1980 TURFGRASS RESEARCH SUMMARY

UNIVERSITY OF ILLINOIS

AT URBANA-CHAMPAIGN

(NOT FOR PUBLICATION)

1980 TURFGRASS RESEARCH SUMMARY

This booklet presents the results for 1980 of experiments being conducted in turfgrass management at the University of Illinois. The format of the book has been changed from previous years to include statistical analysis of the research data. The use of statistical analysis allows us to make accurate interpretation of our data and thus, better recommendations. The change in format delayed the publications of the results. We hope this has not inconvenienced anyone.

The weather in Urbana for 1980 was characterized by high temperature and low rainfall. This resulted in generally lower turfgrass quality despite the use of irrigation. The results of the experiments should be judged with the weather conditions in mind.

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

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TABLE OF CONTENTS

KENTUCKY BLUEGRASS BLEND EVALUATION

J. E. Haley and D. J. Wehner

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

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

Adelphi	Touchdown-Adelphi
Majestic	Majestic-Brunswick
Merion	Merion-Brunswick
Ram #1	Merion-Majestic
Brunswick	Baron-Majestic
Baron	Baron-Brunswick
Touchdown	Experimental Varieties:
Columbia	
Majestic-Touchdown	BFC-46-1 P-15 28-T
Brunswick-Adelphi	BFB-35-1

Plots were established August 24, 1978 and are 5 ft x 6 ft with each cultivar or blend replicated 3 times. The turf is mowed 2-3 times per week at 1.5 inches. Fertilizer is applied 4 times per year in 1 lb N/1000 sq ft increments. Plots are irrigated as needed to prevent wilt.

Due to a large Poa annua infestation after seeding and an extremely dry spring and summer in 1979, the plots did not become well established until the following year. The plots were rated for the first time in April of 1980.

In April of 1980, most plots were of average quality. (Table 1) Majestic and Brunswick exhibited the best quality. By early summer, all plots had improved quality. Majestic, Adelphi, Columbia-Touchdown, and the experimental cultivar P-15-28-T exhibited generally good quality throughout the season. Majestic-Adelphi and Majestic showed excellent resistance to dollar spot. Merion, Baron, and Ram #1 maintained good quality until early August when quality was seriously reduced by dollar spot infection (<u>Sclerotinia homoeocarpa</u>). In early October several cultivars and blends showed a susceptibility to rust (<u>Puccinia sp</u>). These include Touchdown, Merion, BFC-46-1, Merion-Majestic, Majestic-Touchdown, Merion-Brunswick. It is expected that all plots will be well-established by Spring of 1981 and varietal differences will be more clearly defined.

Table 1. Kentucky bluegrass blend evaluation.

Cultivar	Quality[1] ($\bar{X}$) 4/6	5/30	6/26	8/6	10/3	11/07	Average over all dates	Dollar Spot[2] 8/6	Rust[2] 10/1
Adelphi	5.7 bcdef[3]	7.0 abcd	7.0[4]	6.8 abc	7.3 a	7.2 a	7.1 ab	7.3 abcde	8.3 abc
Majestic	6.8 a	7.0 abcd	6.8	7.3 a	6.7 ab	6.8 ab	6.9 abc	8.3 ab	7.0 cd
Merion	4.3 h	7.0 abcd	6.8	5.2 de	6.2 b	5.8 b	6.2 e	5.5 ef	5.2 e
Ram 1	5.8 bcde	7.0 abcd	6.8	4.7 e	6.3 ab	7.2 a	6.4 cde	4.8 f	8.8 a
Brunswick	6.3 ab	6.7 cd	7.2	6.2 abcd	6.7 ab	6.2 ab	6.6 bcde	7.2 abcde	8.0 abc
Baron	5.2 efg	6.8 bcd	7.2	5.5 cde	7.0 ab	6.7 ab	6.6 abcde	5.7 def	8.7 ab
Touchdown	5.5 cdef	7.0 abcd	6.7	5.7 bcde	6.2 b	6.0 b	6.3 de	6.3 bcdef	5.8 de
Columbia	5.5 cdef	7.7 ab	7.5	6.8 abc	7.2 ab	6.8 ab	7.2 a	7.7 abcd	8.3 abc
Majestic-Touchdown	5.8 bcde	7.0 abcd	7.2	6.5 abcd	6.5 ab	6.2 ab	6.7 abcde	7.5 abcde	5.3 e
Majestic-Adelphi	6.2 bc	6.5 dc	6.5	7.3 a	7.2 ab	6.7 ab	6.8 abcd	8.7 a	8.5 ab
Brunswick-Adelphi	5.7 bcdef	6.7 dc	6.8	6.5 abcd	7.0 ab	7.2 a	6.8 abcd	7.3 abcde	7.8 abc
Touchdown-Adelphi	5.0 fgh	7.8 a	7.0	5.8 abcde	7.2 ab	6.8 ab	6.9 abc	6.3 bcdef	7.3 bc
Majestic-Brunswick	6.0 bcd	6.8 bcd	7.2	6.3 abcd	6.2 b	6.0 b	6.5 bcde	6.8 abcde	7.5 abc
Merion-Brunswick	5.0 fgh	6.5 dc	7.2	6.2 abcd	6.7 ab	5.8 b	6.5 cde	6.7 abcdef	5.3 e
Merion-Majestic	5.3 defg	6.8 bcd	7.2	5.8 abcde	6.3 ab	5.8 b	6.4 cde	6.3 bcdef	5.5 e
Baron-Majestic	5.5 cdef	6.0 d	6.7	6.2 abcd	6.5 ab	6.2 ab	6.3 de	6.8 abcde	8.3 abc
Baron-Brunswick	5.5 cdef	6.5 dc	6.7	6.8 abc	7.2 ab	6.2 ab	6.7 abcde	7.3 abcde	8.0 abc
BFC-46-1	5.0 fgh	6.5 dc	6.8	6.7 abcd	6.7 ab	6.7 ab	6.7 abcde	7.5 abcde	5.0 e
BFB-35-1	5.2 fg	7.2 abc	7.0	6.0 abcde	7.2 ab	6.5 ab	6.8 abcde	6.2 cdef	7.3 bc
P-1528T	4.7 gh	6.3 dc	6.7	7.2 ab	7.3 a	7.2 a	6.9 abc	7.8 abc	8.7 ab

[1] Quality ratings were made using a scale of 1 through 9 with 1 representing very poor quality and 9 representing the best quality.

[2] Disease ratings were made using a scale of 1 through 9 with 1 representing complete necrosis and 9 representing no visible disease.

[3] Within a date and observation,means with the same letter are not significantly different.

[4] Scores within this column were not significantly different at the 0.05 level.

USDA NATIONAL KENTUCKY BLUEGRASS TRIAL

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

The turf program at the University of Illinois is one of 35 participants in a nationwide Kentucky bluegrass trial. This test will examine 84 Kentucky bluegrass cultivars under a variety of environmental conditions and cultural regimes.

In Urbana, the plots were established Sept. 15, 1980. Plot size is 5x6 feet and cultivars are replicated 3 times. Prior to establishment the area was fertilized with 1 lb. N/1000 sq. ft. After seeding plots were covered with Soil Guard, a synthetic spray mulch and irrigated as needed. Winter color of the cultivars varied from light green in Vantage, Barblue and experimental varieties H-7, I-13, P-141 and SH-2; to dark green in cultivars Bayside, Birka, Bono, PSU-150 and PSU-173. (Table 2) Over a period of several years we hope to obtain ratings on monthly quality, disease resistance and tolerance to environmental stress. In 1981 we plan to establish this test on sand at our research facility in Kilbourne, Illinois.

Table 2. USDA Kentucky bluegrass cultivar evaluation

Cultivar	Color[1]	Cultivar	Color[1]	Cultivar	Color[1]
Adelphi	7.0 cde[2]	Touchdown	7.0 cde	Sydsport	6.7 def
Glade	7.3 bcd	Welcome	7.0 cde	Mer pp 300	7.0 cde
Birka	8.7 a	WW Ag 463	6.3 efg	Mer pp 43	6.7 def
Monopoly	6.7 def	WW Ag 480	7.0 cde	Mona	6.7 def
Ram-1	7.0 cde	Bono	8.7 a	Lovegreen	7.0 cde
Fylking	7.0 cde	Kenblue	6.7 def	Bristol	7.0 cde
Cheri	6.7 def	Harmony	7.0 cde	Victa	7.0 cde
243	7.0 cde	American	7.0 cde	Enoble	7.0 cde
Wabash	7.0 cde	Vanessa	8.0 ab	SH-2	5.3h
Nugget	7.0 cde	Mosa	7.7 bc	NJ 735	6.3 efg
239	7.0 cde	Cello	8.0 ab	S.D. Common	6.7 def
S-21	6.3 efg	WW Ag 478	7.0 cde	Merion	7.0 cde
PSU-190	7.0 cde	Piedmont	6.3 efg	Ba-61-91	7.0 cde
PSU-150	8.7 a	Majestic	7.7 bc	Bayside	8.7 a
PSU-173	8.7 a	Bonnieblue	7.0 cde	225	7.0 cde
Kimono	7.0 cde	Vantage	6.0 fgh	R141 (Mystic)	5.3 h
Baron	7.0 cde	Merit	7.0 cde	Admiral	7.0 cde
Enmundi	7.0 cde	Argyle	6.7 def	Eclipse	7.3 bcd
Plush	6.7 def	Charlotte	7.0 cde	Escort	8.0 ab
Parade	7.0 cde	A-20-6	7.0 cde	K3-162	7.0 cde
Trenton	6.7 def	A-20	7.0 cde	K3-179	7.3 bcd
Rugby	7.0 cde	H-7	5.7 gh	K3-178	6.7 def
SY-01617	7.0 cde	I-13	5.7 gh	K1-152	6.3 efg
Banff	7.0 cde	A20 6A	6.3 efg	Barblue	5.7 gh
Dormie	6.3 efg	N 535	6.7 def		
Holiday	7.0 cde	1528T	7.3 bcd		
Germonimo	7.0 cde	Shasta	7.0 cde		
Aspen	7.0 cde	Columbia	6.7 def		
MLM-18011	7.3 bcd	Apart	7.0 cde		
CEB-VB-3965	7.7 bc	A-34	7.0 cde		

[1]Color ratings are based on a scale of 1 through 9 with 9 representing dark green and 1 representing complete chlorosis. Color is a reflection of genetic color and not meant to reflect quality.

[2]Within a date and observation, means with the same letter are not significantly different.

PERENNIAL RYEGRASS CULTIVAR EVALUATION

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

In the past, perennial ryegrass was usually considered a temporary lawn or nursegrass in seed mixtures. In Illinois, deterioration during the summer months has presented perennial ryegrass from becoming an important permanent turfgrass. Improved varieties with better color, density, mowing quality, and disease resistance have challenged the traditional image of perennial ryegrass.

Plots of 14 perennial ryegrass cultivars were established August 24, 1978. Plots measured 5 x 6 ft and each cultivar was replicated 3 times. Plots are mowed at 1.5 in, fertilized 4 times per year with 1 lb N/1000 sq ft per application and are irrigated as needed to prevent wilt. The following cultivars were established in our trials:

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

Due to a very dry spring and summer in 1979, and a hot dry summer in 1980, turf quality was not high. (Table 3) *Poa annua* invasion after seeding has also reduced plot quality. The cultivars M-456, Blazer, Loretta, Derby and Omega showed excellent resistance to Corticium red thread (*Corticium fuciforme*). CBS-M-16-7-78 was most seriously damaged by this disease. In 1980, quality for all cultivars was fair to good in May and decreased rapidly under the hot humid environment that prevailed in June and July. Under these conditions Derby and Pennfine have generally ranked highest while Caravelle, Yorktown and Blazer have ranked lowest among the cultivars tested. With the onset of cooler fall temperatures quality improved. For most cultivars, highest quality ratings were obtained in September.

Table 3. Perennial ryegrass cultivar evaluation.

