1978 TURFGRASS RESEARCH SUMMARY

UNIVERSITY OF ILLINOIS

AT URBANA-CHAMPAIGN

(NOT FOR PUBLICATION)

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A. 2. a. <u>Kentucky bluegrass cultivar evaluation.</u>
J. E. Haley and A. J. Turgeon.

The intraspecific variability of Kentucky bluegrass has allowed the development of many cultivars and experimental selections that differ widely in their color, texture, density, environmental adaptation, disease susceptibility, and other factors. There are 52 cultivars plus 10 blends and 4 mixtures from an April, 1972, planting under test at this station. Plots measure 6 x 8 ft and each variety is replicated three times. Fertilizer is applied 4 times per year to supply a total of 4 pounds of nitrogen per 1000 sq. ft., using a 10-6-4 analysis fertilizer. Mowing is performed 2 or 3 times per week at 1.5 inches. The turf is irrigated as needed to prevent wilt. The basis for these efforts is that improvements in the characteristics and adaptation of a turfgrass reduce its dependency on cultural practices designed to compensate for its weaknesses. Thus, turfgrass management is made simpler and higher turfgrass quality is obtainable with the use of improved cultivars.

Due to the late spring green-up this year (reflected in the April quality data), the incidence of Helminthosporium melting-out disease was obscured; however, the May and June quality data provide some indication of the ranking of cultivars as influenced by this disease (Table 1). For example, Nugget is slow to green up in spring but has excellent resistance to melting out; the May and June quality ratings are 5.3 (poor) and 2.7 (good), respectively. The poor rating for May indicates late green-up while the good June rating reflects melting-out resistance. The decline in summer quality shown in the early August rating is typical of Nugget under central Illinois conditions.

Some incidence of stripe smut disease was evident in early June; however, this disease was not as severe as in 1977 due, presumably, to the continually wet weather during this period. In mid-August, some fusarium blight symptoms were beginning to appear, but disease incidence was not sufficient to take data.

Comparison of blend quality with that of the component cultivars alone, shows the mitigating effects of the cultivars upon each other as in previous years. For example, the quality in June for the Nugget-Park blend is intermediate between that observed for Nugget and Park. This reflects the differential susceptibility of these cultivars to melting-out disease. Similar comparisons can be made for other blends in the study.

Generally, many of the newer, melting-out-resistant cultivars have provided acceptable lawn turf quality over the years except where fusarium blight has been severe. In other studies where these cultivars have been subjected to higher or lower cultural intensities, quality levels have varied depending upon the adaptation of these cultivars to cultural extremes. Data from these supplemental evaluations are shown under Kentucky bluegrass cultivar management.

A new Kentucky bluegrass cultivar evaluation was established in August, 1978. This evaluation contains 20 cultivars and cultivar blends, 13 of which have not been previously tested at the University of Illinois. These include the cultivars Columbia, BFC-46-1, BFB-35-1, P-1528T and the blends Majestic-Touchdown, Majestic-Adelphi, Brunswick-Adelphi, Touchdown-Adelphi, Majestic-Brunswick, Merion-Brunswick, Merion-Majestic, Baron-Majestic, and Baron-Brunswick.

A. 2. a. Expanded Kentucky bluegrass selection evaluation.
J. E. Haley and A. J. Turgeon.

With the introduction of many new experimental selections, an additional series of Kentucky bluegrass plots were planted in September, 1974, to determine their performance in central Illinois. Plot size was 5 x 6 ft. and each selection was planted at 2 lb./1000 sq. ft. in three replicate plots. Cultural practices are conducted as in the Kentucky bluegrass cultivar evaluation.

Due to the dry spring there was little disease evident in these plots. Quality level varied with Kentucky bluegrass selection and time during the growing season (Table 2). Several selections from Warren's Turf Nursery (WTN) were particularly outstanding.

A. 2. b. Creeping bentgrass cultivar evaluation.
J. E. Haley and A. J. Turgeon.

Creeping bentgrass cultivars were established in May, 1973 in plots measuring 6 by 8 ft with three replications of each. Mowing height is 0.25 in. and the plots receive a total of 4 lb. N/1000 sq. ft. annually. Irrigation is performed as needed to prevent wilting. A preventative 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 3). One of the poorest cultivars was Toronto which deteriorated severely in 1974 due to red leaf spot and now annual bluegrass covers almost 50 percent of these plots. Other cultivars with reduced quality because of annual bluegrass invasion are Pennlu and Arlington. Good turfgrass quality has been observed with Morrissey, Cohansey, Old Orchard, Pennpar and the experimental selection MSU-AP-38. The experimental selections MSU-AP-18 and MSU-AP-28 deteriorated substantially with the cooler, drier weather.

Table 1. Quality of Kentucky bluegrass cultivars in 1978.

Cultivar	Spring Green-up 4/7/78	Quality[1]					
		10/11/77	5/18/78	6/20/78	8/4/78	10/9/78	11/2/78
A-20(seeded)	3.7	2.7	2.0	2.3	2.3	3.0	3.0
A-20 (veg.)	4.0	2.7	3.0	3.0	2.3	3.0	3.3
A-34	4.0	3.0	3.0	4.0	4.0	4.0	3.0
A-20-6	4.0	1.7	2.3	2.3	3.0	3.7	2.7
Adelphi	4.0	3.0	3.3	3.0	3.0	2.7	2.7
Ba 61-91	5.0	4.3	3.3	2.7	3.3	4.7	4.3
Ba 62-55	5.7	3.7	3.7	3.3	3.7	4.0	3.3
Baron	5.3	4.0	3.3	3.3	3.7	3.7	3.0
Bonnieblue	4.7	4.7	3.3	3.7	4.3	5.0	4.3
Brunswick	4.3	5.2	3.3	3.0	3.3	4.3	3.3
Campina	5.0	4.7	5.0	4.3	4.3	5.0	4.7
Cheri	6.0	3.3	3.3	3.3	3.3	3.7	3.3
Delft	4.0	5.3	4.0	3.3	4.0	5.0	3.7
Enmundi	5.3	3.7	3.7	3.3	3.3	4.3	3.7
EVB-305	6.0	6.0	4.0	4.0	4.3	6.0	4.7
Entopper	5.0	5.0	5.0	4.3	4.7	4.3	4.3
Enoble	6.0	4.0	3.7	3.3	3.7	4.0	3.7
Fylking	5.0	5.7	3.7	3.0	3.7	5.7	4.0
Galaxy	4.3	4.0	3.7	3.7	4.0	4.7	3.7
Geronimo	4.3	5.3	4.0	3.3	4.0	5.3	4.7
Glade	5.7	4.7	4.3	3.3	3.0	3.7	3.0
Kl-131	5.3	4.7	3.3	3.0	3.3	4.7	4.0
Kl-132	4.7	4.7	4.0	3.3	3.3	4.3	4.0
Kl-133	5.0	5.7	4.7	3.3	4.3	4.7	4.0
Kl-138	4.0	7.0	6.0	5.3	4.3	5.3	4.3
Kl-143	4.7	5.0	4.0	3.3	4.0	5.0	4.0
Kl-157	2.3	5.3	5.0	3.3	5.0	6.0	5.0
Kl-158	4.3	3.3	5.0	3.7	4.0	3.7	3.0

Table 1 (cont'd.)

