky Bluegrass/Tall Fescue Sward.

Season	Organism Turfgrass Host	
	Kentucky Bluegrass	Tall Fescue
early May	D. poae	D. poae
mid May	D. poae	D. poae
early June	D. poae	D. poae
mid June	D. poae & B. sorokiniana	D. poae & D. dictyoides
early July	B. sorokiniana & D. poae	B. sorokiniana
mid July	B. sorokiniana	B. sorokiniana
early August	B. sorokiniana	B. sorokiniana
mid August	B. sorokiniana	B. sorokiniana
early September	B. sorokiniana	B. sorokiniana
mid September	B. sorokiniana & D. poae	B. sorokiniana & D. poae & D. dictyoides
early October	B. sorokiniana & D. poae	B. sorokiniana & D. poae

Table 2

Efficacy of various fungicides applied to control leaf spot diseases in a mixed Kentucky bluegrass/tall fescue sward subject to drought and wear-stress.

		Date									
		Visual Estimate of Disease[a)]									
Fungicide	Rate oz/1000	6/1	6/15	6/27	7/13	7/27	8/10	8/24	9/7	9/21	10/5
Daconil	6.0	3.6	4.2	6.0	7.6	8.0	8.4	8.6	6.0	4.8	3.6
Dyrene	4.0	3.8	4.6	6.0	7.8	8.0	8.6	8.6	6.0	5.0	3.8
Chipco 26019	2.0	4.2	5.0	6.8	7.9	8.6	8.6	9.0	6.0	5.2	4.0
Vorlan	2.0	4.0	4.2	6.0	7.8	8.4	8.6	8.8	6.0	5.0	4.0
Apache	2.0	6.0	6.0	7.0	8.0	9.0	9.2	9.6	7.2	6.0	5.4
Terraclor	1.0	4.2	4.0	6.0	7.6	8.2	8.9	8.8	6.6	5.4	3.6
Spotless	2.0	5.5	5.6	7.2	7.8	8.6	9.0	9.0	7.0	6.2	5.0
DPX	1.0	7.0	6.9	7.2	8.2	9.2	9.4	9.0	7.4	6.2	5.2
SDS 66533	2.0	6.6	6.8	7.0	8.0	8.8	9.0	9.0	7.6	6.0	5.0
Rubigan[b)]	1.0	8.0	8.6	9.0	9.6	10.0	10.0	10.0	10.0	9.2	7.9
Bayleton	1.0	8.2	8.6	9.0	9.6	10.0	10.0	10.0	10.0	9.0	7.8
Tersan 1991	2.0	6.5	6.0	6.6	7.4	8.6	9.2	9.0	6.2	6.0	4.0
Duosan	4.0	6.2	6.6	6.0	7.8	9.0	9.6	9.2	6.4	5.9	4.2
Control	-	7.0	8.2	9.5	10.0	10.0	10.0	9.5	9.5	8.5	7.5

a) On a scale of 1-10, with 10 being 100% of leaves showing one or more lesions.

b) Leaves in plots treated with the systemics frequently had many more than one lesion per leaf and were subject to severe and prolonged melting out.

a) Disease rated on scale of 1-10, where 10 = 100% of leaves with 1 or more lesions, abbreviated D_I.

Color rated on scale of 1-10, where 1 = green and 10 = dark green, abbreviated C.

Density rated on scale of 1-10, where 1 = barren and 10 = dense, lush canopy, abbreviated D.

b) water first available during July 27-31, 1987.

c) No attempt was made to estimate water volume, data taken only from those replicates receiving water.

Table 3

Fungicide efficacy as affected by supplemental water available to a mixed Kentucky bluegrass/tall fescue sward.