Cultivar	Quality[1] 5/22	6/25	7/23	8/13	9/25	10/21	Average of all dates	Red Thread[2] 5/22	Pythium[2] 6/22
Loretta	7.0 ab[3]	5.3 a	4.0 ef	4.0 ab	8.0 a	6.7 ab	5.8 abcd	7.7 a	5.7 abc
Citation	5.7 cd	4.7 a	5.3 bcd	5.3 a	7.3 ab	7.3 ab	5.9 abc	7.0 ab	5.0 bc
Manhattan	6.7 abc	4.7 a	3.3 f	4.0 ab	7.3 ab	7.0 ab	5.5 cd	7.0 ab	3.7 c
Omega	6.0 bcd	4.3 a	4.0 ef	4.3 ab	7.0 ab	6.7 ab	5.4 d	8.0 a	4.0 bc
Birdie	5.0 d	4.7 a	6.0 abc	5.0 ab	7.7 a	7.0 ab	5.9 abcd	7.0 ab	6.0 abc
Caravelle	5.7 cd	3.3 b	3.3 f	3.7 b	5.0 c	5.3 c	4.4 e	7.0 ab	5.0 bc
Yorktown	6.7 abc	5.3 a	4.3 def	3.7 b	6.3 b	7.3 ab	5.6 bcd	7.3 ab	6.3 ab
Derby	5.7 cd	5.3 a	6.7 a	5.3 a	7.3 ab	6.3 bc	6.1 ab	8.0 a	7.7 a
Pennfine	5.3 d	5.0 a	6.3 ab	5.3 a	7.7 a	7.3 ab	6.2 a	6.7 ab	7.7 a
Regal	5.7 cd	4.3 a	5.0 cde	5.3 a	7.0 ab	6.3 bc	5.6 bcd	7.0 ab	5.7 abc
CBS-M-16-7-78	5.3 d	5.3 a	5.3 bcd	4.7 ab	7.0 ab	7.0 ab	5.8 abcd	5.7 b	6.3 ab
M-456	7.3 a	5.0 a	4.3 def	4.3 ab	7.0 ab	7.7 a	5.9 abc	8.3 a	5.7 abc
Blazer	6.7 abc	5.0 a	4.7 de	3.7 b	6.3 b	7.3 ab	5.6 bcd	7.7 a	5.0 bc
Fiesta	6.0 bcd	4.3 a	5.0 cde	5.3 a	7.7 a	7.3 ab	5.9 abc	7.3 ab	5.3 abc

[1] Quality ratings were made using a scale of 1 through 9 with 1 representing very poor quality and 9 representing best quality.

[2] Disease ratings were made using a scale of 1 through 9 with 1 representing total necrosis and 9 representing no visual disease symptoms.

[3] Within a date and observation, means with the same letter are not significantly different.

1973 CREEPING BENTGRASS CULTIVAR EVALUATION

J.E. Haley

Creeping bentgrass cultivars were established in May, 1973 in plots measuring 6 by 8 feet with three replications of each. Mowing height is 0.25 inches. Plots receive a total of 4 lb N/1000 sq.ft. annually. Irrigation is performed as needed. A preventive fungicide program was followed from June through September.

The cultivars varied widely in their quality ratings due to differences in texture, color, density,annual bluegrass invasion and disease incidence. (Table 4) In general, quality has been greatly reduced since establishment due to disease incidence and the development of a heavy thatch layer that prevents water penetration to the soil below. This recently has been an especially serious problem because of the extreme dry, hot conditions of the 1979, 1980 summers. Good turfgrass quality has been observed in Penncross and Pennpar. Old Orchard and Morrissey have deteriorated in the past year and Nimisilla and MSU-AP-18 continued to perform poorly.

Table 4. 1973 Creeping bentgrass cultivar evaluation

Cultivar	Quality[1]						Snow Mold[2]		% Annual Bluegrass[3]
	5/18/79	7/17/79	10/15/79	4/06/80	5/28/80	7/23/80	3/20/79	4/06/80	5/18/79
Seaside	4.7 bcd[4]	6.3 ab	6.7 ab	6.7 abcd	6.0 abcde	6.3 a	4.0 ef	8.3 ab	13.3 abcde
Penncross	6.3 a	7.3 a	7.7 a	6.3 bcd	7.3 a	5.7 ab	6.0 abcde	7.3 abcd	3.0 de
Washington	5.3 abc	6.7 a	6.3 abc	7.0 abc	6.0 abcde	3.7 bcd	6.7 abc	6.7 abcde	7.3 cde
Toronto	4.0 cd	5.0 b	4.7 d	6.0 cd	5.3 bcde	5.7 ab	5.7 abcdef	8.7 a	18.3 abc
Cohansey	4.7 bcd	6.3 ab	6.0 abcd	7.0 abc	6.3 abcd	6.0 a	4.3 def	7.3 abcd	4.0 de
Pennpar	5.7 ab	7.0 a	7.0 ab	7.0 abc	7.0 ab	6.3 a	7.0 ab	8.3 ab	6.0 cde
Pennlu	3.3 d	6.0 ab	5.0 cd	6.3 bcd	5.7 abcde	5.3 abc	6.7 cdef	7.3 abcd	21.7 ab
Arlington	4.7 bcd	7.0 a	5.7 bcd	6.0 cd	6.0 abcde	4.7 abcd	4.3 def	6.0 cde	15.0 abcd
Emerald	4.3 bcd	6.7 a	5.0 cd	7.3 ab	5.0 cde	4.7 abcd	5.0 bcdef	6.0 cde	23.3 a
Congressional	4.0 cd	6.3 ab	5.7 bcd	7.7 a	6.3 abcd	6.0 a	4.3 def	6.7 abcde	23.3 a
Old Orchard	5.0 abc	7.0 a	7.3 ab	6.3 bcd	4.3 e	3.0 d	4.7 cdef	5.3 de	9.3 bcde
Metropolitan	4.7 bcd	6.0 ab	5.0 cd	5.7 de	6.7 abc	6.0 a	5.0 bcdef	6.3 bcde	11.7 abcde
Collins	4.3 bcd	6.7 a	6.7 ab	6.0 cd	6.3 abcd	6.3 a	5.7 abcdef	8.0 abc	15.0 abcd
Nimisilla	4.0 cd	7.3 a	2.7 e	6.3 bcd	2.7 f	3.3 cd	3.7 f	2.7 f	13.3 abcde
Morrissey	6.3 a	6.7 a	7.0 ab	7.0 abc	4.3 e	3.3 cd	6.3 abcd	7.7 abc	4.0 de
MSU-AP-18	4.7 bcd	7.3 a	6.3 abc	5.0 e	4.7 de	3.7 bcd	6.3 abcd	5.0 e	10.0 bcde
MSU-AP-28	5.0 abc	7.3 a	7.0 ab	6.0 cd	5.7 abcde	4.7 abcde	7.7 a	6.7 abcde	5.7 cde
MSU-AP-38	6.3 a	7.3 a	7.7 a	7.0 abc	5.3 bcde	3.3 cd	7.3 a	7.0 abcde	0.7 e

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

[2]Snow mold ratings are made on a scale of 1 through 9, 9 representing no visual disease symptoms and 1 representing complete necrosis.

[3]Ratings represent the total % of annual bluegrass in each plot based on visual observation.

[4]Within a date and observation, means with the same letter are not significantly different.

KENTUCKY BLUEGRASS-PERENNIAL RYEGRASS MIXTURES

J. E. Haley and D. J. Wehner

Mixtures of Kentucky bluegrass and perennial ryegrass have been used to combine the advantages of rapid establishment and persistence of the turf under a wide range of environmental conditions. A traditional concern over combining these species has been the potential domination of perennial ryegrass if seeded too heavily or if it comprises too much of the mixture by weight. The purpose of this study was to determine the effect of different percentages of perennial ryegrass, by seed weight, on the species composition of a mixed turf using two perennial ryegrass and two Kentucky bluegrass cultivars.

Four combinations of two Kentucky bluegrass (Fylking and A-34) and two perennial ryegrass (Citation and Pennfine) cultivars were planted in May 1975. The perennial ryegrass component of each cultivar combination was 5, 10, 15, 20, 25 or 50 percent of the seed mixture, by weight. Plots measured 1.5 by 1.8 m and each seed mixture was replicated three times in a randomized complete bulk design. The seeding rate for all mixtures was 30 g/plot. Establishment and maintenance were as in A. After two years, two 5 x 5-cm plugs were extracted from all replications of plots planted with 5, 10, 15, 20, and 50% perennial ryegrass, for determining the distribution of Kentucky bluegrass and perennial ryegrass by shoot counts.

Combinations of Kentucky bluegrass and perennial ryegrass at different percentages of seed weight yielded significantly different proportions of the two species in plots, depending upon the cultivars selected. A-34 Kentucky bluegrass was more competitive than Fylking, while Pennfine perennial ryegrass was more competitive than Citation. These differences are most striking at the five percent level of perennial ryegrass in the seed mixtures; after three years, the Pennfine-Fylking mixture was nearly 50 percent perennial ryegrass based on shoot counts while the Citation-A-34 mixture was less than five percent.

Since the rapid germination and vigorous seedling growth of perennial ryegrass makes it desirable in seed mixtures for rapid soil cover, but undesirable where it becomes the dominant component of the turf, the selection of appropriate cultivars of these species is important in achieving the seemingly opposing objectives of rapid cover and a predominantly Kentucky bluegrass turf.

Turf quality generally decreased as the percent ryegrass increased. This reflected the differential growth rate of the two species during cool weather, and the reduced quality of the perennial ryegrass during warmer periods.

SOILLESS SOD ON SAND AND SILT LOAM

A.J. Turgeon, J.E. Haley, D.J. Wehner

One of the presumed advantages of soilless (washed) sod is the elimination of the potentially troublesome interface effect that results where the soil carried with the sod (muck) differs substantially in its physical properties from the underlying medium at the transplant site. Spomer and Turgeon (vertical soil water retention is newly sodded, drained turfgrass sites, Commun. in Soil Sci. and Plant Anal. 8:417-423, 1977) reported substantially higher water retention in the muck and silty clay loam sod-soil layers than in the underlying sand medium 48 hours following irrigation. These differentials in surface and subsurface moisture can adversely affect initial rooting and subsequent turfgrass growth.

Field studies by Turgeon (comparative advantages of soilless sod for Kentucky bluegrass propagation, Rasen Gruflachen Bergrunungen 8:13-15, 1977) showed that soilless sod roots faster than conventional sod under moderate temperatures, but is more prone to desiccation under conditions of high-temperature stress. Where sand and silt loam media were both tested, rooting was more rapid in the sand as long as desiccation did not occur. In another study, Turgeon, Berns, and Warren (a mechanized washing system for generating soilless sod, Agronomy Journal 70:349-350, 1978) reported that reductions in sod strength of 'A-20' Kentucky bluegrass accompanying successive washings were due to the addition of moisture rather than from the removal of soil. Thoroughly washed sod (4 times) was comparable in sod strength when dry to dry, unwashed sod. When saturated, however, both washed and unwashed sod had significantly lower sod strengths.

The current field study was initiated in September 1976 to determine the long-term results from the use of soilless and conventional sods of muck-grown 'A-20' Kentucky bluegrass planted on silt loam and sand media. Observations to date indicate that: (1) irrigation and fertilization requirements of both sod types (especially soilless) are considerably greater on sand compared to silt loam soil, (2) thatching tendency was greater on sand than on soil, presumably due to the abundance of earthworms and other organisms within the soil and their relatively low numbers or absence in sand, and (3) core cultivation is less effective in sand than in soil for cycling the media underlying the sod for incorporation into the thatch layer. Thus, where sod is planted to a sand base, sand topdressing may be necessary to fully integrate the sod and subsequently developed thatch into the sand medium.

FAIRWAY RENOVATION WITH THE USE OF EMBARK AND ROUNDUP

C. Stynchula and D. J. Wehner

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

A field study was initiated on September 15, 1980 on the University of Illinois Golf Course, Savoy IL. Glyphosate (Roundup) and three application rates of mefluidide (Embark) were applied on 6' x 12' plots on the seventeenth fairway of the Orange Course. Glyphosate was applied at a rate of 2 lb. ai/A for complete eradication of the existing Kentucky bluegrass - Poa annua stand. Embark was applied at three rates of .125 lb. ai/A, .25 lb. ai/A and .5 lb ai/A. This application retarded growth of the existing stand but continued to provide a playable turf surface. Renovation procedures were initiated a week after the chemical treatments. Two methods of overseeding were employed. The first method used a Ryan greensaire to penetrate the soil. Warren's A-34 Kentucky bluegrass was broadcast over the plots at a rate of 1 lb/1000 sq. ft. A steel mat was used to break up soil plugs and to drag seed into the holes. The second method used a Rodger's seeder with slicer blades which are run in one direction over the plots. Warren's A-34 bluegrass seed at a rate of 1 lb/1000 sq. ft. was drilled into the plots on 1 inch centers. Preliminary data on germination showed consistent seedling emergence in all plots. The seedlings reached a height of approximately 3/4 inch by mid-November. Plots will be evaluated through this season to determine amount of seedlings which become mature plants and density of the A-34 bluegrass per plot.