Cultivar	Spring Green-up 4/7/78	Quality[1] 10/11/77	5/18/78	6/20/78	8/4/78	10/9/78	11/2/78
K1-187	4.7	5.0	4.3	3.0	4.3	5.0	3.7
Kenblue	3.7	4.3	4.7	3.7	3.7	4.3	4.0
IL-3817	4.7	4.7	4.3	4.3	4.3	4.7	4.0
Majestic	4.0	4.0	4.0	4.0	4.0	4.3	4.3
Merion	4.7	4.7	3.7	4.0	4.3	4.3	3.7
Monopoly	6.7	4.3	3.7	3.3	3.3	4.3	4.0
Nugget	6.3	6.0	5.3	2.7	4.0	5.3	4.7
P-59	4.6	2.3	3.0	3.7	3.7	4.0	2.3
P-140	2.3	2.7	4.0	2.3	2.7	3.0	3.3
Parade	3.7	3.3	3.0	3.7	3.7	3.7	3.0
Park	3.7	4.7	5.0	4.3	4.7	5.3	4.5
Pennstar	4.3	4.3	4.3	3.7	4.0	5.0	4.0
Plush	4.0	4.3	4.0	3.3	3.3	4.0	3.3
PSU-150	3.7	2.7	3.3	2.7	2.0	3.3	3.0
PSU-169	3.3	4.3	3.3	2.7	3.3	4.3	4.7
PSU-190	4.3	5.0	3.7	3.3	3.7	5.0	4.3
PSU-197	4.7	5.0	4.0	4.0	4.0	5.4	4.7
Ram #1	5.7	3.3	4.3	3.7	3.7	4.7	3.3
Ram #2	4.0	5.7	4.7	3.0	4.0	4.7	3.7
Rugby	5.0	3.7	3.7	4.0	3.7	4.3	3.3
Sodco	5.3	2.3	3.3	2.7	3.0	2.3	2.7
Sydsport	5.3	3.3	3.7	3.7	3.3	3.3	3.7
Touchdown	5.3	3.0	2.3	3.7	2.7	3.0	2.3
Vantage	4.0	4.3	4.0	4.0	4.0	3.7	3.3
Victa	5.0	4.3	3.7	3.3	3.7	3.7	4.0
Windsor	2.3	3.0	4.3	3.7	4.7	5.0	4.0
. . . . .Blends.							
Merion + Kenblue	3.3	4.7	4.7	3.7	4.3	5.0	4.0

Table 1 (cont'd)

Cultivar	Spring Green-up 4/7/78	Quality[1]					
		10/11/77	5/18/78	6/20/78	8/4/78	10/9/78	11/2/78
Merion + Pennstar	4.0	4.3	4.3	3.7	4.3	5.3	4.0
Merion + Baron	5.0	4.0	4.0	3.3	3.3	5.3	4.3
Nugget + Pennstar	5.3	5.3	5.0	2.7	3.7	5.0	4.3
Nugget + Park	3.0	6.0	4.7	3.7	4.0	5.7	4.7
Nugget + Glade	5.7	5.0	4.3	3.7	2.7	4.3	4.0
Nugget + Adelphi	4.3	4.0	4.0	3.0	3.7	4.7	3.7
Victa + Vantage	5.3	4.7	3.7	3.3	3.0	4.7	4.0
P-59 + Brunswick	4.3	4.3	3.0	3.0	3.7	4.3	4.0
Blend 38	4.7	3.7	3.0	3.0	3.3	3.0	2.7
. . . . .Mixtures.							
Fylking + Jamestown RF	4.7	5.3	4.0	4.0	4.0	4.7	4.0
Fylking + Pennlawn RF	4.3	5.7	4.3	3.7	4.3	5.0	4.7
Fylking + C-26 RF	4.0	5.7	4.7	4.0	4.3	5.3	5.3
Fylking + Pennfine PR	2.3	4.7	4.3	4.7	4.7	5.3	5.0

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

Table 2. Expanded Kentucky bluegrass cultivar and experimental selection evaluation.

	Quality						
Selection	10/11/77	4/11/78	5/18/78	6/21/78	8/1/78	10/3/78	11/1/78
Adiker A214	4.7	6.0	4.7	4.3	6.3	4.3	4.7
Adiker K1096	4.0	5.0	3.7	4.7	4.0	4.7	4.7
Burl D517	5.7	5.3	5.0	4.0	5.0	4.7	4.7
Burl F1086	4.0	5.0	4.0	4.0	4.0	4.0	3.7
Burl F1145	3.0	5.3	3.7	3.3	4.3	3.3	3.7
Burl F2039	5.3	5.7	5.0	4.3	5.7	4.7	4.7
Calturf P-143	4.0	4.0	4.7	4.3	5.3	4.7	4.7
Green K860	5.3	5.7	5.0	4.3	5.7	4.0	4.3
GWSH #2	4.7	5.0	4.3	3.7	5.0	4.0	4.7
NK P154	3.3	4.3	4.7	3.7	4.3	3.3	3.7
P-3N	4.0	5.3	3.3	3.3	4.3	3.3	3.7
P-167	5.3	5.0	5.0	4.7	5.7	5.0	4.0
Princetown 104	2.7	4.7	3.0	2.3	2.3	1.3	2.7
Princetown 164	4.3	5.0	4.7	3.7	4.3	3.0	4.0
K1-80	5.0	3.7	6.3	5.7	6.7	5.7	5.3
K1-88	5.0	5.0	6.7	5.7	7.0	5.3	5.7
K1-121	5.0	3.3	5.0	5.0	6.3	5.0	4.7
K1-122	5.0	3.7	7.0	5.7	7.3	5.0	5.3
K1-136	6.0	4.0	5.3	5.3	5.3	5.0	5.0
K1-140	5.3	4.0	5.7	4.7	5.3	4.7	4.7
K1-144	4.0	6.0	3.7	3.3	4.0	4.3	4.3
K1-152	4.3	5.0	4.3	4.0	4.3	3.7	3.7
K1-153	3.7	3.0	4.7	4.3	5.0	4.3	5.3
K1-154	3.0	3.0	4.3	4.0	4.0	4.0	4.7
K1-165	4.7	4.7	4.0	4.3	4.7	4.7	4.0
K1-189	4.0	5.7	3.0	3.7	3.3	4.0	4.3
K2-200	4.7	3.7	4.0	4.0	5.0	4.3	4.7
K3-162	3.3	2.0	3.3	4.3	3.0	4.3	3.0
K3-164	4.3	5.3	4.3	4.3	3.3	3.7	3.7

Table 2. (Cont'd.)