Fungicide	Date: Visual Estimates of Disease, Color and Density[a)] 8/27[b)] DI	C	D	8/10 DI	C	D	9/24 DI	C	D	9/7 DI	C	D	9/11 DI	C	D	10/5 DI	C	D
Daconil	8.0	2.0	2.2	8.4	2.0	2.0	8.6	1.6	1.6	6.0	5.6	5.4	4.8	6.6	6.2	3.6	6.8	6.6
Daconil & water [c)]	-	-	-	2.0	8.0	8.4	1.6	8.6	8.8	0.0	9.2	9.0	0.0	9.6	9.4	0.0	10.0	9.6
Dyrene	8.0	2.0	2.0	8.6	2.0	2.0	8.6	1.6	1.6	6.0	5.2	5.4	6.0	6.6	6.0	3.8	6.8	6.4
Dyrene & water	-	-	-	2.0	8.0	8.0	1.6	8.6	8.6	0.0	9.0	9.0	0.0	9.6	9.4	0.0	9.6	9.4
Chipco 26019	8.6	2.0	2.0	8.6	2.0	2.0	9.0	1.6	1.6	6.0	5.0	5.0	5.2	5.8	6.8	4.0	6.0	6.0
Chipco & water	-	-	-	2.6	8.0	8.0	2.0	8.2	8.6	0.0	9.0	9.2	0.0	9.6	9.4	0.0	9.6	9.4
Vorlan	8.4	2.2	2.2	8.6	2.0	2.0	4.8	1.6	1.6	6.0	5.0	5.0	5.0	6.0	6.0	4.0	6.2	6.2
Vorlan & water	-	-	-	2.0	8.0	8.0	1.8	8.4	8.2	0.0	9.2	9.2	0.0	10.0	9.8	0.0	10.0	9.8
Apache	9.0	1.8	2.0	9.2	1.6	2.0	9.6	1.5	1.5	7.2	4.0	4.0	6.0	5.6	5.6	5.4	6.0	6.0
Apache & water	-	-	-	2.6	7.6	7.6	2.4	8.0	8.4	1.0	8.6	8.6	0.0	9.0	9.0	0.0	9.4	9.2
Terraclor	8.2	2.4	2.0	8.9	2.0	2.0	8.8	1.6	1.6	6.6	5.5	5.0	5.4	6.0	5.6	3.6	6.2	6.0
Terraclor & water	-	-	-	2.0	7.4	7.8	2.0	9.0	7.8	0.0	8.6	8.4	0.0	9.0	8.6	0.0	9.4	9.0
Spotless	8.6	2.0	2.2	9.0	1.8	1.8	9.0	1.4	1.4	7.0	4.0	4.2	6.2	5.8	5.2	5.0	6.2	6.0
Spotless & water	-	-	-	3.0	7.6	7.8	2.0	8.2	7.9	1.0	8.6	8.6	0.0	9.0	9.0	0.0	9.2	9.2
DPX	9.2	1.8	2.0	9.4	1.8	1.8	9.0	1.4	1.4	7.4	3.4	3.2	6.2	5.6	5.6	5.2	6.0	6.0
DPX & water	-	-	-	3.0	7.6	7.2	2.0	8.2	8.0	4.0	8.6	8.8	0.0	9.0	8.6	0.0	9.2	9.0
SDS 66533	8.8	1.8	2.0	9.0	1.6	1.6	9.0	1.6	1.5	7.6	3.0	3.2	6.0	6.4	5.6	5.0	6.0	6.0
SDS & water	-	-	-	3.0	7.8	7.4	2.0	8.2	8.0	0.8	8.5	8.8	0.0	9.0	9.2	0.0	9.4	9.4
Rubigan	10.0	0.8	0.8	10.0	0.5	0.5	10.0	0.5	0.5	10.0	0.5	0.5	9.2	2.0	1.6	7.9	4.0	3.6
Rubigan & water	-	-	-	7.6	3.0	3.6	3.2	4.9	5.2	1.6	7.6	2.4	1.0	8.0	7.6	1.0	8.0	7.6
Bayleton	10.0	0.8	1.0	10.0	0.5	0.5	10.0	0.5	0.5	10.0	0.5	0.5	9.0	2.0	2.0	7.8	4.2	3.6
Bayleton & water	-	-	-	2.8	3.0	3.8	3.1	5.0	5.2	1.5	7.6	7.6	1.0	8.2	7.6	1.0	8.0	7.5
Tersan 1991	8.6	2.0	2.0	9.2	1.6	1.6	9.0	1.6	1.6	6.2	3.6	3.6	6.0	6.0	5.6	4.0	6.4	6.4
Tersan & water	-	-	-	3.0	7.6	7.4	2.0	8.2	8.0	0.0	8.6	9.0	0.0	9.0	9.6	0.0	9.0	9.6
Duosan	9.0	2.0	2.0	9.6	1.6	1.6	9.2	1.6	1.6	6.4	3.0	3.0	5.9	6.0	5.4	4.2	6.6	6.0
Duosan & water	-	-	-	2.6	7.8	7.8	1.6	8.2	8.1	0.6	8.6	8.2	0.0	9.0	9.0	0.0	9.0	9.2
Control	10.0	1.0	1.0	10.0	0.6	0.6	9.5	0.5	0.5	9.5	1.0	1.0	8.6	3.6	2.5	2.5	5.6	5.8
Control & water	-	-	-	4.8	6.0	6.0	3.2	7.6	7.1	3.4	7.0	7.0	4.0	7.4	7.3	3.6	7.4	7.0