In a second study conducted in the greenhouse, mefluidide sprayed on Kentucky bluegrass seeds inhibited their germination. Additional greenhouse studies are being set up to determine how quickly overseeding can be done after treatment of the existing turf with mefluidide.

PHYTOTOXICITY OF BENTAZON AND LINURON TO KENTUCKY BLUEGRASS CULTIVARS

J. E. Haley and D. J. Wehner

Kentucky bluegrass, the principal turfgrass used in Illinois, is adapted to a wide range of environmental conditions and uses. Within the species (P. pratensis) many cultivars of Kentucky bluegrass exist. They differ widely in characteristics such as color, texture, density, environmental and cultural adaptation, and disease susceptibility. A study initiated in July 1980 examined the effects of selected herbicides on 34 cultivars of Kentucky bluegrass.

In Octoer 1979, 4 inch plugs were taken from a Kentucky bluegrass evaluation trial and established in plots 8 x 24 in. Cultivars used in the test were as follows:

A-20	Enoble	Park
A-34	Fylking	Pennstar
A-20-6	Galaxy	Plush
Adelphi	Geronimo	Ram #1
Baron	Glade	Rugby
Bonnieblue	Kenblue	Sodco
Brunswick	Majestic	Sydsport
Campina	Merion	Touchdown
Cheri	Monopoly	Vantage
Delft	Nugget	Victa
Enmundie	Parade	Windsor
Entopper		

The plugs are fertilized 4 times per year with 1 lb N/1000 sq. ft. Mowing height is 2 in. The area is hand weeded. Herbicides were applied July 15, 1980. The maximum air temperature at this time was 99°F with high humidity.

Linuron (O.M. Scott) and Basagran (BASF Wyandothe Corporation) were chosen for the test. Previous testing has indicated these herbicides may cause some degree of damage on cool season turfgrass. Linuron was applied in a granular formulation with a drop spreader at 2.2 lb a.i./A (1/2 recommended rate), 4.4 lb a.i./A (recommended rate), and 8.8 lb a.i./A (2 times recommended rate). Basagran was applied as a soluble liquid using a back pack CO_2 sprayer (Spray volume 28.5 GPA) at rates of .5 lb a.i./A, 1 lb a.i./A, and 2 lb a.i./A. The recommended rate for Basagran is 1-2 lb acre. The plugs were irrigated for 15 min. following the Linuron application. Basagran application followed this irrigation while the foliage was still wet.

There was no visual evidence of phytotoxicity to cultivars sprayed with Basagran at .5, 1 or 2 lb a.i./A or with Linuron at 2.2 lb a.i./A. Some plugs treated with 4.4 lb a.i./A Linuron displayed a slight chlorosis. This chlorosis was very minor and occurred on all cultivars.

Phytotoxicity to the cultivars was greatest with Linuron at 8.8 lb a.i./A (twice the recommended rate). At this rate, all cultivars exhibited chlorosis and in some cases, minor leaf tip burn. The chlorosis gradually disappeared but when compared to the untreated plugs was still evident 1 month after treatment. There were indications that some cultivars are more sensitive to Linuron than others. A-34, Fylking, Glade, Galaxy, Pennstar, and Sydsport showed more damage than other cultivars 17 days after treatment, but had recovered to some extent 30 days after initial application. On the other hand, Geronimo, Kenblue, and Sodco showed a steady decline after treatment damage was greater 30 days following herbicide treatment than at 17 days following treatment.

Table 5. Phytotoxicity of Linuron to 34 Kentucky bluegrass cultivars when applied at 8.8 lb. a.i./A.

Cultivar	Phytotoxicity[1] 7/21	8/01	8/15
A-20	8.0 bcd[2]	8.0 abcd	8.0 abcd
A-34	7.3 def	6.0 g	7.0 def
A-20-6	7.7 cde	8.7 ab	9.0 a
Adelphi	8.0 bcd	7.3 cdef	8.7 ab
Baron	8.0 bcd	8.0 abcd	8.7 ab
Bonnieblue	7.7 cde	7.7 bcde	7.7 bcde
Brunswick	6.7 f	7.3 cdef	7.0 def
Campina	7.7 cde	8.0 abcd	8.0 abcd
Cheri	8.0 bcd	7.3 cdef	9.0 a
Delft	8.0 bcd	8.0 abcd	8.0 abcd
Enmundie	8.3 abc	8.0 abcd	8.7 ab
Entopper	8.3 abc	8.3 abc	8.3 abc
Enoble	8.3 abc	8.7 ab	8.3 abc
Fylking	7.7 cde	6.3 fg	7.7 bcde
Galaxy	7.0 ef	6.0 g	8.0 abcd
Geronimo	8.3 abc	7.0 defg	6.7 efg
Glade	7.0 ef	6.3 fg	7.7 bcde
Kenblue	8.0 bcd	6.7 efg	5.7 g
Majestic	8.0 bcd	7.7 bcde	8.0 abcd
Merion	8.0 bcd	7.0 defg	8.0 abcd
Monopoly	8.7 ab	8.3 abc	9.0 a
Nugget	8.0 bcd	7.7 bcde	8.3 abc
Parade	8.0 bcd	8.0 abcd	8.7 ab
Park	8.7 ab	8.7 ab	7.7 bcde
Pennstar	7.0 ef	6.0 g	7.7 bcde
Plush	7.3 def	7.0 defg	7.7 bcde
Ram #1	8.3 abc	8.0 abcd	8.3 abc
Rugby	7.7 cde	8.0 abcd	8.7 ab

Table 5. (Cont'd.)

Cultivar	Phytotoxicity[1]		
	7/21	8/01	8/15
Sodco	8.0 bcd	7.3 cdef	6.3 fg
Sydsport	7.3 def	6.7 efg	8.0 abcd
Touchdown	7.7 cde	7.3 cdef	7.3 cdef
Vantage	7.7 cde	7.3 cdef	7.7 bcde
Victa	8.3 abc	8.3 abc	8.3 abc
Windsor	7.7 cde	7.3 cdef	8.0 abcd

[1]Phytotoxicity ratings were made on a scale of 1 through 9 with 9 representing no visible phytotoxicity and 1 representing complete necrosis.

[2]Within a date, scores with the same letter are not significantly different.

POSTEMERGENCE CONTROL OF CRABGRASS AND BROADLEAF WEEDS

J. E. Haley

Postemergence control of both broadleaf weeds and annual grasses found together in an established turf can be difficult since the herbicide used may be highly effective on certain weeds and ineffective on others. Combinations of two or three herbicides provide broad-spectrum control that is necessary where several weed species are present. This study was designed to investigate the use of Daconate 6 (MSMA), a postemergence control for crabgrass, in combination with MCPP and 2,4-D, a herbicide combination used for broadleaf weed control.

On June 20, 1980, Daconate 6 was applied in combination with NCPP and 2,4-D, to a golf course rough at rates of 2 lb ai/A, 1.0 lb ai/A and 0.5 lb ai/A respectively. Other plots were treated with a MCPP, 2,4-D premix at 1.0 lb ai/A (MCPP) and 0.5 lb ai/A (2,4-D) and with MCPP alone at 1.0 ai/A and 2.4-D alone at 0.5 lb ai/A. At this time, the MSMA compound was also applied alone at 2.0 lb ai/A. Ten days later a second plot was established with the MSMA, 2 lb ai/A treatment. An untreated control was also included in the evaluation. Phytotoxicity ratings are reported as percent of control where the control is 0% and exhibits no phytotoxic effects. Plot size was 4 x 8 feet and each treatment was replicated 3 times. Materials were applied with a CO_2 pressurized backpack sprayer with a spray volume of 28 gal/A.

Phytotoxicity to the existing turf was evident in plots treated with MSMA, alone or in combination (Table 6). Some of this damage could be attributed to high temperatures and lack of irrigation during the droughty testing period. Postemergence crabgrass control was significantly better with MSMA alone or in combination with MCPP and 2,4-D (Table 7). In general, MSMA alone showed little control of broadleaf weeds. Clover control was significantly better with MCPP applications in any combination. Dandelion control was evident where 2,4-D was applied and control was significantly better in MSMA, MCPP and 2,4-D combination plots. There was no significant differences among herbicides controlling red sorrel although all treated plots contained fewer red sorrel plants than the untreated check (Table 8).

Table 6. Phytotoxicity to a Kentucky bluegrass turf from postemergence herbicides.

Material	Rate lb ai/A	Phytotoxicity[1] 6/26[2]	6/30[2]	7/7[2]	7/14[2]	7/22[3]
MSMA; MCPP + 2,4-D	2.0; 1; 0.5	37.0a	37.0a	40.7b	25.9b	16.7
MSMA	2.0	37.0a	40.7a	37.0b	22.2bc	15.0
MCPP + 2,4-D	1.0 + 0.5	0b	7.4b	11.1c	11.1cd	26.1
MCPP	1.0	14.8b	11.1b	7.4c	3.7d	7.8
2,4-D	0.5	3.7b	3.7b	0c	3.7d	5.6
MSMA*	2.0	0b	0b	70.4a	66.7a	58.8

*Application made at 10 days following 5 primary herbicide treatments

[1] Phytotoxicity ratings reported as percent of check where the check is 0° and shows no phytotoxic effects.

[2] Within a date, means with the same letter are not significantly different.

[3] Within this date scores are not significant.

Table 7. Phytotoxicity to crabgrass from postemergence herbicide.

Material	Rate lb ai/A	Phytotoxicity[1]		
		6/30[2]	7/7[2]	7/14[2]
MSMA, MCPP + 2,4-D	2, 1.0 + 0.5	52.9a	33.3b	22.2b
MSMA	2.0	55.6a	37.0b	22.2b
MCPP + 2,4-D	1.0 + .05	0b	0c	7.4c
MCPP	1.0	0b	11.1c	0c
2,4-D	0.5	0b	0c	0c
MSMA*	2.0	0b	59.3a	70.4a

*Application made at 10 days following 5 primary herbicide treatments

[1]Phytotoxicity ratings reported as percent of check where the check is 0% and shows no phytotoxic effects.

[2]Within a date, means with the same letter are not significantly different.

Table 8. Evaluation of phytotoxicity to broadleaf weeds from postemergence herbicides.

Material	Rate lb ai./A	Phytotoxicity[1] 6/26	6/30	7/7	7/14	7/22
Broad leaves (General)						
MSMA, MCPP + 2,4-D	2, 1.0 + 0.5	33.3a[2]				
MSMA	2.0	0b				
MCPP + 2,4-D	1.0 + 0.5	22.2ab				
MCPP	1.0	29.6a				
2,4-D	0.5	11.1ab				
MSMA*	2.0	0b				
Clover						
MSMA, MCPP + 2,4-D	2.0, 1.0 + 0.5		55.6ab	66.7a	74.1a	85.2a
MSMA	2.0		40.7bc	37.0b	44.4ab	63.0a
MCPP + 2,4-D	1.0 + 0.5		59.3ab	70.4a	74.1a	81.5a
MCPP	1.0		70.4a	70.4a	77.8a	81.5a
2,4-D	0.5		25.9c	14.8c	0b	33.3b
MSMA*	2.0		0d	22.2bc	55.6a	81.5a
Dandelion						
MSMA, MCPP + 2,4-D	2.0, 1.0 + 0.5		77.8a	88.9a	88.9a	88.9a
MSMA	2.0		14.8c	14.8b	40.7bc	44.4cd
MCPP + 2,4-D	1.0 + 0.5		66.7a	74.1a	77.8ab	81.5ab
MCPP	1.0		14.8c	25.9b	7.4c	29.6d
2,4-D	0.5		40.7b	70.4a	74.1ab	59.3bc
MSMA*	2.0		0d	25.9b	55.6ab	70.4abc
Sorrel (NS)						
MSMA, MCPP + 2,4-D	2.0, 1.0 + 0.5				40.7	25.9
MSMA	2.0				16.7	29.6
MCPP + 2,4-D	1.0 + 0.5				38.9	40.7
MCPP	1.0				22.2	27.8
2,4-D	0.5				22.2	11.1
MSMA*	2.0				29.6	48.1

*Application made 10 days following 5 primary herbicide treatments.