Selection	Quality						
	10/11/77	4/11/78	5/18/78	6/21/78	8/1/78	10/3/78	11/1/78
K3-166	4.0	4.7	3.0	3.3	4.0	3.0	3.3
K3-168	4.3	3.3	4.3	3.7	3.3	3.3	4.0
K3-169	5.3	3.7	4.7	4.3	6.0	4.7	5.3
K3-170	5.0	3.7	4.0	4.0	4.7	4.0	5.0
K3-171	3.3	4.0	4.0	3.7	3.3	3.3	4.0
K3-172	5.0	4.3	5.0	4.3	4.7	4.7	4.0
K3-174	3.3	4.3	3.3	3.0	3.7	3.0	3.7
K3-178	4.0	5.3	3.7	3.7	4.3	4.0	3.7
K3-179	4.0	4.7	4.0	4.0	4.0	3.7	4.3
K3-180	3.3	3.3	3.7	3.3	3.3	3.0	3.0
K3-181	4.0	5.3	3.7	3.7	4.3	4.0	3.3
K3-182	4.7	3.3	5.3	4.0	5.0	5.3	5.0
K3-222	5.3	4.0	4.7	4.7	5.3	5.0	5.0
K8-176	4.7	4.7	4.7	4.0	4.3	4.0	3.7
WTN-A20-6	3.7	5.3	3.7	3.0	3.3	3.7	4.0
WTN-A29-10	2.7	4.3	3.3	2.3	2.3	2.0	2.7
WTN-H-11	3.3	4.3	3.0	3.3	3.0	2.3	2.7
WTN-I-13	2.7	4.3	3.0	2.3	2.3	2.0	2.0
WTN-N-1	3.0	4.3	3.7	3.0	2.3	2.7	2.3
WTN-N-37	4.3	5.7	5.3	3.3	3.3	3.7	3.7
WTN-O-59	4.0	4.3	4.7	4.0	3.0	4.0	3.7
WTN-O-758	3.3	3.3	3.3	2.7	2.3	3.0	3.0
Newport	5.3	4.3	4.7	4.7	5.3	4.7	5.3
Park	5.0	4.0	5.3	4.3	5.0	5.7	5.3
Aquilla	3.7	6.0	3.7	4.3	4.0	4.7	4.0
. . . . . . Blends							
#1 WTN	4.3	4.7	3.3	3.3	3.0	3.0	3.3
#2 WTN	4.0	4.7	3.3	2.7	3.3	2.3	2.3
Prato-Fylking-Pennstar	5.7	5.0	4.3	4.0	5.7	5.0	4.7
Adelphi-Aquilla-Parade-Nugget	4.3	5.3	5.0	4.0	4.7	3.7	4.0

Table 2. (Cont'd.)

Selection	Quality 10/11/77	4/11/78	5/18/78	6/21/78	8/1/68	10/3/78	11/1/78
Adelphi-Aquilla-Parade	3.7	5.3	3.7	4.0	4.7	4.7	4.7
Majestic-Nugget	4.3	5.7	4.3	3.7	3.7	5.0	5.0
Adelphi-Baron	4.0	4.7	4.0	4.3	4.7	3.7	3.7
Bonnieblue-Brunswick-Parade	4.0	4.3	4.3	2.7	3.0	2.7	3.7
Baron-Nugget	5.0	6.7	5.7	4.0	4.7	4.0	4.0
Pennfine-Majestic	5.3	2.3	4.7	5.0	5.0	5.3	4.7
Sydsport-Majestic	4.0	5.3	4.0	2.7	3.0	3.3	3.3

Table 3. Creeping bentgrass cultivar evaluation.

Cultivar	Snow Mold[1]	% Poa annua	Fall Color[2]	Quality[3]				
	3/29/78	6/6/78	10/14/77	10/12/77	6/6/78	8/9/78	10/11/78	10/31/78
Seaside	5.3	31.7	1.0	3.7	5.0	4.3	4.3	4.0
Penncross	5.3	15.0	2.0	3.7	3.7	3.7	4.3	4.3
Washington	4.3	16.7	1.0	5.0	4.0	3.7	4.0	4.3
Toronto	5.0	45.0	1.0	4.7	5.7	4.7	5.7	5.3
Cohansey	6.0	10.0	1.0	3.7	4.3	4.3	3.0	3.0
Pennpar	3.7	16.7	1.0	3.3	3.7	3.3	3.0	4.0
Pennlu	5.0	53.3	3.0	5.0	5.7	4.7	5.3	5.3
Arlington	5.0	43.3	3.0	4.3	4.3	4.7	5.3	5.3
Emerald	5.7	35.0	1.0	4.3	5.0	5.0	4.0	4.7
Congressional	4.7	36.7	1.0	4.0	5.3	4.3	5.0	3.7
Old Orchard	4.3	11.7	2.0	4.0	3.7	3.7	3.3	3.7
Metropolitan	7.0	15.0	1.0	4.0	4.7	4.3	4.7	5.3
Collins	3.0	36.7	3.0	5.0	4.7	3.0	4.0	4.3
Nimisilla	5.0	25.0	7.0	6.7	5.7	5.0	5.3	5.3
Morrissey	3.7	6.7	1.0	5.3	3.0	3.3	3.7	2.7
MSU-AP-18	3.7	36.7	7.0	6.3	5.0	3.7	5.0	6.0
MSU-AP-28	3.7	16.7	7.0	5.7	3.7	3.7	5.3	6.0
MSU-AP-38	3.3	5.7	1.0	5.0	3.3	2.3	3.3	3.7

[1] Snow mold disease ratings were made using a scale of 1 through 9 with one representing no apparent disease and 9 representing complete necrosis of the turf.

[2] Fall color rating based on degree of purple coloration; 1 represents no purple tinge, 4 represents some light purple tinge, and 9 represents a dark purple cast.

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

A. 2. c. Coarse fescue cultivar evaluation.
J. E. Haley and A. J. Turgeon.

Coarse fescues include tall fescue (*Festuca arundinacea*) and meadow fescue (*F. elatior*). These are similar species that are very difficult to distinguish from each other based on vegetative features. Although tall fescue is the principal turfgrass species, the recent introduction of a meadow fescue selection from the Michigan Agricultural Experiment Station necessitates the use of the collective reference -- coarse fescue.