CONTROL OF LARGE BROWN PATCH IN TALL FESCUE

Annamarie Pennucci

INTRODUCTION

The control of large brown patch, incited by Rhizoctonia solani, is of prime importance of turfgrass managers in the Midwest. The disease occurs on all major turfgrasses in the transition zone, although its importance to zoysia and bermudagrass have not been eluciated. On bentgrass, bluegrass and tall fescue the disease is of critical importance. Control measures are generally ineffective or of short duration. Frequent chemical applications result in high budgets and the potential for excess compaction and chemical loss from the turf surface. The search continues for appropriate fungicides as well as proper timing for cultural practices such as nitrogen fertilizers, potassium fertilizers and herbicide use. Trials were established as the Horticultural Research Center at Southern Illinois University to test new and experimental fungicides for their efficacy in controlling this disease.

MATERIALS AND METHODS

A mixed stand of tall fescue (Festuca arundinacea) and Kentucky bluegrass (Poa pratensis), mown at 2.5 inches weekly, was treated with fungicides in a split block design. The area received its first fungicide treatments on June 13, with repeat treatments made every 14 days. On June 18, approximately 5 pounds of infected tall fescue clippings, derived from another site, were spread evenly across each of the 6x10 foot plots. The clippings were irrigated lightly twice a day for a week, and the inoculation was repeated monthly to insure adequate infection. Beginning July 1, the split blocks were treated with standard preventative controls, Daconil and Dyrene. All fungicides were applied in 2 gallons of water per 1000 square feet with a CO_2 backpack sprayer delivering 60 psi.

RESULTS

Successful inoculation with infected clippings insured moderate to severe disease pressure in all the plots. In untreated control plots, pressure ranged from 44 to 79% with the tall fescue more prone to disease than the Kentucky bluegrass or invasive crabgrass (Table 1). The inclusion of Daconil or Dyrene sharply limited disease in all plots and midsummer disease pressure averaged 15%. Of the experimental fungicides tested here, Apache (MF 654) and SDS 720 compared very favorably with the older industry standard Thiramad. Two newer compounds, Rhizolex and Spotless were also quite effective in limiting disease progress although they could not prevent initial infection. The systemics, KWG 0519 and SDS 63539 were unable to adequately contain this diseases and levels were unacceptably high. The Pythium control agents, Koban, Banol and Alliette, were ineffective in controlling this non-target disease, however, percent plot infection was only half that of untreated controls, indicating the activity of one or more asymptomatic or "hidden" organisms. The Pythium season overlaps that of brown patch in the transition zone and the multiplicity of Pythium causal organisms suggests the likelihood of its contribution to disease in some form.

The inclusion of the standard preventative fungicides greatly improved the control rendered by these fungicides. With Daconil or Dyrene present in the plot (not a true tank-mix) control averaged 90% or better for Apache, either SDS compound, Rhizolex, Spotless and Thiramad. The inclusion of these standard materials greatly improved the control rendered by the new systemic KWG and by the Pythium fungicides. Generally the disease pressure in these plots exceeded 12% during the midsummer with levels as high as 18% common. These combinations were more effective early or late in the season while the control seen in August was generally unacceptable. The most consistent control was seen with either Daconil or Dyrene plus Apache, SDS 720, Spotless or Thiramad. The importance of very early preventative applications cannot be determined from these trials but it appears that an initial treatment date of June 13 may well follow early infection and the first cycle of disease. Applications of these compounds may need to be made in May or even earlier to afford greater and more consistent control of large brown patch.