[1]Phytotoxicity ratings as percent of check where the check is 0% and shows no phytotoxic effects.

[2]Within a date, means with the same letter are not significantly different.

NS. Scores are not significantly different.

CONTROLLED-RELEASE PREEMERGENCE HERBICIDE FORMULATIONS FOR CONTROL OF CRABGRASS IN TURF

David R. Chalmers, H. J. Hopen, and A. J. Turgeon

Commercial formulations of preemergence herbicides are applied to turf in a readily bioavailable form, free to react with environmental components of the turfgrass ecosystem. Biologically active herbicides can be depleted from the environment by a number of ways (such as volatilization, sorption by organic matter, adsorption by plants, and chemical, photochemical and microbial degradation) resulting in reduced periods of weed control. This often necessitates the use of repeat applications of the herbicide to achieve effective weed control. A possible alternate method of extending herbicide activity is to regulate the bioavailability of the active ingredient through the use of controlled-release preemergence herbicide formulations.

Formulations used for these studies were provided by the USDA formulation chemist, B. Shasha, from the Northern Regional Research Center in Peoria, Illinois. The control-release carrier under study is starch xanthide (sx), a granular material made from corn starch. The starch xanthide formulation physically encapsulates the herbicide within a granular porous matrix. Release of the active ingredient is through diffusion and decomposition of the matrix.

The 1980 studies include a continuation of field studies initiated in 1979 that included: a) a comparison of relative performance of six sx-benefin formulations, and b) evaluation of different combinations of starch xanthide (sx) and commercial formulations (cf) of benefin. A greenhouse comparison of sx-benefin was also included in 1980.

Field Studies: All plots measured 5 x 6 ft. for all experiments and contained each treatment plus control in three replications. The turf was a Kenblue-type Kentucky bluegrass maintained at a mowing height of 1.0 inch, fertilized with a 10-6-4 ($N:P_2O_5:K_2O$) water soluble fertilizer and irrigated as needed to prevent wilt. The plot area was overseeded twice with large crabgrass to ensure weed pressure: Dec. 1, 1979 (0.5 lb/1000 ft^2) and April 26, 1980 (1.0#/1000 ft^2). Herbicide formulations were applied to all studies on May 1, 1980 and watered in. Rates of benefin/acre varied with the study and are included in the following tables. Data were collected periodically during the season for evaluations of phytotoxicity and weed control.

Greenhouse Study:

Four different sx-benefin formulations were compared with the cf at 2 and 4 lb/acre rates on two soil types (a Plainfield sand, and a Flanagan silt loam) to evaluate controlled-release characteristics.

Treatments were surface applied once (9/29/80) to soil or sand contained in 4 inch (dia.) plastic pots arranged in a randomized complete block design with five replications. Sx compounds contained approximately 2% benefin and were of a 20-40 mesh particle size. Cf of benefin was a specially formulated 0.5% G. Treatments were immediately watered in following application.

Large crabgrass seed (approximately 20% viable) was sown (100 seeds/pot) at intervals of 1, 21, 42 and 63 days following herbicide treatment. All pots were kept moist by a mist system operating for 15 seconds every 10 minutes for 2-3 hours/day. Greenhouse temperatures ranged from 70-80F at the conclusion.

Data were collected on the basis of # of crabgrass plants that would develop to the 2-leaf stage and beyond. Raw data were subjected to an analysis of variance for each seeding date and treatment means compared using Duncan's multiple range comparison test. Data is expressed as percent control of crabgrass based on the untreated check.

Results: Field Studies

All formulations produced acceptable control of large crabgrass without injury to the desired turf (Table 9). Control however, did not appreciably differ between the six sx-benefin formulations tested (Table 10).

When different combinations of sx-benefin were combined with cf-benefin, only the 2 lb/acre treatments produced differences in control (Table 10). Control obtained from 2 lb treatments was greatest when benefin was applied as cf, indicating that while sx-benefin may give good control of crabgrass, it does not have an advantage over the cf under these experimental conditions.

Results: Greenhouse (Table 11)

There were no significant differences between treatments at the 4 lb rates on either sand or soil media at any date. The following discussion will be concerned with 2 lb/acre treatments.

All compounds gave excellent control of the initial seeding on both sand and soil. When crabgrass was seeded after 21 days, all sx-compounds on sand and 3 sx-compounds (H_2O_2-.30; Iron-.30; H_2O_2-.17) on soil resulted in significantly greater control than the cf. This advantage over the cf on sand was maintained for all sx-compounds at seeding date 42 and two sx-compounds (Iron .17; Iron .30) at seeding date 63. On soil the benefit obtained from the sx-types over the cf disappeared at seeding dates of 42 and 63 days after application. Control obtained from cf treatments did not differ with media.

Results indicate that starch xanthide formulations of benefin can extend the effective period of control beyond that obtained with the commercial formulation. This advantage however, is more pronounced on sand rather than soil media.

Table 9.

COMPARISON OF RELATIVE PERFORMANCE OF DIFFERENT STARCH XANTHIDE FORMULATIONS FOR THE CONTROL OF CRABGRASS IN KENTUCKY BLUEGRASS TURF

Starch Xanthide Herbicide Formulation Polymer	Crosslinking Agent	Degree of Substitution	% AI	% Crabgrass 10/2
Acid Modified Flour			2%	3.2 a*
Corn Starch	$Fe_2(SO_4)_3$	0.3	2%	2.7 a
Corn Starch	$Fe(SO_4)_3$	0.17	2%	1.7 a
Corn Starch	H_2O_2	0.3	2%	1.5 a
Corn Starch	H_2O_2	0.17	2%	1.8 a
Corn Starch	H_2O_2	0.17	7%	4.2 a
UNTREATED CHECK	-----	-----	-----	44.2 a
2 lb/acre				9.2 A
4 lb/acre				7.7 A

* Within date values with a letter in common do not differ significantly at the 5% level as determined by Duncan's multiple range test.

Table 10.

Evaluation of Different Combinations of Starch Xanthide (SX) and Commercial Formulations (CF) of Benefin for Crabgrass Control in Kentucky Bluegrass Turf.

Total Benefin Applied (Lbs/Acre)	Carrier Application Rates (Lbs/Acre) CF	SX	% Crabgrass 8/12	8/27	9/9	10/2
4	4	0	0.3 a	0.7 a	0.7 a	0.7 a
4	3	1	0.7 a	0.7 a	1.0 ab	0.0 a
4	2	2	1.0 a	2.0 ab	0.7 a	0.7 a
4	1	3	0.7 a	2.0 ab	3.0 ab	2.3 abc
4	0	4	0.0 a	1.0 ab	1.3 ab	1.3 a
3	3	0	1.0 a	1.0 ab	1.0 ab	0.7 a
3	2.25	0.75	1.3 a	1.3 ab	2.0 ab	2.0 abc
3	1.5	1.5	0.7 a	0.7 a	1.0 ab	0.7 a
3	0.75	2.25	1.7 a	2.3 ab	1.7 ab	0.7 a
3	0	3	2.3 a	3.0 ab	5.0 ab	2.3 abc
2	2	0	3.0 a	1.0 ab	0.7 a	0.3 a
2	1.5	0.5	2.3 a	3.7 ab	3.0 ab	3.0 abc
2	1	1	3.0 a	3.7 ab	5.3 b	5.3 c
2	0.5	1.5	1.0 a	1.3 ab	1.7 ab	1.7 ab
2	0	2	3.7 a	5.0 a	5.0 ab	5.0 bc
Untreated Check			30 b	33.3 c	33.3 c	38.3 d

*Within date values with a letter in common do not differ significantly at the 5% level as determined by Duncan's multiple range test.

Table 11. Percent control of crabgrass seeded after four post application periods following application of 2 rates of five preemergence herbicide formulations of benefin to two soil types.

Rate (#/Acre)	Media	Sx Formulation: Crosslinking Agent - Degree of Substitution	Post Application Period Before Seeding (Days): 1	21	42	63
			% Control[1]			
2 lb	Sand	Iron - 0.30	98 a[*]	100 a	81 ab	73 abc
		Iron - 0.17	100 a	92 a	81 ab	87 ab
		H_2O_2 - 0.30	100 a	98 a	86 ab	58 abcd
		H_2O_2 - 0.17	100 a	97 a	72 ab	45 cd
		CF	98 a	63 c	33 d	36 d
	Soil	Iron - 0.30	100 a	90 a	64 bcd	10 cd
		Iron - 0.17	100 a	68 bc	45 d	0 cd
		H_2O_2 - 0.30	100 a	96 a	66 bcd	24 bcd
		H_2O_2 - 0.17	100 a	88 ab	51 cd	0 d
		CF	98 a	60 c	43 d	19 cd
4 lb	Sand	Iron - 0.30	100 a	100 a	98 a	93 a
		Iron - 0.17	100 a	100 a	100 a	87 ab
		H_2O_2 - 0.30	100 a	100 a	98 a	93 a
		H_2O_2 - 0.17	100 a	98 a	98 a	91 a
		CF	100 a	98 a	67 abc	69 abcd
	Soil	Iron - 0.30	100 a	100 a	85 ab	57 abc
		Iron - 0.17	100 a	100 a	81 ab	33 abcd
		H_2O_2 - 0.30	100 a	100 a	95 a	81 ab
		H_2O_2 - 0.17	100 a	92 a	75 abc	29 abcd
		CF	100 a	94 a	83 ab	39 abcd

[*] Within date values with a letter in common do not differ significantly at the 5% level as determined by Duncan's Multiple Range test.

[1] Data based on % of crabgrass in the untreated check controlled by treatment.

THE EFFECT OF MOWING HEIGHT AND IRRIGATION REGIME ON PREEMERGENT HERBICIDE ACTIVITY

B. Branham, A. J. Turgeon, and D. J. Wehner

This experiment is designed to show the effects of irrigation and mowing height on preemergent herbicide activity. Seven different irrigation regimes are used; three daily rates, twice/wk, once/wk, once/2 wk, and no water. Mowing heights of 1.5 and 0.75 inches are two additional treatments. The preemergent herbicides, Benefin, Bensulide, and Dacthal, are applied on May 1 and September 1 at rates of 3 lbs, 10 lbs, and 12 lbs active ingredient/acre, respectively.

Each plot is replicated three times and a check plot is included with no herbicide treatment. The plots are overseeded with crabgrass and *Poa annua* at a rate of 0.25 lb/M. In the spring, *Poa annua* invasion is rated while crabgrass is monitored throughout the summer and fall.

The amount of *Poa annua* found in the plots did not differ greatly under different irrigation regimes, except on plots where no water was applied. Where no water was applied, there was significantly less *Poa annua*. Less than 5% *Poa annua* was found in plots mowed at 1.5 inches. This would indicate that mowing height is more important than irrigation amount and frequency in *Poa annua* invasion. At the 0.75 inch mowing height, Benefin and Bensulide provided moderate control of *Poa annua* while the results from Dacthal were variable.

Data on crabgrass control shows that as of August 5, Benefin has provided the best control at both mowing heights. Generally, the most crabgrass is seen in plots receiving daily irrigation. Plots mowed at 1.5 inches have a less severe infestation of crabgrass than plots mowed at 0.75 inches. As of this date, Bensulide and Benefin are providing approximately the same level of control.