Plots were established in September, 1974, measuring 5 by 6 ft. in three replications. The plots are mowed two or three times per week at 1.5 inches. Total annual fertilization is 4 lb. N/1000 sq. ft. applied in 1-lb increments in April, May, August and Sepember with a 10-6-4 water-soluble fertilizer. Irrigation is conducted as needed to prevent wilting.

Quality of the MSU meadow fescue deteriorated substantially during late summer due, presumably to its poor heat tolerance (Table 4). The experimental selections KO-111 and K4-206 were superior to the others in persistance and general quality. Under this cultural program other turfgrasses - Kentucky bluegrass and annual bluegrass - were more competitive and established persistant stands within the coarse fescue plots. Poor competitive ability and intolerance of the selections to the climatic extremes (heat and cold stresses) in central Illinois are the primary reasons for reduced quality in this evaluation.

Table 4. Coarse fescue cultivar evaluation.

Cultivar	Quality[1]						
	10/11/77	4/11/78	5/17/78	6/14/78	7/28/78	10/3/78	11/1/78
MSU	7.0	2.7	3.0	5.0	7.3	6.0	6.7
Maris-Kasbah	6.0	5.0	5.7	6.0	7.0	6.0	6.0
Maris-Jebal	6.7	4.3	5.7	4.7	7.0	6.0	6.0
KO-103	6.7	4.7	5.7	4.3	7.0	6.0	7.3
KO-111	4.0	4.7	4.0	4.0	5.7	4.0	5.0
K4-206	3.3	4.7	3.7	4.7	5.3	4.0	5.0
K8-108	5.7	4.0	4.7	4.7	6.3	5.7	6.3

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

A. 2. d. Perennial ryegrass cultivar evaluation.
J. E. Haley and A. J. Turgeon.

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

Perennial ryegrass plots were established in September, 1972. Plots measured 6 by 8 ft. and each cultivar was replicated 3 times. Mowing, fertilization, and irrigation were performed as for the Kentucky bluegrass cultivars.

Due to a late spring and little winter injury the cultivars maintained high quality throughout May; however, quality declined substantially during the severe midsummer months (Table 5). Of all the cultivars tested, Manhattan best maintained its high quality throughout the season.

Table 5. Perennial ryegrass cultivar evaluation.

Cultivar	Quality[1]						
	10/12/77	4/7/78	5/18/78	6/14/78	8/14/78	10/10/78	11/2/78
Pelo	5.7	2.6	4.3	4.3	5.0	5.3	4.0
NK-100	5.3	4.3	4.3	5.0	5.3	5.7	4.3
NK-101	5.3	3.6	4.3	4.0	4.7	6.3	5.0
NK-200	5.7	3.6	4.3	4.7	5.0	6.0	5.0
Manhattan	4.3	2.0	2.7	3.3	3.7	4.0	3.0
Pennfine	4.7	3.0	4.3	5.0	4.7	5.0	4.3
Common	6.0	4.0	6.3	6.0	6.3	6.7	6.0
K8-137	4.7	3.0	4.3	4.3	5.0	5.7	5.0
K8-142	4.0	3.0	3.3	4.0	5.0	5.7	4.3

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

A. 3. Kentucky bluegrass - perennial ryegrass mixtures.
A. J. Turgeon and Rick Wilson.

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 block design. The seeding rate for all mixtures was 30 g/plot. Establishment and maintentance were as in A. After two years, two 5 by 5-cm plugs were extracted from all replications of plots planted with 5, 10, 15, 20, 25, 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 (Figure 1). 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. These differences are further evident in the snow mold data taken in late March; due to the high susceptibility of the perennial ryegrasses to this disease, the severity of snow mold is indicative of the proportion of perennial ryegrass in the plots (Table 6).

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.

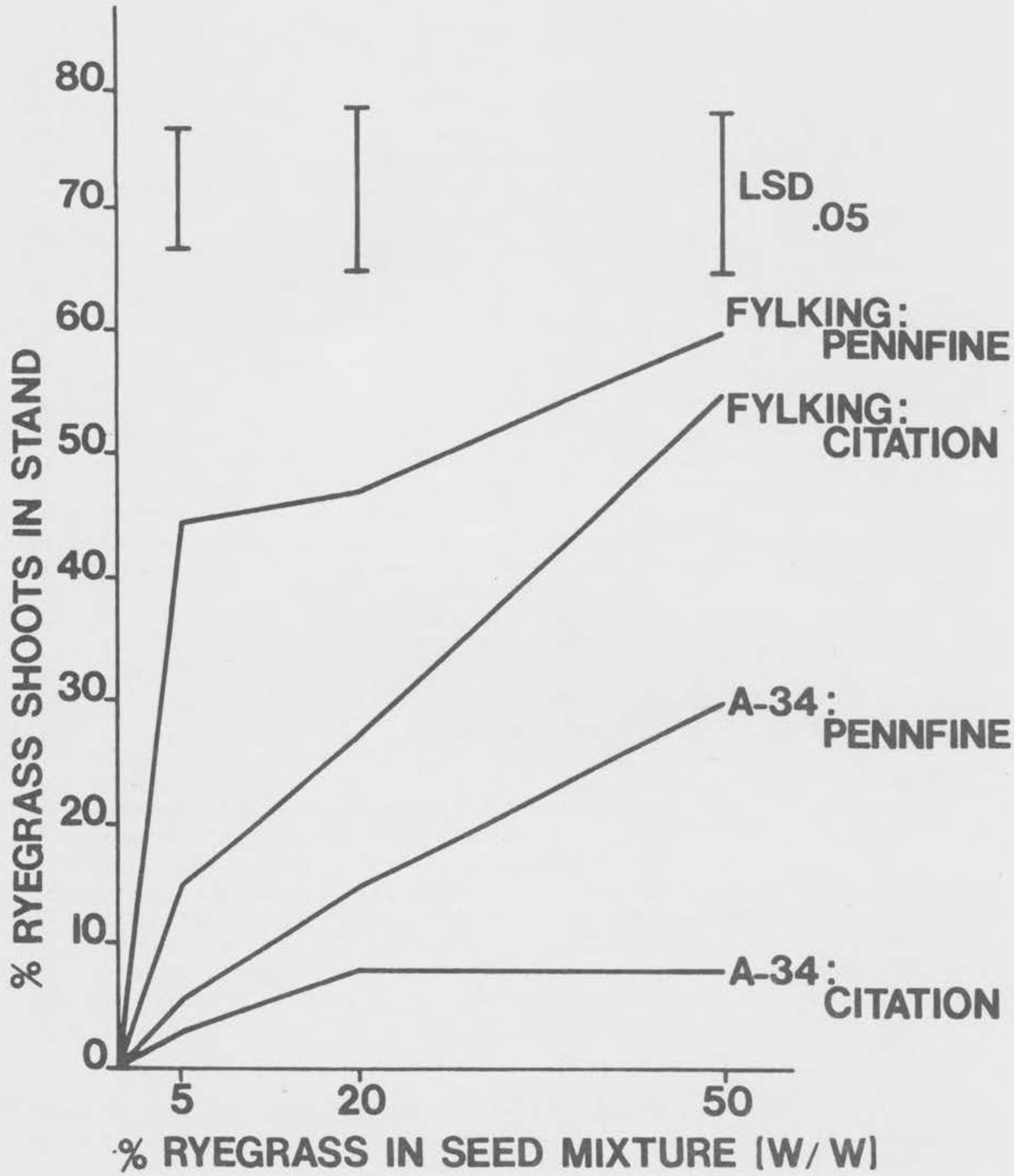


Figure 1. Effects of cultivars and % ryegrass seed by weight on the ryegrass component in ryegrass-Kentucky bluegrass communities.