Table 1. Control of Large Brown Patch Disease In Tall Fescue

		% Disease by Date														
		7/1			7/15			8/1			8/15			9/1		
Fungicide	Rate/ 1000	D_1	D_2	--	D_1	D_2	--	D_1	D_2	--	D_1	D_2	--	D_1	D_2	--
Apache	2	3.0	3.2	16.6	3.6	4.0	10.2	4.5	5.0	18.8	6.6	8.0	10.2	3.2	4.0	8.2
SDS 63539	1	6.6	6.6	22.2	7.6	8.0	20.6	12.2	10.9	22.6	14.6	14.0	16.6	8.6	9.4	10.6
SDS 720	1	3.2	4.0	10.2	4.0	5.1	12.2	6.2	6.6	16.9	8.0	8.6	14.4	5.0	6.0	12.6
Rhizolex	2	3.0	3.8	14.4	4.6	5.2	16.6	8.2	8.6	20.2	10.6	12.0	18.8	4.0	4.6	16.2
Koban	2	6.6	7.0	32.2	8.8	9.0	36.2	14.6	13.8	38.8	16.6	18.0	30.2	8.0	9.2	26.6
Banol	2	6.6	6.0	30.2	9.0	8.8	30.2	13.6	14.2	36.6	16.0	17.0	28.6	9.6	8.7	22.4
Alliette	2	6.8	6.2	26.6	8.6	8.8	30.6	12.8	14.0	38.0	18.2	12.6	26.4	9.0	8.0	24.4
Spotless	2	3.2	3.8	16.2	4.2	4.6	10.6	5.0	5.6	14.6	6.6	8.0	10.9	3.0	3.6	9.6
Thiramad	2	2.4	3.0	8.6	3.0	3.0	4.9	4.2	5.0	8.8	4.6	5.0	6.7	2.8	3.0	4.5
KWG 0519	1	6.6	7.2	36.2	8.9	9.6	32.2	18.6	14.6	36.6	18.8	18.0	26.6	9.8	10.0	22.8
Control	--	12.2	12.8	44.6	14.2	16.0	59.6	12.2	10.6	68.2	12.2	10.8	78.8	6.8	7.2	62.3

WEATHER DATA FOR URBANA, ILLINOIS 1987

	AIR TEMPERATURE		SOIL TEMPERATURE GRASS		SOIL TEMPERATURE SOIL		PRECIPITATION	RELATIVE HUMIDITY		DEW
	MAX	MIN	MAX	MIN	MAX	MIN	(INCHES)	MAX	MIN	
01MAR87	54	35	42	38	42	38	0.48	100	84	
02MAR87	38	28	39	37	40	36	0	95	75	
03MAR87	53	30	42	38	44	36	0	100	46	
04MAR87	48	27	42	38	44	36	0	100	32	LIGHT
05MAR87	52	35	41	38	43	36	0	100	36	
06MAR87	62	32	42	40	48	38	0	100	40	
07MAR87	70	33	47	41	54	40	0	100	30	
08MAR87	75	42	50	46	56	45	0	100	26	
09MAR87	73	36	51	46	57	46	0	100	28	
10MAR87	37	18	46	40	47	38	0	95	45	
11MAR87	37	14	39	37	38	38	0	100	30	LIGHT
12MAR87	39	19	39	37	40	35	0	100	30	
13MAR87	48	30	41	38	44	35	0	88	32	
14MAR87	57	47	48	46	47	40	0	82	36	
15MAR87	64	34	46	43	50	43	0.05	100	36	
16MAR87	45	33	45	43	45	39	0.25	100	80	
17MAR87	52	28	44	40	44	38	0	80	36	
18MAR87	55	34	43	42	45	38	0	100	42	
19MAR87	48	40	44	43	46	42	0.25	100	45	
20MAR87	59	38	44	42	47	40	0	100	60	
21MAR87	62	29	45	42	48	40	0	100	30	
22MAR87	65	40	47	42	48	40	0.02	100	45	
23MAR87	67	42	50	47	56	42	0	82	26	
24MAR87	74	50	51	48	57	45	0	62	24	
25MAR87	60	40	50	48	51	46	0.25	100	62	
26MAR87	48	38	49	46	47	45	0.04	100	80	
27MAR87	46	41	47	46	45	43	0.06	100	100	
28MAR87	55	40	49	47	50	45	0.01	100	76	
29MAR87	62	50	51	47	52	44	0	100	56	
30MAR87	51	24	51	44	43	40	0.08	100	74	
31MAR87	35	20	45	40	41	36	0	92	44	
TOTAL							1.49			
AVERAGE	54.5	33.8	45.5	42.3	47.1	40.1		96	47.9	
ACCUMULATIVE TOTAL							4.29			