EVALUATION OF NORTRON FOR CONTROL OF ANNUAL BLUEGRASS

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

On September 22, 1980 studies were established to evaluate the use of Nortron (produced by Fisons Incorporated) for control of Poa annua. Nortron 4F (4 lb ai/gallon flowable) and Nortron 2.5 G (a 2.5% granular) were applied at rates of 1 and 2 lb. ai/A in September, 1 and 2 lb. ai/A in September with an additional application of 1 lb. ai/A one month later and 1 lb. ai/A application in October only. Granular material was applied by hand. The flowable material was applied with a CO_2 pressurized backpack sprayer. Due to high winds the flowable was mixed with 500 ml. water and this volume was sprayed evenly over the 30 square foot plots (resulting spray volume was approximately 181 gal/A. A plywood frame surrounded the plots to prevent spray drift). Material was applied to an established creeping bentgrass annual bluegrass turf maintained at 0.75 in. and to an area predominantly annual bluegrass that had been treated with glyphosate and then verticut. Plot size was 5 x 6 and each treatment was replicated 3 times.

The plots on the established bentgrass/annual bluegrass area were evaluated for phytotoxicity to both creeping bentgrass and annual bluegrass. No damage was evident until three-four weeks following treatment. In general, phytotoxicity to both species was not severe. Where injury occurred, turf was 'off color' and slow growing. It appeared that the flowable formulation resulted in more serious injury than granular formulations. Phytotoxicity was most apparent at rates of 2 lb. ai/A and 2 lb. ai/A plus 1 lb. ai/A. (Table 12).

Plots on the area which had been treated with glyphosate were rated for germination (1 representing no germination). In this test, flowable and granular materials exhibited no difference in annual bluegrass control. Except for the plots which received only an October applicator, there appeared to be no differences in control of annual bluegrass among rates. These two studies will be reevaluated in the spring to determine the extended value of formulations and rates (Table 13).

A test to evaluate phytotoxicity of Nortron on thirty-four Kentucky bluegrass cultivars was established Sept. 25, 1980. Nortron 4F was applied at rates of 1 lb ai/A, 2 lb. ai/A and 4 lbs. ai/A. Material was sprayed using a CO_2 pressurized backpack sprayer with a spray volume of 28.0 gal/A. The 34 Kentucky bluegrass cultivars were established from four inch plugs in the fall of 1979. Each plug is centered in an 8 x 24 inch plot and replicated 3 times. Plugs were maintained at a 2½-3 inch mowing height. The area was hand weeded, fertilized with approximately 3 lb. N/1000 sq. ft./year and irrigated as needed. Phytotoxicity was not evident on any cultivars until the area had been mowed. Then, the damage appeared as stunting of the turfgrass plant. No stunting was apparent on plugs treated with the 1 and 2 lb. ai/A rates. All cultivars exhibited some stunting when treated with 4 lb. Nortron/A. Cultivars most seriously affected were Enoble, Merion, Park, Glade, Vantage, Fylking, A-34, Galaxy, Parade, Brunswick, Windsor, Ram #1 and Touchdown. (Table 14).

Table 12. Control of annual bluegrass with Fison's Nortron in a creeping bentgrass - annual bluegrass area.

Formulation Rate[5] (lb. a.i./A)	Phyto to Annual Bluegrass[1] 10/20	10/28	11/3	Phyto to Creeping Bentgrass[1] 10/20	10/28	11/3	% Bentgrass/Plot[2,4] 10/1	11/3
Nortron 4.0 F 1 + 0	8.3 abc[3]	8.3 a	9.0 a	8.3 ab	8.3 bc	9.0 a	38.3 a	68.3 a
Nortron 4.0 F 1 + 1	8.0 abc	8.3 a	8.7 a	8.3 ab	8.7 ab	8.3 bc	38.3 a	35.0 ab
Nortron 4.0 F 2 + 0	7.3 cd	7.0 b	8.3 a	7.0 dc	8.0 c	8.0 c	26.7 a	30.0 b
Nortron 4.0 F 2 + 1	6.7 d	7.0 b	7.0 b	6.7 d	8.0 c	8.0 c	18.3 a	27.7
Nortron 4.0 F 0 + 1	8.7 ab	8.3 a	9.0 a	8.7 ab	9.0 a	9.0 a	28.3 a	30.0 b
Nortron 2.5 G 1 + 0	8.7 ab	9.0 a	9.0 a	8.3 ab	9.0 a	8.7 ab	46.7 a	43.3 ab
Nortron 2.5 G 1 + 1	8.7 ab	9.0 a	8.7 a	8.3 ab	9.0 a	9.0 a	40.0 a	33.3 ab
Nortron 2.5 G 2 + 0	8.3 abc	8.0 ab	8.7 a	8.0 ab	8.7 ab	8.7 ab	28.3 a	38.3
Nortron 2.5 G 2 + 1	7.7 bc	8.3 a	8.7 a	7.7 bc	8.7 ab	8.7 ab	20.0 a	27.7 b
Nortron 2.5 G 0 + 1	9.0 a	8.7 a	9.0 a	9.0 a	9.0 a	9.0 a	26.7 a	51.7 ab
Check ---	9.0 a	9.0 a	9.0 a	9.0 a	9.0 a	9.0 a	50.0 a	60.0 ab

[1] Phytotoxicity to annual bluegrass/creeping bentgrass rated on a scale of 1 through 9, 9 representing no damage, 1 representing complete necrosis.

[2] Percent bentgrass/plot is a visual estimate of creeping bentgrass cover per plot.

[3] Within a date and observation, means with the same letter are not significant.

[4] For % bentgrass/plot LSD.05 = 23.13

[5] First application was made on Sept. 25, 1980; second application was made on Oct. 21, 1981.

Table 13. Control of annual bluegrass with Fison's Nortron on turf pretreated with glyphosate.

Formulation Rate[3] (lb a.i./A)		Germination[1]				
		10/1	10/7	10/20	10/28	11/3
Nortron 4.0 F	1 + 0	1.7c[2]	1.7bc	2.0c	2.0b	1.3b
Nortron 4.0 F	1 + 1	1.3c	1.3bc	1.3c	1.3b	1.3b
Nortron 4.0 F	2 + 0	1.0c	1.0c	1.0c	1.0b	1.0b
Nortron 4.0 F	2 + 1	2.0c	1.3bc	1.3c	1.3b	1.3b
Nortron 4.0 F	0 + 1	2.3bc	2.3ab	3.7	5.0a	4.7a
Nortron 2.5 G	1 + 0	1.7c	1.7bc	2.0c	2.0b	2.0b
Nortron 2.5 G	1 + 1	1.3c	1.7bc	2.0c	2.0b	2.0b
Nortron 2.5 G	2 + 0	1.3c	1.0c	1.3c	1.3b	1.0b
Nortron 2.5 G	2 + 1	1.3c	1.3bc	1.3c	1.7b	1.7b
Nortron 2.5 G	0 + 1	3.3ab	3.3a	5.0a	6.0a	6.0a
Check	--	3.7a	3.3a	4.3ab	5.3a	5.3a

[1]Germination is a visual rating based on number and vigor of seedlings, 1 representing no germination.

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

[3]First application was made on Sept. 25, 1980; second application was made on Oct. 21, 1981.

Table 14. Degree of stunting on 34 Kentucky bluegrass cultivars treated with Nortron 4 F. at a rate of 4 lb. ai/A

Cultivar	Stunting[1]	Cultivar	Stunting[1]
A-20	6.7 bcd[2]	Park	4.7 gh
A-34	5.3 efgh	Pennstar	6.0 cdef
A-20-6	6.0 cdef	Plush	6.7 bcd
Adelphi	7.0 bc	Ram #1	5.3 efgh
Baron	5.7 defg	Rugby	6.0 cdef
Bonnieblue	5.7 defg	Sodco	6.3 cde
Brunswick	5.3 efgh	Sydsport	6.3 cde
Campina	6.0 cdef	Touchdown	5.3 efgh
Cheri	6.3 cde	Vantage	5.0 fgh
Delft	6.0 cdef	Victa	6.0 cdef
Enmundie	6.0 cdef	Windsor	5.3 efgh
Entopper	6.7 bcd		
Enoble	4.3 h		
Fylking	5.0 fgh		
Galaxy	5.3 efgh		
Geronimo	7.0 bc		
Glade	5.0 gh		
Kenblue	6.7 bcd		
Majestic	6.0 cdef		
Merion	4.7 gh		
Monopoly	7.7 ab		
Nugget	6.0 cdef		
Parade	5.3 efgh		

[1]Stunting was evaluated on a scale of 1 through 9, with 9 representing no visible stunting and 1 representing complete stunting of the turf.

[2]Scores with the same letter are not significantly different.

Effects of Fungicides on Reducing Development of Leaf Spot and Melting-out on Kentucky Bluegrass in 1980

M. C. Hirrel, M. C. Shurtleff and G. L. Fagiolo

To date the study of turfgrass epidemiology has been confined to a few rating dates at certain times during the season in an attempt to determine when chemical control would be most effective. Such critical point models are useful in timing chemical sprays, but they do little in evaluating disease progress and how chemical applications can act to reduce the rate of disease development. This year weather from the latter part of March to the first of May was conducive for the development of leaf spot and melting-out epidemics on bluegrass incited by Helminthosporium vagans and other species. The purpose of this study was to observe how different fungicides, in combination and with different timings, affect the development of this disease from the leaf blight to the crown rot stage.

To evaluate and chart the course of a melting-out epidemic over an eight-week period, a qualitative visual rating of color, stand, and disease severity over a 152.5 cm^2 (25 square feet) plot was correlated with a quantitative estimate of the amount of disease present, as numbers of leaf lesions in a 5 cm^2 (2 square inches) area. A randomized complete block design of 20 treatments, 19 fungicides and one untreated check, with four replications was used. Timing of fungicide treatments was either 3 sprays at 2-week intervals, or 2 sprays at 3-week intervals. The first spray application was made the week of April 14 following the first mowing of the season and the last spray was applied the week of May 19.

Differences in disease severity began after May 19 (on May 19 ratings ranged from 0.60-1.10) and were first noticed on May 28. Disease severity continued to increase until June 6, and for most treatments had declined to below the May 28 rating by June 12 (Table 1). Fungicide treatments could be divided into three basic groups based on the disease severity index of the plots compared to the untreated checks on the same rating date. At the height of the epidemic, between May 28 and June 6, Group I treatments had little or no effect on reducing disease severity compared to the check. Group II treatments for the most part reduced disease severity; however, it was the Group III treatments that consistently reduced disease severity for the duration of the epidemic. The rate of infection and disease development was calculated[1] for each group and further describes the amount of disease control attributed to fungicide treatment. Infection rate for Group I and the check was 0.148 and 0.138, respectively; for Group II, the rate was 0.078, and for Group III, it was 0.042.

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[1] Van der Plant, J. E. 1963. Plant Diseases: Epidemics and Control. Academic Press. New York. p. 21. Infection rate (r) for foliar diseases developing by continuous compound interest-like growth curve: $r = \frac{2.3}{t_2 - t_1}\left(\log \frac{X_2}{1-X_2} - \log \frac{X_1}{1-X_1}\right)$,

where t_2 and t_1 are rating dates and X_2 is the disease severity rating at t_2 and X_1 is the disease rating at t_1.

Disease severity ratings were in close agreement with lesion numbers in 5 cm^2 of turfgrass (Table 2). Differences in lesion numbers could be detected nearly 14 days before differences in disease severity and, in general, the increase and decline in lesion numbers preceded a similar curve for disease severity by 7 to 10 days. During May, the check and Group I treatments had nearly twice as many lesions per 15 cm^2 as the Group II treatments, and 3-4 times as many as the Group III treatments. In June, however, the differences in lesion number decreased. For the check and Group I treatments the decrease was one-third to one-half the numbers present in May. With Group II the decrease was one-fourth to one-third the numbers observed in May, but there was little or no difference in lesion numbers between May and June for treatments in Group III. Thus, the effect of the Group III fungicides is one of reducing lesion numbers which correlates to a low disease severity index.

A more thorough analysis of the epidemic was not possible due to an abrupt change in weather conditions. High June and July temperatures and low rainfall stalled, then decreased the leaf spot phase of the epidemic to the point where disease severity and lesion numbers were poorly correlated. The death of crowns did not take place in many of the treatments until the onset of the drought period. This may also explain why the leaf spot phase failed to develop again in late summer. Such conditions make it difficult to separate symptoms associated with disease from those associated with drought. Results from data collected from mid to late spring suggest that (1) certain fungicides alone or in combination will effectively reduce the onset and development of Helminthosporium leaf spot, and (2) development of a leaf spot epidemic can be observed earlier if lesion counts rather than disease severity ratings are made. Thus, by choosing the proper fungicide or fungicide combination and knowing the developmental stage of the disease we can make timely spray applications and thereby, more effectively control turfgrass diseases and reduce the cost of disease management.