Table 6. Incidence of typhula snow mold in Kentucky bluegrass-perennial ryegrass turfgrass communities.

% Perennial Ryegrass in Seed Mixture		Kentucky Bluegrass Fylking	A-34
		Snow Mold Rating[1]	
Pennfine	0	4.0	1.7
	5	7.7	3.7
	10	8.3	4.3
	15	9.0	4.3
	20	9.0	5.0
	25	9.0	4.7
	50	9.0	7.0
Citation	0	3.7	2.0
	5	6.0	3.0
	10	6.3	2.7
	15	7.0	2.3
	20	6.3	3.7
	25	6.7	3.0
	50	7.3	4.3

[1] Snow mold rating was made on March 28, 1978, using a scale of 1 to 9 with 1 representing no disease and 9 representing very severe disease incidence.

B. 2. b. Influence of thatch on mobility and transformation of nitrogen carriers applied to turf. K.E. Nelson, A.J. Turgeon, and J.R. Street.

Thatch frequently exists as part of the edaphic environment of a turfgrass community and, thus, should be considered when attempting to determine the fate of topically applied fertilizers in turf. The purpose of these investigations was to determine the influence of a thatch layer on the vertical mobility and transformations of soluble and slowly soluble N carriers following application.

Measurements of N leaching, retention, and volatilization were made using undisturbed cores of thatch and Flanagan silt loam (Aquic Argiudoll) soil. Urea was selected as the soluble N carrier, and isobutylidene diurea (IBDU) was the slowly soluble N carrier. For the leaching studies, the cores were placed in a specially designed apparatus constructed from plexiglass and porous ceramic plates. Under continuous suction, the media cores drained in a fashion similar to that expected in the field. Leachates from the cores were collected and analyzed daily for N. At the conclusion of each 15-day experiment, the media cores were separated into upper and lower portions, and also analyzed for total N content.

Results showed that urea-N was more readily leached from the media cores than was IBDU-N (Table 7). Subtracting leached N from untreated cores, the difference between urea- and IBDU-treated cores was approximately nine-fold. Substantially more N was leached from thatch cores than from soil due, presumably, to the coarser texture and greater aeration porosity of the thatch. In the first few days following application of the fertilizers, some of the leached N was in the form of unhydrolyzed urea. A significant interaction between media and N carrier was observed; where urea was applied to the thatch cores, nearly all of the nitrogen leached through while almost none of the IBDU-N was leached (Figure 2). In comparison, more of the IBDU-N and less of the urea-N was leached from the soil cores. Presumably, this reflects the more favorable conditions in soil for solubilizing N from IBDU as well as the reduced infiltration and greater adsorptive capacity of soil for retaining ammonium nitrogen. The difference between concentrations of total and inorganic N (minus leached urea) was most apparent from urea-treated cores (Figure 3). Essentially no difference in N form in the leachates were observed from IBDU-treated cores.

As expected, N retention was greater in IBDU-treated cores compared to the cores receiving urea (Table 8). Nearly all of the retained N was in the upper portion of the cores. The interaction between media and N carrier, illustrated in Figure 4, shows how N carrier influences the potential for N leaching from thatch. The interaction between N carrier and core section shows that the retention of N in the upper portion of the cores was largely due to the residual IBDU at the core surfaces (Figure 5).

For the volatilization studies, thatch and soil cores were placed in a chamber in which air flow carried NH_3 gas from the cores to a trapping flask containing boric acid solution. Analysis of the trapping solution for N provided an accurate measure of N volatilization as NH_3. While almost no volatilization of N occurred from IBDU-treated cores, substantial N volatilized from urea-treated cores (Table 9). Much more volatilization of N occurred from the thatch than from soil cores. The interaction between media and N carrier, illustrated in Figure 6, shows the higher incidence of N volatilization from urea-treated thatch.

These results suggest that use of urea as the primary N carrier in a turfgrass fertilization program can result in great inefficiencies in N utilization due to its high susceptibility to leaching and volatilization losses. Where a surface thatch layer exists, these losses can be especially large. Selection of slowly soluble N carriers, such as IBDU, for providing N to turfgrasses can be expected to result in more efficient use of the applied N.

Table 7. Comparison of fertilizer and media effects on nitrogen leaching from turf cores as inorganic-N plus urea and as inorganic-N only≠.

	Leached N, mg/core					
	Days after Fertilization					
TREATMENT	1-3	4-6	7-9	10-12	13-15	TOTAL
FERTILIZER						
UREA	12.3	8.1	4.3	2.3	2.9	29.9
IBDU	1.2	1.7	2.3	1.7	1.2	8.1
UNTREATED	0.9	0.7	0.6	1.2	2.0	5.4
Significance	**	**	**	ns	ns	**
MEDIA						
THATCH	6.7	4.9	2.9	1.9	2.3	18.7
SOIL	2.9	2.0	2.1	1.5	1.7	10.2
Significance	**	**	ns	ns	ns	**
N FORM						
INORGANIC[e]	3.7	3.0	1.8	1.0	1.5	11.0
TOTAL-N[f]	5.9	4.0	3.2	2.5	2.5	18.1
Significance	**	ns	ns	ns	ns	*

*,**,ns Significance of the F values at the 0.05 and 0.01 levels and not significant, respectively.

≠ Total N applied as urea or IBDU was 55.8 mg/5-cm-diam. core.