WEATHER DATA FOR URBANA, ILLINOIS 1987

DATE	AIR TEMPERATURE MAX	AIR TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	SOIL TEMPERATURE GRASS MIN	SOIL TEMPERATURE SOIL MAX	SOIL TEMPERATURE SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01APR87	42	37	42	40	42	35	0	78	34	
02APR87	55	26	42	40	42	36	0.13	100	52	
03APR87	39	22	41	38	39	35	0	100	40	
04APR87	46	23	42	39	42	36	0	100	32	
05APR87	51	33	43	38	45	38	0	80	28	
06APR87	57	38	42	41	48	39	0	100	50	
07APR87	60	40	46	45	48	44	0.03	84	48	
08APR87	71	39	50	45	57	44	0	80	18	
09APR87	67	30	51	45	58	47	0	100	19	MODERATE
10APR87	71	39	54	47	62	47	0	48	16	
11APR87	73	38	51	48	57	49	0.47	100	28	
12APR87	60	33	50	47	57	43	0.14	100	68	
13APR87	65	42	50	47	56	44	0	100	50	
14APR87	60	54	55	54	57	52	0.5	100	75	
15APR87	63	44	54	51	57	49	0.42	100	86	
16APR87	54	48	53	52	51	49	0.25	100	100	
17APR87	60	45	53	51	54	49	0	100	100	MODERATE
18APR87	67	46	60	53	64	50	0	100	62	
19APR87	74	55	60	54	67	53	0	100	46	
20APR87	79	55	63	57	72	56	0	100	42	
21APR87	85	59	64	58	75	59	0	100	32	
22APR87	87	48	65	59	76	61	0.28	100	36	
23APR87	68	45	61	56	62	53	0.04	100	100 —	
24APR87	58	45	57	55	56	52	0.16	100	72	LIGHT
25APR87	63	38	57	53	58	49	0	100	30	
26APR87	66	46	59	54	64	49	0	100	28	LIGHT
27APR87	74	50	61	56	69	55	0.39	100	32	
28APR87	70	38	61	56	64	52	0	100	26	LIGHT
29APR87	68	52	60	56	68	52	0	68	28	
30APR87	88	44	61	57	71	56	0	56	28	
TOTAL							2.81			
AVERAGE	64.7	41.7	53.6	49.7	57.9	47.8		93.1	46.9	
ACCUMULATIVE TOTAL							7.1			

WEATHER DATA FOR URBANA, ILLINOIS 1987

	AIR TEMPERATURE		SOIL TEMPERATURE							
			GRASS		SOIL		PRECIPITATION	RELATIVE HUMIDITY		DEW
DATE	MAX	MIN	MAX	MIN	MAX	MIN	(INCHES)	MAX	MIN	
01MAY87	42	37	42	40	42	35	0	78	34	
02MAY87	74	51	64	58	68	55	0	95	40	
03MAY87	85	55	64	60	73	62	0	100	30	LIGHT
04MAY87	78	53	64	60	73	62	0	100	47	
05MAY87	68	39	60	55	68	52	0	92	32	
06MAY87	70	46	60	56	80	56	0	82	32	
07MAY87	77	40	65	56	80	55	0	80	25	
08MAY87	76	48	62	58	72	69	0	100	30	
09MAY87	75	48	66	60	79	63	0	100	25	
10MAY87	83	54	62	58	74	61	0	100	34	
11MAY87	85	58	64	60	75	65	0	100	40	
12MAY87	87	52	65	61	75	65	0.51	100	44	
13MAY87	72	48	65	60	71	60	0	100	36	
14MAY87	82	52	66	60	72	61	0	90	50	
15MAY87	86	56	70	65	78	63	0.02	90	35	
16MAY87	77	51	67	62	76	65	0	96	24	
17MAY87	85	56	69	62	80	65	0	90	24	
18MAY87	89	64	69	65	79	70	1.52	100	54	
19MAY87	80	67	70	68	75	70	0.07	100	84	MODERATE
20MAY87	88	69	75	59	80	70	0	100	56	
21MAY87	90	65	76	72	83	72	0.1	100	64	
22MAY87	90	62	77	71	83	71	0	100	40	
23MAY87	76	52	72	67	82	69	0	100	60	
24MAY87	69	46	71	65	81	67	0	100	56	
25MAY87	77	60	70	65	81	67	0.34	100	38	
26MAY87	81	64	70	66	75	68	0.04	100	64	MODERATE
27MAY87	88	67	74	69	82	69	0	100	44	
28MAY87	90	65	74	70	85	72	0	100	36	
29MAY87	90	67	.	.	85	73	0	73	38	
30MAY87	91	68	73	70	85	73	0	100	65	
31MAY87	84	66	73	71	80	72	0.57	100	64	MODERATE
TOTAL							3.17			
AVERAGE	80.2	55.7	67.3	62.3	76.5	64.4		95.7	43.4	
ACCUMULATIVE TOTAL							10.27			