Table 15. Disease severity ratings of Helminthosporium melting-out and leaf spot on Kentucky bluegrass following fungicide treatments

Treatment	Mean Melting-out-Leaf Spot Severity Index[1]		
	May 28	June 6	June 12
Check (untreated)	2.85	4.20	3.25
Group I. Disease severity similar or slightly lower than the check			
Bayleton 25% WP 2 oz, 3S 2W[2]	4.50	4.40	3.40
Acti-dione RZ, 0.5 oz, 2S 3W	3.65	4.25	2.00
Bayleton 1 oz; Acti-dione TGF 0.5 oz, 3S 2W	3.42	2.84*	2.05
Acti-dione TGF, 2.1% WP 1 oz, 3S 2W	3.05	2.45*	1.55
Bayleton, 25% WP 4 oz, 3S 2W	2.90	2.60*	3.20
Bayleton 0.5 oz; Daconil 3 oz,[3] 3S 2W	2.00	1.30*	4.75
Acti-dione RZ 0.5 oz; Acti-dione TGF 0.34 oz, 3S 2W	2.20	2.40*	3.05
Group II. Disease severity often lower than the check			
Acti-dione RZ 0.5 oz; Acti-dione TGF 0.34 oz, 2S 4W	2.85	3.00*	1.25*
Bayleton 2 oz; Dyrene 8 oz, 3S 2W	1.50*	1.15*	1.55
Daconil 2787 3 oz,[3] 3S 2W	1.45*	2.55	2.00
Acti-dione RZ 0.5 oz; Acti-dione TGF 0.34 oz, 3S 3W	2.15	2.70*	1.30*
Bayleton 1.0 oz; Acti-dione TGF 0.34 oz, 3S 2W	1.81*	2.38*	1.76
Group III. Disease severity consistently lower than the check			
Acti-dione TGF 0.34 oz; Daconil 1.5 oz,[3] 3S 2W	1.70*	1.00*	0.80*
Tersan LSR, 80% WP, 4 oz 3S 2W	1.60*	2.20*	0.90*
Acti-dione TGF 0.5 oz; Daconil 1.5 oz,[3] 3S 2W	1.40*	1.90*	0.80*
Chipco 26019 1 oz; Tersan LSR 3 oz, 3S 2W	1.20*	1.40*	0.75*
Dyrene, 50% WP 8 oz, 3S 2W	1.05*	1.15*	0.85*
Chipco 26019, 50% WP 2 oz, 3S 2W	0.85*	0.65*	0.65*
Chipco 26019, 50% WP 4 oz, 3S 2W	0.60*	1.00*	0.20*

* Treatment means different from the check at the 5% level of significance.

1 Rating scale 0-5 with 0 = no disease and 5 = severe melting out over 50% of 152.5 cm^2 (25 square feet) turf plot.

2 S = number of sprays, W = number of weeks between sprays.

3 Daconil should have been used at the 6 oz rate rather than 3 oz to be equivalent to Dyrene at 8 oz.

Table 16. Amount of Helminthosporium leaf spot lesions in a 5 cm^2 area of turfgrass

Treatment	Mean Lesion Numbers/5 cm^2;Rating Date					
	May			June		
	15	21	26	6	12	18
Check (untreated)	2.85	4.20	3.25	1.85	2.20	3.45
Group I[1]						
Bayleton 25% WP 2 oz, 3S 2W[2]	4.50	4.40	3.40	2.63	2.20	3.40
Acti-dione RZ, 0.5 oz, 2S 3W	3.65	4.25	2.00*	1.90	2.25	3.05
Bayleton 1 oz; Acti-dione TGF 0.5 oz, 3S 2W	3.42	2.84	2.05*	1.90	2.25	3.05
Acti-dione TGF, 2.1% WP 1 oz, 3S 2W	3.05	2.50*	1.55*	1.65	2.10	0.90
Bayleton, 25% WP 4 oz, 3S 2W	2.90	2.60*	3.20	2.45	2.40	2.80
Bayleton 0.5 oz; Daconil 3 oz,[3] 3S 2W	2.00	1.45	4.75	1.90	1.45*	2.50
Acti-dione RZ 0.5 oz; Acti-dione TGF 0.34 oz, 3S 2W	2.05	2.40*	3.05	1.80	1.65	1.80
Group II						
Acti-dione RZ 0.5 oz; Acti-dione TGF 0.34 oz, 2S 4W	2.85	2.90	1.25*	1.10*	1.40*	2.95
Acti-dione RZ 0.5 oz; Acti-dione TGF 0.34 oz, 3S 3W	2.15	2.70*	1.20*	1.65	2.05	1.80*
Bayleton 1.0 oz; Acti-dione TGF 0.34 oz, 3S 2W	3.42	2.84	2.05*	1.90	2.25	3.05
Bayleton 2 oz; Dyrene 8 oz, 3S 2W	1.50*	1.15*	1.55*	1.45	1.50	2.10*
Daconil 2787 3 oz,[3] 3S 2W	1.45*	2.30*	2.00*	1.50	2.10	1.60*
Group III						
Acti-dione TGF 0.34 oz; Daconil 1.5 oz,[3] 3S 2W	1.75*	1.00*	0.80*	1.10*	2.25	2.10*
Tersan LSR, 80% WP, 4 oz 3S 2W	1.65*	1.20*	0.90*	2.60	2.35	2.30*
Acti-dione TGF 0.5 oz; Daconil 1.5 oz,[3] 3S 2W	1.40*	1.90*	0.80*	1.70	1.75	1.65*
Chipco 26019 1 oz; Tersan LSR 3 oz, 3S 2W	1.20*	1.40*	0.75*	2.10	1.05*	2.00*
Dyrene, 50% WP 8 oz, 3S 2W	1.05*	1.15*	0.85*	1.45	1.15*	1.70*
Chipco 26019, 50% WP 2 oz, 3S 2W	0.85*	0.65*	0.65*	1.05*	0.90*	1.30*
Chipco 26019, 50% WP 2 oz, 3S 2W	0.60*	0.65*	0.65*	0.55*	0.70*	0.60*

*Treatment means different from check at 5% level of significance.

[1] Treatments grouped according to disease severity index (Table 15).

[2] S = number of sprays, W = number of weeks between sprays.

[3] Daconil should have been used at the 6 oz rate rather than 3 oz to be equivalent to Dyrene at 8 oz.

1980 INSECT CONTROL RESULTS

Roscoe Randell[1/]

Annual white grub, Cyclocephla immaculata larvae were again a problem in central Illinois. Oftanol applied in September, 1979 controlled white grubs during the summer, 1980. Sevin and Dursban provided effective control of annual white grubs. In general, white grub populations were less in 1980 than in 1978 and 1979 (Table 17 & 18).

[1/] Extension Specialist in Agricultural Entomology, University of Illinois, Champaign-Urbana, Illinois.

Table 17.

ANNUAL WHITE GRUB CONTROL - 1980

U. of I. Golf Course, Savoy, IL

Treatment lb a.i./A.	Rep.	Grubs/sq. ft. Sampling dates 9-22	10-3
Oftanol G 2	1	6	0
	2	7	0
Sevin + Dursban 4 + 2	1	8	3
	2	3	1
	3	0	0
	4	4	0

Recount: 20-25 grubs per square foot.
Applied insecticides: Sept. 12, 1980
Sampling results: Sept. 22, 1980 and Oct. 3, 1980

Table 18.

ANNUAL WHITE GRUB CONTROL - 1980

University of Illinois, Urbana

Treatment a.i./A.	Rep.	Sampling dates 10/12/79	Sampling dates 10/3/80
Isofenfos (Oftanol 5G) 2 lb.	1	5	0
	2	6	0
	3	3	0
	4	4	0
Untreated -	1	45	18
	2	42	17
	3	41	20
	4	44	16

Re-sampling of Oftanol and untreated plot established in 1979.
Plot size: 10 x 10 ft., 4 replicates of each treatment.
Treatments applied: 8-18-1979.

ANNUAL BLUEGRASS CULTURAL STUDIES

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

Many intensively cultured turfs has substantial populations of annual bluegrass mixed with other cool-season turfgrasses. In some cases, the fairway turfgrass is predominantly or exclusively annual bluegrass. Yet, research emphasis has always been on "controlling" annual bluegrass while attempting to increase populations of other "desired" turfgrass species. J. M. Vargas at Michigan State University determined that the decline of annual bluegrass during midsummer stress periods was due, at least in some instances, to anthracnose disease, and that an effective fungicide application program plus adequate nitrogen fertilization were important for sustaining annual bluegrass during stress periods. The purpose of these studies is to determine how several cultural variables, including fertilization and fungicide treatments, influence the quality and disease susceptibility of annual bluegrass turf.

The first experiment was arranged in a split-plot design with fungicide treatment (weekly rotation of a systemic fungicide and a contact fungicide) versus no fungicide as the main plots, and nitrogen (urea)-potassium (KCl) fertilization treatments as the subplots. The second experiment was organized the same way except that subplot treatments were different levels of phosphorous fertilization with a uniform treatment of urea (3 lb N/1000 sq ft/yr) and potassium (1.5 lb K_2O/1000 sq ft/yr) across the plot area.

None of the treatments maintained an acceptable level of quality through July and August, although plots receiving fungicide treatment did not appear to deteriorate to the extent of plots not sprayed with fungicide (Table 19). Deterioration of the plots not receiving fungicide appeared to be due to climatic stress as the typical anthracnose disease symptoms were not always evident. Plots receiving high nitrogen fertility (6 lb/1000 sq ft/yr) deteriorated rapidly with the onset of hot, dry weather. This may be a result of their lush condition, stimulated by high N applications, going into this stressful period. (Table 20)

No consistent beneficial effect from potassium fertilization was observed. The phosphorous fertilization experiment has not shown any difference among phosphorous treatments but, as in the first experiment, fungicide treatment resulted in better turfgrass quality.

Table 19. Evaluation of Fungicide Use on Annual Bluegrass Over All Fertility Treatments.

Treatment	Quality[1,3]						Snow Mold[2,3]
	4/18	5/29	6/26	7/15	8/13	8/26	4/18
Fungicide	5.2	5.8	5.4	2.7	3.2	3.3	5.6
No Fungicide	5.2	6.0	4.5	1.3	1.4	1.3	6.2

[1]Quality ratings are based on a scale 1 through 9, with 1 representing poorest quality and 9 representing best quality.

[2]Snow mold ratings are based on a scale of 1 through 9 with 1 representing complete necrosis and 9 representing no visible signs of disease.

[3]Statistically means were not significantly different.

Table 20. Effects of different nitrogen and potassium fertilization levels on the quality of an annual bluegrass turf sustained with and without fungicide treatments.

Treatment	Rate lb/M/YR N or K_2O	Fungicide[1] Quality[2] 4/18	5/29	6/26	7/15	8/13	8/26	Snow Mold[3] 4/18	No Fungicide[1] Quality 4/18	5/29	6/26	7/15	8/13	8/26	Snow Mold[3] 4/18
Urea	3	5.0[4]	5.7	4.7	2.7abc	3.7	3.7	5.0	6.0	5.3	4.7	1.3c	1.0	1.0	6.3
Urea + K	3 + 1.5	6.0	6.0	5.7	2.7abc	3.3	3.3	6.0	6.0	5.7	4.0	1.3c	1.0	1.0	7.7
Urea + K	3 + 3	6.3	5.7	5.3	3.3a	3.3	2.7	6.7	6.0	6.3	4.3	1.3c	1.3	1.3	6.7
Urea	6	5.0	5.7	7.0	2.7abc	2.7	3.0	4.3	4.7	6.3	5.3	1.0c	1.0	1.3	4.7
Urea + K	6 + 3	4.0	6.3	7.3	2.7abc	3.0	3.0	3.3	4.0	6.3	5.3	1.0c	1.0	1.0	4.7
Urea + K	6 + 6	4.7	6.0	6.0	2.3abc	2.3	2.3	4.0	4.7	6.3	6.7	1.3c	1.0	1.0	4.7
K	3	5.3	5.3	3.7	2.7abc	3.7	4.3	7.7	5.0	5.7	3.3	1.7bc	2.3	2.0	7.3
Untreated		5.3	6.0	3.3	3.0ab	4.0	4.3	7.7	5.0	6.0	2.3	1.3c	2.3	2.0	7.7

[1]Fungicide treatments were a weekly rotation of contact fungicide and systemic fungicide applied at recommended rates for disease prevention.