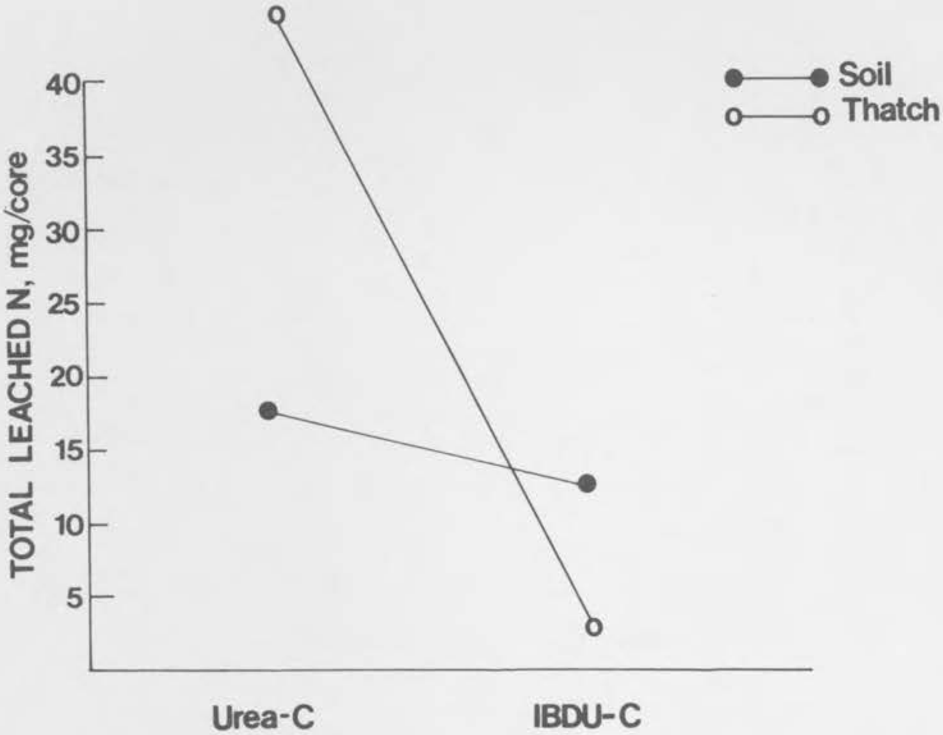


Figure 2. Interaction between media (soil vs thatch) and N-carrier (urea vs IBDU).

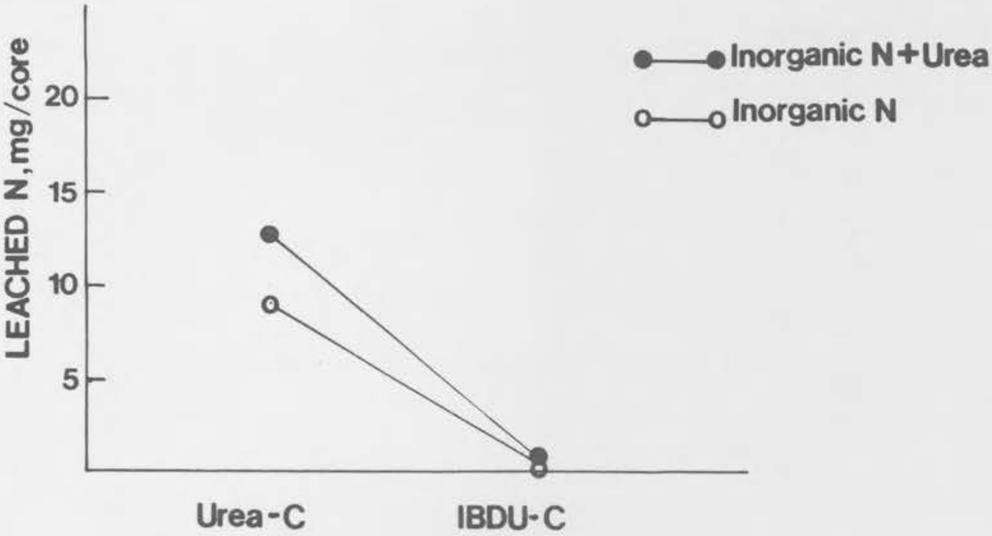


Figure 3. Interaction between N-form in leachates and N-carrier used in fertilization.

Table 8. Comparison of fertilizer and media effects on nitrogen retention, in upper and lower turf cores.

TREATMENT	RESIDUAL N MG/CORE
FERTILIZER	
UREA	16.8
IBDU	45.8
Significance	**
MEDIA	
THATCH	25.4
SOIL	37.2
Significance	ns
CORE SECTION	
UPPER	29.9
LOWER	1.3
Significance	**

**, ns Significance of the F values at the 0.01 level and not significant, respectively.

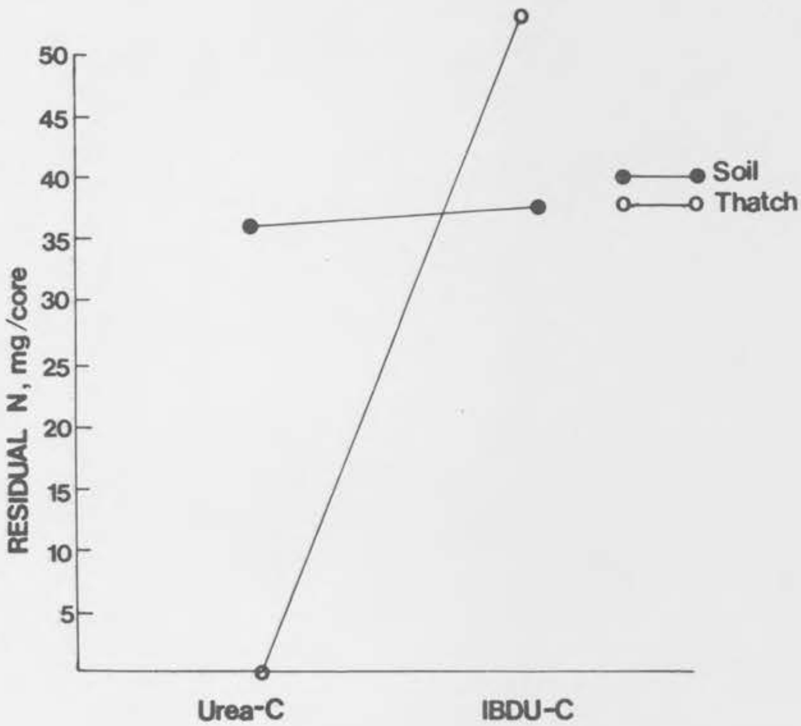


Figure 4. Interaction between media (soil vs thatch) and N-carrier (urea vs IBDU) showing that the differences in N retention were due primarily to the susceptibility of urea-N to leaching from thatch.