WEATHER DATA FOR URBANA, ILLINOIS 1987

DATE	AIR TEMPERATURE MAX	AIR TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	SOIL TEMPERATURE GRASS MIN	SOIL TEMPERATURE SOIL MAX	SOIL TEMPERATURE SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01JUN87	85	65	75	71	78	72	0.01	100	58	
02JUN87	81	67	76	72	80	71	0.25	90	55	
03JUN87	82	59	78	73	80	67	0.5	100	60	
04JUN87	78	56	74	70	76	65	0	100	28	
05JUN87	75	53	73	68	80	65	0	100	36	LIGHT
06JUN87	84	57	73	70	83	72	0	90	35	
07JUN87	84	58	73	69	84	73	0	100	36	
08JUN87	88	67	80	70	83	68	0	95	35	
09JUN87	90	62	75	70	86	63	0	100	46	
10JUN87	72	52	73	62	80	69	0	100	46	
11JUN87	78	61	71	65	80	69	0	86	36	
12JUN87	86	72	71	68	79	70	0	100	48	
13JUN87	92	65	76	70	85	74	0	100	36	
14JUN87	94	65	77	73	85	75	0.01	100	44	LIGHT
15JUN87	100	70	79	73	89	77	0	100	40	
16JUN87	93	62	83	72	92	76	0	95	50	
17JUN87	90	68	80	74	90	76	0	100	46	
18JUN87	92	68	81	75	91	79	0	100	40	
19JUN87	93	66	85	78	90	73	0	95	38	
20JUN87	83	70	81	77	84	74	0.1	100	55	
21JUN87	86	70	81	78	84	76	0.35	95	60	
22JUN87	85	69	82	78	84	75	0.1	100	55	
23JUN87	84	70	87	76	88	75	0	100	42	–
24JUN87	84	64	80	77	82	72	0	90	50	
25JUN87	88	65	86	73	90	72	0	95	45	
26JUN87	84	63	84	77	86	78	0	100	45	
27JUN87	84	60	84	67	87	66	0	85	28	
28JUN87	78	54	77	70	81	70	0	100	32	
29JUN87	83	64	77	70	84	70	0.02	100	36	
30JUN87	89	68	81	79	84	77	0.25	95	45	
TOTAL							1.59			
AVERAGE	85.5	63.7	78.4	72.2	84.2	72		97	43.5	

ACCUMULATIVE TOTAL 11.86

WEATHER DATA FOR URBANA, ILLINOIS 1987

	AIR TEMPERATURE		SOIL TEMPERATURE							
			GRASS		SOIL		PRECIPITATION	RELATIVE HUMIDITY		DEW
DATE	MAX	MIN	MAX	MIN	MAX	MIN	(INCHES)	MAX	MIN	
01JUL87	75	65	76	74	74	71	0.56	100	100	
02JUL87	76	63	76	72	72	68	0	100	86	
03JUL87	82	62	78	72	82	71	0	100	60	
04JUL87	86	66	78	72	77	68	0	100	66	
05JUL87	87	66	80	76	85	76	0	100	60	
06JUL87	80	68	78	76	76	73	0.21	100	96	
07JUL87	86	65	78	72	80	74	0.07	100	60	
08JUL87	86	65	80	76	81	77	0.02	100	74	MODERATE
09JUL87	85	67	79	76	80	72	0.05	100	82	
10JUL87	82	68	79	77	79	74	0.37	100	74	MODERATE
11JUL87	89	71	83	78	85	75	0	95	55	
12JUL87	90	74	82	79	87	75	0	100	76	
13JUL87	90	65	83	80	88	74	0.05	95	55	
14JUL87	75	62	80	75	76	69	0.08	100	66	MODERATE
15JUL87	77	61	79	74	81	69	0.05	100	40	
16JUL87	77	56	76	72	75	66	0.23	100	56	
17JUL87	79	62	77	72	82	66	0	.	.	
18JUL87	88	71	83	74	90	71	0	100	54	
19JUL87	89	71	81	77	89	76	0	100	50	LIGHT
20JUL87	90	70	82	79	89	80	0	100	66	
21JUL87	90	66	83	78	91	80	0	100	58	
22JUL87	92	66	85	77	92	80	0	100	40	
23JUL87	90	67	85	79	92	80	0	100	48	
24JUL87	92	69	.	.	92	79	0	100	54	
25JUL87	90	70	85	80	91	81	0	100	62	
26JUL87	92	72	87	81	93	84	0	100	60	
27JUL87	94	66	86	79	91	77	0.32	100	66	
28JUL87	94	68	81	78	81	75	0.43	100	60	
29JUL87	92	70	82	78	84	75	0	95	65	
30JUL87	90	70	88	75	88	74	1	90	60	
31JUL87	91	68	87	76	85	78	4.48	100	60	
TOTAL							7.92			
AVERAGE	86.3	66.8	81.2	76.1	84.1	74.5		99.2	63.6	