[2]Quality ratings were made on a scale of 1 through 9, with 9 representing best quality and 1 representing very poor quality.

[3]Snow Mold ratings were made on a scale of 1 through 9, with 9 representing no visible disease symptoms and 1 representing complete necrosis.

[4]Statistically means were not significantly different at 0.05 level.

GASEOUS NITROGEN LOSSES FROM TURF BY AMMONIA VOLATILIZATION

W. A. Torello, D. J. Wehner, and A. J. Turgeon

Ammonia volatilization is recognized as a major pathway of nitrogen loss from agricultural soils under certain soil and environmental conditions. Past research has shown conclusively that pH, cation exchange capacity, type of ammonium salt applied, temperature, and moisture all affect the rate and potential for nitrogen loss from soils as volatile NH_3.

Information on the potential for ammonia volatilization from fertilized turfgrass stands is lacking. Most ammonia volatilization research on turf to date has been performed on turfed areas where underlying soils possess high pH levels due to their calcareous nature. These soil conditions are not only limited in geographical location, but are also known to greatly enhance the process of ammonia volatilization. The potential for ammonia volatilization from turfgrass areas where underlying soils are neutral to acidic in nature has been shown to be substantial, especially where a layer of thatch exists (2). Therefore, further research into the mechanisms and extent of NH_3 volatilization from similar turfgrass environments under different cultural conditions is warranted.

A turf microecosystem has been developed at the University of Illinois to study the fate of various agricultural chemicals in closed, controlled environments. The use of the UIUC Turf Microecosystem as a tool for studying ammonia volatilization is considered to be more accurate than previously reported methods. The UIUC Turf Microecosystem has been described in detail by Branham and Turgeon (1).

The primary objective of this study was to compare NH_3-N losses from turf following fertilizer applications of sulfur coated ureas (SCU), urea, IBDU, UF, Formolene, and FLUF (Flowable Liquid Ureaformaldehyde), and NH_4NO_3. Secondary objectives were to evaluate the effects of rate of nitrogen application, mode of application, and presence of thatch on NH_3 volatilization from turf.

A comparison of ammonia volatilized from turf after application of seven different nitrogen fertilizers at various application rates is shown on Table 21. Application rates of 6.0 lb-N/1000 ft^2 were used to make gross comparisons. However, even at this rate of application, UF, IBDU, SCU, and NH_4NO_3 lost only negligible amounts of nitrogen as NH_3. At the 1.0 lb-N/1000 ft^2 application rate SCU and urea lost 1.4 and 1.6% of N applied respectively. The slowly soluble fertilizer materials FLUF and Formolene lost 4.6 and 3.4% of applied N at the 1.0 lb-N rate of application. These results show ammonia volatilization does occur but to a limited extent. These results are in sharp contrast to previous results obtained by Nelson et. al. (2) for central Illinois.

The effects of mode of application and thatch are shown on Table 22. Urea applied as a liquid resulted in higher losses of N through NH_3 volatilization. A layer of thatch seemed to decrease these losses, but only slightly. Again, these results are in sharp contrast to those obtained by Nelson et. al. (2).

Nitrogen losses from turf by NH_3 volatilization do exist in central Illinois but to a rather limited extent. Central Illinois soils are not calcareous in nature and, as such, do not possess high pH levels which drastically elevate the process of NH_3 volatilization. Further research into the mechanism of ammonia volatilization from turf grown in soils having a neutral to acidic pH level is ongoing at the University of Illinois and is reported elsewhere in this summary.

Table 21. Comparison of ammonia volatilization from turf after application of seven different nitrogen fertilizers at various rates of application.

Treatment	Rate of Application ($lb\text{-}N/1000\ ft^2$)	Mean ($\bar{X}$) Percent N Volatilized
UREA	1.0	1.6
UREA	6.0	8.6
SCU	1.0	1.4
SCU	6.0	2.3
NH_4NO_3	6.0	0.1
IBDU	6.0	0.01
UF	6.0	0.01
FLUF	1.0	4.6
FORMOLENE	1.0	3.4
FORMOLENE	2.0	4.0

Table 22. The effects of mode of application and thatch on ammonia volatilization from turf after liquid or prilled urea applications (1.0 lb-N/1000 ft^2)

Treatment	Rate of Application (lb-N/1000 ft^2)	Mean ($\bar{X}$) Percent N Volatilized
Thatched Turf		
Liquid Urea	1.0	2.8
Prilled Urea	1.0	1.7
No Thatch		
Liquid Urea	1.0	4.6
Prilled Urea	1.0	1.6

A Mechanism for Ammonia Volatilization from Turf in Central Illinois

W. A. Torello, and D. J. Wehner

Ammonia volatilization from turf after nitrogen fertilization has been shown to occur in central Illinois to a limited extent. Soils having high pH levels (calcareous) are known to greatly elevate losses of nitrogen by NH_3 volatilization. Since these soil types are not prevalent in central Illinois, another factor other than the soil reactions may be involved in NH_3-N losses.

Research was undertaken to determine the extent of urease activity in thatch and on the surfaces of turfgrass tissue. Urease is an enzyme which hydrolyzes or releases nitrogen from urea. Without the action of urease, urea would exist in the soil for extended periods of time and not provide the more favorable forms of nitrogen to the turfgrass plants (NH_4^+, NO_3^-). Furthermore, if urease activity was non-existent, the rate of NH_3 volatilization following urea application would be quite low, even in calcareous soils. This is because NH_4^+ or NH_3 released by the hydrolyzation of urea react with various ions in the soil at high pH levels to produce large concentrations of gaseous NH_3. If urease activities were very high on turfgrass tissue and in thatch, then high levels of NH_4^+ could accumulate on water films covering these materials. Since the hydrolyzation of urea by urease can induce a temporary alkaline pH level within these water films, NH_3 volatilization can occur and become accelerated by subsequent drying.

A comparison of urease activity between thatch, turfgrass tissue, and underlying soil is shown in Table 23. Thatch and turfgrass tissue are shown to have 18 to 30 times more urease activity compared to soil. These results are not conclusive evidence that the above described mechanism exists, but the data does give credence to the hypothesis.

Turgeon et al. (1) have shown that where an extensive thatch exists, it can constitute the primary growing media with underlying soil being of secondary importance. Under these conditions, high levels of urease activity could be beneficial. Urea is mobile and moves quickly down through the thatch. Rapid hydrolysis of urea by urease as it moves through the thatch may allow greater concentrations of NH_4^+ to exist within the root zone.

Further research characterizing urease activity within and upon turfgrass tissues may also provide much needed information on foliar nitrogen uptake after urea applications.

[1]Turgeon, A. J., K. A. Hurto, and L. A. Spomer. 1977. Thatch as a turfgrass growing medium. Ill. Res. 19(3):3-4.

Table 23. Comparison of urease activity between turfgrass clippings, thatch, and underlying soil.

Treatment	% Dry Weight	Number of Repetitions	Mean Urease Activity*
Turfgrass Clippings	25.6	5	1076.3
Thatch	53.0	9	1486.5
Soil	84.0	7	60.0

* Urease activity expressed as ug urea hydrolyzed/g dry wt. of sample/hr.

PUTTING GREEN NITROGEN FERTILITY

J. E. Haley

In April 1976 a study was initiated to evaluate different nitrogen sources and rates of application on an established Penncross creeping bentgrass turf. The turf area was maintained at 0.25 inch mowing height. The area received weekly fungicide applications June through September. Irrigation was performed as needed, however, due to a heavy thatch layer, localized dry spots occurred which prevented thorough wetting of underlying soil. Plot size was 5 x 6 feet and each treatment was replicated three times. Materials were applied by hand.

Quality varied with nitrogen source, (Table 24) rate of application and season. Generally, all treatments provided good quality turf following the spring applications. However, the plots receiving the treatment UF + Urea at 0.25 lb N/1000 sq. ft. each were rated as only fair. Quality decreased throughout the dry, hot summer and by September quality throughout all treatments was only poor to fair. Dollar spot incidence in late May did not vary from treatment to treatment or with different rates.

Table 24. Creeping Bentgrass Fertilization Evaluation

Material	Rate[1] (lb.N/1000) sq.ft.	5/27	6/26[4]	7/23[4]	9/4	Dollar Spot 5/28
$NH_4(NO_3)$	1	8.0 a[3]	5.7	5.0	3.7	8.0 a
$NH_4(NO_3)$	1/2	6.7 bc	6.7	5.3	4.3	8.7 a
Urea	1	7.3 ab	6.3	5.0	3.3	8.3 a
Urea	1/2	7.0 b	5.7	4.7	3.7	8.7 a
NH_42SO_4	1	7.0 b	6.3	5.3	3.3	8.7 a
UF	1	6.7 bc	5.3	5.3	4.0	8.7 a
IBDU	1	6.7 bc	6.0	5.0	3.3	8.0 a
Milorganite	1	6.0 cd	6.0	5.7	4.0	8.0 a
UF + Urea	1/2 + 1/2	7.3 ab	7.0	5.3	4.0	8.0 a
UF + Urea	1/4 + 1/4	5.7 d	4.0	4.0	4.3	8.3 a

[1]Fertilizer applications are made in April, May, August, and September. 1980 applications April, May and September only.

[2]Quality ratings are based on a scale of 1 through 9 with 9 representing best quality, 1 representing worst quality.

[3]Within a date and observation, means with the same letter are not significant.

[4]Scores within this column were not significantly different at the 0.05 level.

IRON FERTILIZATION OF KENTUCKY BLUEGRASS

A. Yust and D. Wehner

Introduction

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

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

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

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

Iron sulfate and iron chelate at rates of 0,1,2 and 4 pounds of actual iron per acre were combined with nitrogen at rates of 0,0.5 and 1.0 pounds per 1000 square feet and applied to a mature Touchdown-Columbia Kentucky bluegrass stand at the Ornamental Horticulture Research center. Foliar applications of the fertilizer treatments were made to the individual 30 square foot plots with a CO_2 sprayer on July 26, 1980 and October 1, 1980. Visual color ratings and chlorophyll determinations were made weekly until color differences no longer existed. Fresh weights and dry weights of clippings taken from the plots were also recorded.

Plots receiving iron showed a greening response 24 hours after both the July 26 and the October 1 treatments. Differences in green color between treatments were detectable for about four weeks after the July 26 treatment. Green color differences due to the October 1, 1980 treatments were noticeable throughout the fall and well into the winter until the first snow cover. These plots will be monitored for early spring greenup and for any overwinter stress that may have occurred as a result of the treatments.

Four more application of the above treatments will be made at times approximating applications made by home lawn care companies. Also, a field study will be conducted to determine at what iron fertilization level toxicity symptoms occur.

Literature cited:

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

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

NITROGEN FERTILIZER MATERIALS AND PROGRAM EVALUATION

J. E. Haley and T. W. Fermanian

Good turfgrass growth is dependent on an adequate supply of all essential elements, as well as on other environmental and cultural factors. Nitrogen is the essential element that receives the most attention in turfgrass fertilization programs. One reason for emphasis on nitrogen is that grasses give a good response to nitrogen fertilization. The behavior of nitrogen, both in the plant and in the soil, place it in the position of being the control element. Supplies of other elements are kept at adequate levels and the turf manager regulates growth by adding or withholding nitrogen.

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

The objectives of this study are to evaluate several slow-release nitrogen sources on a "Baron" Kentucky bluegrass turf. The Kentucky bluegrass area was planted in the spring of 1978 and treatments were initiated on May 2, 1979. Treatments consist of 15 nitrogen carriers or combinations applied at 1 lb N/1000 sq ft in April, May, August, and September (Program I); 2 lb N/1000 sq ft applied in April and August (Program II); and 4 lb N/1000 sq ft applied in April (Program III).