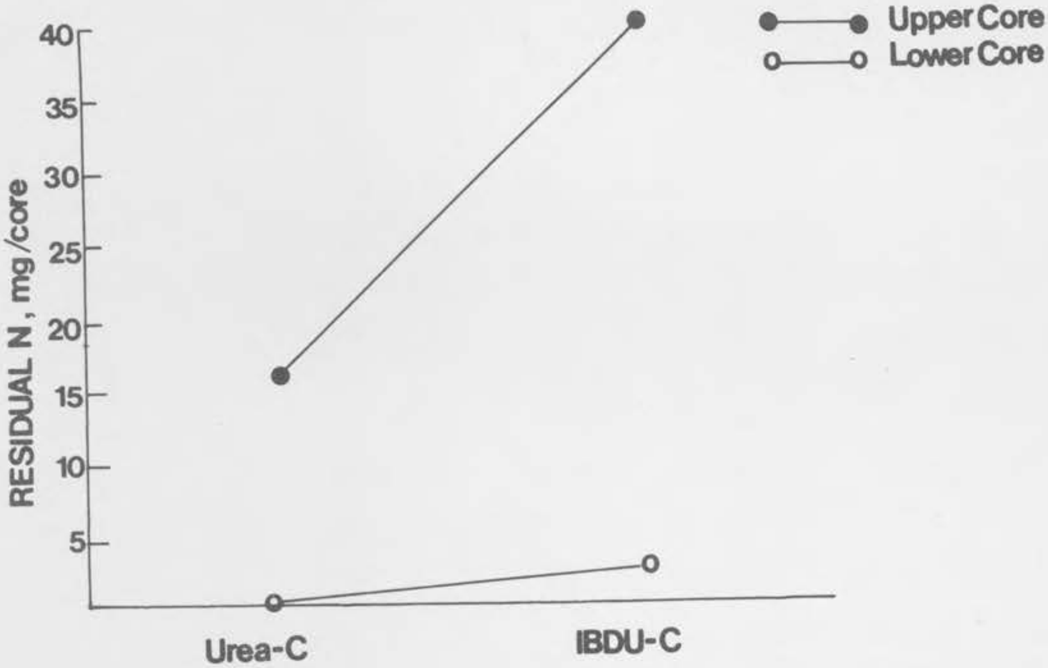


Figure 5. Interaction between N carrier and core section as they influence N retention by the media.

Table 9. Comparison of fertilizer and media effects on the volatilization of ammonia from turf cores receiving 55.8 mg N.

	Volatilized N, mg/core Days after Fertilization								
TREATMENT	1	2	3	4	5	6	7	8	TOTAL
FERTILIZER									
UREA	3.36	3.98	2.51	1.34	0.77	0.62	0.37	0.14	13.09
IBDU	0.02	0.00	0.01	0.00	0.04	0.10	0.07	0.03	0.27
UNTREATED	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02
Significance	**	**	**	**	**	*	ns	ns	**
MEDIA									
THATCH	1.54	2.30	1.60	0.89	0.54	0.48	0.29	0.11	7.75
SOIL	0.72	0.35	0.08	0.00	0.00	0.00	0.00	0.00	1.15
Significance	**	**	**	**	**	*	*	*	**

*,**,ns Significance of the F values at the 0.05 and 0.01 levels and not significant, respectively.

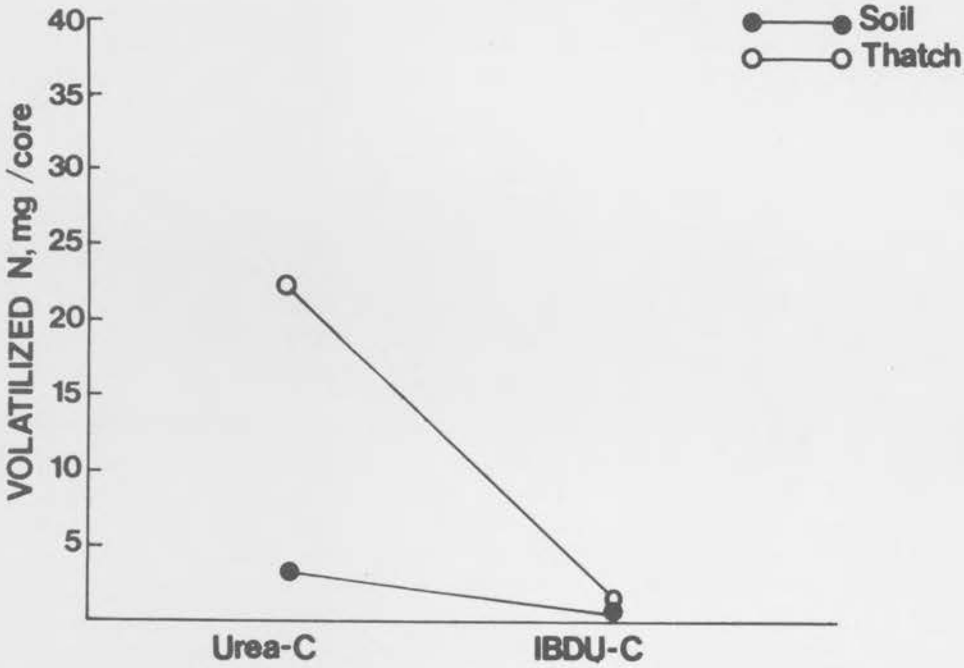


Figure 6. Interaction between media (soil vs. thatch) and N carrier (urea vs IBDU) showing considerably more volatilization urea-treated thatch.

B. 2. b. Factors influencing the cation exchange capacity of turfgrass thatch. T. K. Danneberger and A. J. Turgeon.

Previous studies performed at the University of Illinois have shown that where a substantial thatch layer exists, it can serve as the primary growth medium for turfgrasses. Physically, thatch is a highly porous medium with considerable aeration porosity, but poor nutrient- and water-holding capacities. Earlier attempts at measuring the cation exchange capacity (CEC) of thatch samples led to highly variable and inconclusive results. Much of the variability was apparently due to differences in: structural organization, pH, soil mineral matter concentration and type, degree of organic matter decomposition, and extraction technique. Therefore, this project was initiated: first, to develop a method for obtaining consistent and accurate measurements of CEC with thatch; and, second, to determine the extent to which the aforementioned variables influence the CEC measurement.

Samples of 2-inch-deep Kentucky bluegrass thatch were collected from a Chicago lawn site, and CEC was measured using different extracting reagents, including: ammonium acetate, sodium acetate, calcium acetate, and barium acetate. Each reagent was used on both undisturbed and finely ground (40 mesh) samples to determine the effect of grinding on CEC. Undisturbed samples of known volume were placed in open glass cylinders packed at both ends with glass wool. Reagents and solvents were allowed to pass through the samples slowly to: wash adsorbed ions from the exchange sites, saturate the exchange sites with specific cations (ammonium, sodium, calcium or barium), and, then, remove the cations for quantitative determination.