ACCUMULATIVE TOTAL 19.78

WEATHER DATA FOR URBANA, ILLINOIS 1987

	AIR TEMPERATURE		SOIL TEMPERATURE							
			GRASS		SOIL		PRECIPITATION	RELATIVE HUMIDITY		DEW
DATE	MAX	MIN	MAX	MIN	MAX	MIN	(INCHES)	MAX	MIN	
01AUG87	89	71	80	79	81	77	0.36	100	86	LIGHT
02AUG87	94	74	85	80	87	80	0	100	64	MODERATE
03AUG87	95	75	85	81	90	81	0	100	82	
04AUG87	93	72	87	81	96	81	0.03	100	60	
05AUG87	84	61	84	77	84	75	0	100	66	
06AUG87	83	62	83	75	84	72	0	95	50	
07AUG87	85	64	83	77	91	74	0	100	46	
08AUG87	89	68	84	76	87	74	0	96	46	
09AUG87	86	70	84	77	86	74	0.5	100	60	
10AUG87	83	61	83	75	84	71	0	90	50	
11AUG87	82	63	81	77	81	72	0	100	64	
12AUG87	82	63	81	71	94	65	0	100	52	
13AUG87	85	66	81	77	89	75	0	100	50	
14AUG87	90	74	82	77	88	76	0	100	70	
15AUG87	87	70	80	78	83	78	0.09	100	78	
16AUG87	88	70	81	78	85	79	0	100	78	LIGHT
17AUG87	94	72	81	78	85	79	0	95	50	
18AUG87	86	62	83	77	85	73	0	100	36	
19AUG87	85	62	80	76	84	73	0	100	36	
20AUG87	85	64	81	75	87	73	0	100	75	
21AUG87	88	66	81	76	87	75	0.18	100	46	
22AUG87	90	65	79	77	81	76	0.52	100	60	
23AUG87	80	56	78	73	78	69	0	100	64	– MODERATE
24AUG87	75	50	78	72	82	68	0	100	36	
25AUG87	72	49	75	55	75	72	0	100	40	MODERATE
26AUG87	67	57	72	69	70	65	0.6	100	96	
27AUG87	89	62	74	69	74	70	2.32	100	82	MODERATE
28AUG87	68	61	74	71	71	67	0.08	100	90	
29AUG87	77	52	70	70	72	65	0	100	60	LIGHT
30AUG87	80	54	74	70	76	75	0	100	40	MODERATE
31AUG87	83	60	73	70	78	67	0.11	100	38	
TOTAL							4.79			
AVERAGE	84.3	63.7	79.9	74.6	83.1	73.3		99.2	59.7	
ACCUMULATIVE TOTAL							24.57			