Each treatment was replicated three times with 5 x 6 ft plots in a randomized complete block design. Mowing is performed 2 or 3 times weekly at 1.5 in. and clippings are returned to the plots. Irrigation is performed as needed to prevent wilt. Fertilizer materials are evaluated on a basis of general turfgrass quality with periodic ratings of turf color and visual density.

In general, plots under Program 1 exhibited better spring quality than those under Programs II and III. However, this program produced only fair results throughout the season. Quality for plots under Program II has been intermediate between Programs I and III. Program III provided plots with the highest quality throughout the season except in early spring. Prolific seedhead development in May reduced overall quality under all three programs. Mid-season quality was highest with plots receiving a sulfur-coated urea fertilizer (CIL-SCU, Lakeshore SCU, Lakeshore fairway 28-3-9, Scotts SCU and TVA-SCU) or a combination of a sulfur-coated urea product, IBDU and urea. IBDU exhibited a consistent high quality throughout the season. Milorganite and UF generally produced a low quality turf throughout the spring and summer compared to other treatments. To produce an early response with any slow-release material, it is necessary to initially apply a high rate (as in Program III) or use in conjunction with a water-soluble source such as urea.

Table 25. Nitrogen sources, rates, and application frequencies.

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

Table 26. Evaluation of nitrogen sources, rates and application frequencies.

	Program I (1 lb N/1000 sq ft in Apr., May, Aug., Sept.)									
	Quality[1]						Color[2]	Density[3]	Dollar Spot[4] [5]	Fusarium[4]
Fertilizer	4/6	5/29	6/20	7/29	8/26	10/3	6/26	6/20	8/06	8/26
Scotts 1.9/1 Methylene Urea	6.0	6.7	7.3 bc	6.0	4.7	5.7	8.0	7.3	7.3 abcd	8.3
Hercules UF	5.3	5.7	6.0 d	5.7	4.3	6.0	6.3	6.3	6.3 cd	6.7
Milorganite	6.0	6.0	6.7 cd	5.0	4.0	5.3	7.0	6.7	5.7 de	7.0
Swifts IBDM	7.0	6.0	6.3 d	6.0	5.3	6.7	7.0	7.0	6.7 bcd	8.0
CIL-SCU	6.0	7.0	8.0 ab	7.0	5.7	6.7	8.0	8.0	8.7 a	8.7
Lakeshore SCU	6.3	7.0	8.3 a	7.3	6.3	7.0	7.7	8.3	8.0 abc	8.3
Lakeshore Fairway	6.0	7.0	8.7 a	7.0	4.0	6.3	7.3	8.3	8.3 ab	8.3
Scotts-SCU	6.0	7.0	8.7 a	7.0	6.3	7.0	8.0	7.7	8.0 abc	8.0
Urea	6.0	7.3	8.7 a	5.7	4.7	6.3	3.0	8.0	7.3 abcd	8.0
TVA-SCU	6.3	7.0	8.3 a	7.0	6.7	7.3	8.0	7.7	8.3 ab	7.3
IBDU 24%, TVA-SCU 57% Urea 19%	5.7	6.7	8.3 a	6.7	5.3	6.7	7.3	7.7	8.0 abc	9.0
IBDU 37%,CIL-SCU 43%, Urea 20%	6.0	6.3	8.0 ab	7.0	4.7	5.7	7.7	7.3	7.0 abcd	7.0
IBDU 39%, TVA-SCU 40% Urea 20%	7.0	6.3	7.3 bc	7.3	5.7	6.7	8.0	8.0	7.7 abc	6.7
IBDU 22%, CIL-SCU 60% Urea 18%	7.0	6.7	7.3 bc	7.3	6.3	7.3	8.0	8.7	8.3 ab	8.0
Check	4.0	3.0	3.0 e	3.0	2.0	4.3	3.0	3.0	4.3 e	9.0

[1] Quality ratings are made on a scale of 1 through 9, with 1 representing very poor quality and 9 representing best quality.

[2] Color ratings are made on a scale of 1 through 9, with 1 representing complete chlorosis and 9 representing dark green.

[3] Density ratings are made on a scale of 1 through 9, with 1 representing the least dense and 9 representing the most dense turf.

[4] Disease ratings are made on a scale of 1 through 9 with 1 representing complete necrosis and 9 representing no visible disease symptoms.

[5] Within this column means with the same letter are not significantly different.

Table 27. Evaluation of nitrogen sources, rates and application frequencies.

Program II (2 lb N/1000 sq ft in Apr. and Aug.)

Fertilizer	Quality[1] 4/6	5/29	6/20	7/29	8/26	10/3	Color[2] 6/26	Density[3] 6/20	Dollar Spot[4] 8/6[5]	Fusarium[4] 8/26
Scotts 1.9/1 Methylene Urea	5.0	7.3	7.0 b	6.3	4.3	6.7	7.3	7.7	5.3 def	8.3
Hercules UF	5.3	6.0	6.0 c	4.3	4.3	6.7	6.3	6.3	5.7 cdef	8.7
Milorganite	6.0	6.0	6.0 c	5.3	3.7	6.0	6.7	7.0	6.3 bcdef	6.7
Swifts IBDU	7.0	6.7	7.0 b	7.0	5.3	7.0	7.3	8.0	7.0 abcd	7.7
CIL-SCU	6.3	7.7	8.0 a	6.3	5.3	7.0	8.0	8.0	7.3 abc	8.3
Lakeshore SCU	6.0	7.3	8.0 a	6.7	5.7	7.0	8.0	8.3	6.3 bcdef	7.7
Lakeshore Fairway	5.7	7.0	7.0 b	5.0	4.0	7.0	6.3	8.0	5.0 ef	9.0
Scotts-SCU	5.0	8.0	7.7 ab	7.3	4.7	7.7	7.7	8.3	6.7 abcde	6.7
Urea	5.0	8.0	8.3 a	5.7	4.0	7.3	7.3	8.7	6.3 bcdef	7.3
TVA-SCU	6.3	7.7	8.0 a	8.0	5.7	7.3	8.3	8.0	7.7 ab	8.0
IBDU 24%, TVA-SCU 57%, Urea 19%	5.7	7.3	8.0 a	6.7	4.7	7.0	7.3	8.7	6.3 bcdef	8.7
IBDU 37%, CIL-SCU 43%, Urea 20%	6.0	7.3	7.7 ab	6.7	5.0	7.7	7.0	7.7	6.7 abcde	8.7
IBDU 39%, TVA-SCU 40%, Urea 20%	6.7	7.3	7.7 ab	6.7	4.7	7.0	7.3	8.7	7.3 abc	7.7
IBDU 22%, CIL-SCU 60% Urea 18%	7.0	7.7	7.0 b	6.0	6.3	7.3	8.0	7.7	8.3 a	8.3
Check	4.0	3.0	3.0 d	3.3	2.0	4.0	3.0	3.0	4.7 f	9.0

[1] Quality ratings are made on a scale of 1 through 9, with 1 representing very poor quality and 9 representing best quality.

[2] Color ratings are made on a scale of 1 through 9, with 1 representing complete chlorosis and 9 representing dark green.

[3] Density ratings are made on a scale of 1 through 9, with 1 representing the least dense and 9 representing the most dense turf.

[4] Disease ratings are made on a scale of 1 through 9 with 1 representing complete necrosis and 9 representing no visible disease symptoms.

[5] Within this column means with the same letter are not significantly different.

Table 28. Evaluation of nitrogen sources, rates, and application frequencies.

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

Fertilizer	Quality[1] 4/6	5/29	6/20	7/29	8/26	10/3	Color[2] 6/26	Density[3] 6/20	Dollar Spot[4] 8/6[5]	Fusarium[4] 8/26
Scotts 1.9/1 Methylene Urea	5.0	8.3	8.3 abc	7.7	5.7	5.0	9.0	8.3	7.3 a	7.7
Hercules UF	4.7	6.7	6.7 d	6.3	5.3	6.0	7.3	7.3	7.3 a	7.0
Milorganite	5.7	7.0	7.7 c	7.0	4.3	5.3	8.3	8.0	7.7 a	6.3
Swifts IBDU	5.7	7.0	8.0 bc	7.3	7.0	6.3	8.7	8.3	8.7 a	6.0
CIL-SCU	5.0	8.3	8.7 ab	7.0	7.0	6.0	9.0	8.3	8.7 a	7.3
Lakeshore SCU	5.0	8.3	8.7 ab	8.0	6.3	6.7	8.3	9.0	8.7 a	7.3
Lakeshore Fairway	5.0	8.3	8.3 abc	8.0	6.3	6.3	8.3	8.3	8.7 a	8.7
Scotts SCU	5.0	8.3	8.7 ab	7.3	6.0	6.3	8.3	8.7	9.0 a	6.7
Urea	5.0	8.7	9.0 a	6.7	6.0	5.0	9.0	8.7	8.0 a	8.0
TVA-SCU	5.3	8.7	9.0 a	7.7	5.7	7.3	9.0	9.0	8.7 a	6.0
IBDU 24%, TVA-SCU 57% Urea 19%	5.0	8.7	9.0 a	7.3	5.3	5.7	9.0	9.0	9.0 a	7.0
IBDU 37%, CIL-SCU 43% Urea 20%	5.0	8.3	8.3 abc	7.0	5.7	5.7	8.7	8.7	8.7 a	5.7
IBDU 39%, TVA-SCU 40% Urea 20%	5.7	8.3	9.0 a	7.3	6.0	6.0	9.0	8.3	8.3 a	8.0
IBDU 22%, CIL-SCU 60% Urea 18%	5.3	8.3	8.7 ab	7.0	6.7	6.7	9.0	9.0	8.7 a	5.7
Check	4.0	3.0	3.3 e	3.3	2.0	4.3	3.0	3.3	3.7 b	8.7

[1] Quality ratings are made on a scale of 1 through 9, with 1 representing very poor quality and 9 representing best quality.

[2] Color ratings are made on a scale of 1 through 9, with 1 representing complete chlorosis and 9 representing dark green.

[3] Density ratings are made on a scale of 1 through 9, with 1 representing the least dense and 9 representing the most dense turf.

[4] Disease ratings are made on a scale of 1 through 9 with 1 representing complete necrosis and 9 representing no visible disease symptoms.

[5] Within this column means with the same letter are not significantly different.

MULCHING MOWER STUDY

J. E. Haley and D. J. Wehner

Conventional rotary mowers are typically used with a bagger to catch clippings and thus avoid the accumulation of leaf debris on the turf's surface with each mowing. In recent years, various "mulching" mowers have been introduced which by virtue of their closed housings, do not require a bagger. Clippings are repeatedly chopped and returned to the turf to recycle nitrogen and other nutrients. The primary objectives of this study are to determine the long-term influence of "mulching" mowing compared to conventional rotary mowing with and without clipping removal. Secondary objectives include: determination of the effects of mowing frequency and fertilization rate on annual clipping production and clipping quality (crude protein concentration, digestibility, and feeding quality in poultry)and determination of the influence of clippings on the nitrogen status of a Kentucky bluegrass turf.

The study was initiated on a one-year stand of "Baron" Kentucky bluegrass in April 1979. Main-plot treatments are: mowing at 5 cm with a mulching mower, or with a conventional rear-bagger rotary mower with and without clipping removal, at 1, 2, or 4 times per 2-week period. Subplot treatments are fertilization with 10-6-4 to supply 0, 3 or 6 lb N per 1000 ft^2 per year in increments supplied in April, June, and September. Subplots measured 10 x 6 ft and each treatment combination was replicated 3 times in a randomized complete block design.

An important point of clarification is that the discharge chute of the Toro rear-bagger mower is closed off when the bagger is removed; thus, clippings are not discharged onto the turf but are contained within the housing for additional chopping. This may differ from other rotary mowers that do not have bags or discharge chutes that close when the bag is not in use.

Generally, frequent mowing (1-2 times per week) and a moderate fertility level (3 lb N/1000 sq. ft./year) resulted in the best turf quality. Poorest quality was found where frequent mowing was combined with clipping removal and no applied nitrogen. Plots mowed with the mulching mower were of good quality except where 6 lbs of N was applied with infrequent mowing. On these plots, large deposits of clippings excluded light as well as reduced visual quality. The incidence of dollar spot disease was less severe in plots mowed with the mulching mower. This might indicate a quicker recycling of the nitrogen in the chopped clipping versus conventional clippings.