WEATHER DATA FOR URBANA, ILLINOIS 1987

DATE	AIR TEMPERATURE MAX	AIR TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	SOIL TEMPERATURE GRASS MIN	SOIL TEMPERATURE SOIL MAX	SOIL TEMPERATURE SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01SEP87	75	50	73	68	77	64	0	.	.	
02SEP87	76	52	73	68	78	63	0	100	30	
03SEP87	75	50	73	66	77	64	0	100	56	
04SEP87	78	54	72	67	79	65	0	100	34	
05SEP87	88	55	73	68	81	67	0	100	32	
06SEP87	89	59	74	70	81	70	0	100	37	
07SEP87	89	59	75	71	81	72	0	100	34	
08SEP87	85	65	74	72	79	73	0.03	100	56	
09SEP87	81	60	75	71	79	70	0.01	100	56	
10SEP87	81	59	75	70	79	67	0	100	42	
11SEP87	87	56	70	64	73	65	0	94	34	
12SEP87	83	57	70	64	73	64	0	95	40	
13SEP87	84	50	75	70	82	70	0	100	36	LIGHT
14SEP87	82	57	74	70	80	71	0	100	34	
15SEP87	88	58	76	72	83	71	0.04	100	34	
16SEP87	78	64	73	71	74	71	0.56	100	34	
17SEP87	80	62	73	71	74	70	0.35	100	76	
18SEP87	77	61	73	70	72	67	0.02	100	64	
19SEP87	74	53	73	68	70	63	0	100	62	
20SEP87	75	51	70	66	73	63	0	100	28	LIGHT
21SEP87	68	48	68	63	69	60	0.04	100	52	
22SEP87	68	48	67	64	68	60	0	100	56	
23SEP87	67	49	66	63	67	59	0	100	56 -	
24SEP87	74	48	68	62	73	60	0	100	38	
25SEP87	82	48	65	61	72	55	0	95	30	
26SEP87	73	45	66	61	73	60	0	100	35	
27SEP87	84	47	67	60	75	60	0	100	35	
28SEP87	85	58	70	62	76	61	0	100	24	
29SEP87	84	58	69	66	73	66	1	100	44	
30SEP87	70	49	69	65	69	60	0	100	60	
TOTAL							2.05			
AVERAGE	79.3	54.3	71.3	66.8	75.3	65		99.4	43.1	

ACCUMULATIVE TOTAL 26.62

WEATHER DATA FOR URBANA, ILLINOIS 1987

DATE	AIR TEMPERATURE MAX	AIR TEMPERATURE MIN	SOIL TEMPERATURE GRASS MAX	GRASS MIN	SOIL MAX	SOIL MIN	PRECIPITATION (INCHES)	RELATIVE HUMIDITY MAX	RELATIVE HUMIDITY MIN	DEW
01OCT87	71	36	66	60	64	53	0	100	28	MODERATE
02OCT87	71	37	62	60	65	53	0	100	28	
03OCT87	57	33	62	53	58	50	0	100	26	
04OCT87	58	31	58	53	60	50	0	100	30	MODERATE
05OCT87	66	44	62	51	58	53	0	86	26	
06OCT87	64	31	58	53	57	53	0	100	26	
07OCT87	64	40	57	54	55	51	0.02	100	68	
08OCT87	49	27	55	50	51	41	0	95	58	
09OCT87	60	48	56	50	58	56	0	100	26	
10OCT87	63	40	56	53	59	50	0	90	40	
11OCT87	48	31	54	51	55	44	0.05	100	65	
12OCT87	51	25	55	49	56	43	0	100	34	HEAVY
13OCT87	57	31	54	50	55	45	0	95	35	
14OCT87	62	33	55	50	58	46	0	100	32	
15OCT87	70	34	56	51	58	48	0	100	34	
16OCT87	74	42	59	53	63	53	0	100	34	
17OCT87	76	34	59	54	62	53	0.11	100	34	
18OCT87	65	33	57	52	55	47	0	100	50	
19OCT87	68	42	57	53	59	51	0	100	36	
20OCT87	57	39	54	53	53	49	0.57	100	84	
21OCT87	56	27	55	48	55	52	0.02	100	50	
22OCT87	47	27	50	46	47	41	0	100	60	
23OCT87	55	31	50	45	52	42	0	95	35 –	
24OCT87	54	43	48	47	54	43	0.3	100	38	MODERATE
25OCT87	52	32	53	48	50	43	0.02	100	64	
26OCT87	53	38	52	48	51	45	0	100	52	
27OCT87	58	36	51	48	48	44	0.03	100	52	MODERATE
28OCT87	57	32	52	47	51	41	0	100	36	HEAVY
29OCT87	50	33	49	46	50	44	0	90	45	
30OCT87	54	35	50	47	49	43	0	100	36	
31OCT87	77	34	53	48	56	53	0	100	36	
TOTAL							1.12			
AVERAGE	60.1	34.8	55.3	50.7	55.5	47.7		98.4	41.9	

ACCUMULATIVE TOTAL 27.74

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