Results showed that the ammonium acetate method, widely used for soil CEC determinations, provided substantially higher values than when other extracting reagents were used (Table 10). Also, the variability among replications was much greater with this method. CEC values are typically expressed as me (milli-equivalents) per 100 g (grams). Since "clean" thatch may have a bulk density much lower than that of soil, CEC comparisons between thatch and soil can lead to erroneous conclusions unless expressed on an undisturbed-volume basis. Therefore, the values in Table 10 have also been given as me/100 cc. When the structural integrity of the thatch samples was destroyed by grinding, the volume of the organic material was reduced to approximately one-third that of the undisturbed samples; thus, CEC in me/100 cc increased nearly three-fold. It is assumed that multiplying CEC values for soil and thatch, by their bulk densities will provide values that can be compared for estimating relative nutrient-retention properties. For example, a silt loam with a CEC of 28 me/100 g and a bulk density of 1 g/cc will have a volume-based CEC of 28 me/100 cc. Comparing this to the thatch sample with a CEC of 58 me/100 g, or 5.4 me/100 cc (undisturbed, BaAc-extracted mean in Table 10), shows that the thatch has much lower (approx. one-fifth), not higher, nutrient-retention properties than the soil. These results confirm earlier speculation that nutrient retention by thatch is relatively poor, and help to explain the results obtained by Nelson, Turgeon, and Street in studies to determine the influence of thatch on nitrogen mobility in turf.

Since thatch is a predominantly organic medium, its pH may substantially influence CEC if the exchange sites are due, at least in part, to ionization of hydrogen from carboxyl and hydroxyl groups. A study was undertaken to determine the influence of pH on CEC by varying thatch pH by means of various buffer solutions prior to employing the barium acetate method for CEC determination. Results showed that, as pH increased from 2.5 to 8.0, CEC increased nearly five-fold (Figure 7). Even within a reasonable range of 5.0 to 7.0, the increase in CEC was approximately 40 percent, a substantial increase that may importantly influence the retention of nutrient cations by thatch.

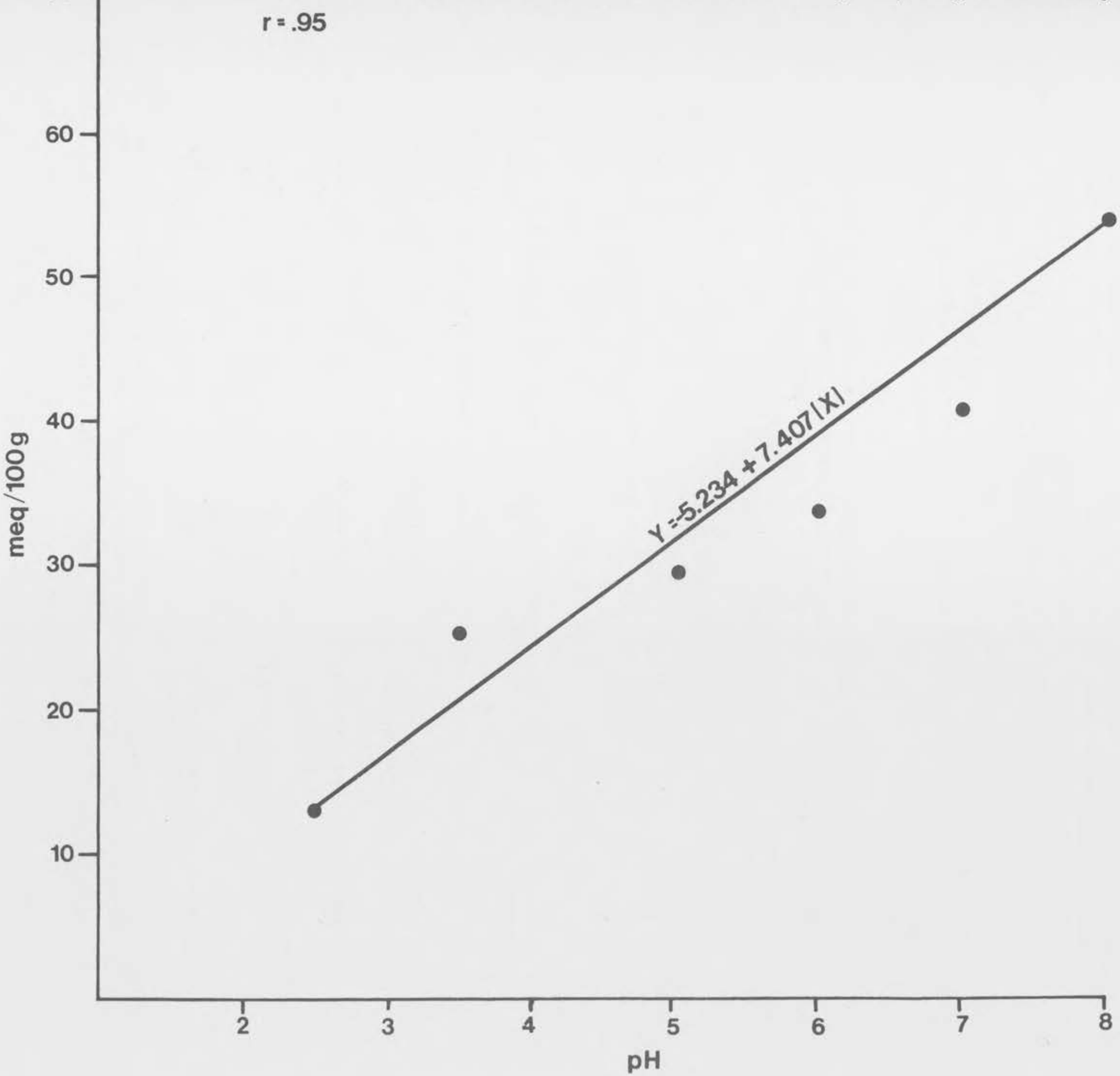
Additional studies are underway to determine the range of variability among naturally occurring thatches and thatch derivitives. Hopefully, increased understanding of this phenomenon in turf will suggest means of improving turfgrass quality where thatch is a persistent and significant problem.

Table 10. Influence of extracting reagent and grinding on the cation exchange capacity of Kentucky bluegrass thatch.[1]

Reagent	Sample	Cation exchange capacity	
		me/100 g	me/100cc
1N-CaOAc	undisturbed	42.94	3.87
	ground	40.88	9.94
1N-NaAc	undisturbed	46.99	4.14
	ground	47.64	10.90
1N-BaAc	undisturbed	58.11	5.41
	ground	57.51	13.65
1N-NH_4Ac	undisturbed	76.24	7.25
	ground	79.67	19.25

[1] Table values are the means of eight replications.

Figure 7. Influence of pH on the cation exchange capacity of Kentucky bluegrass thatch.



C. 1. The utilization of dehydrated, pelleted and ensiled turfgrass clippings as a ruminant feed. J. M. Stookey, F. C. Hinds, A.R. Cobb, A. J. Turgeon.

Work during the past year has emphasized the evaluation of the nutritive value of the crude protein in turf clippings, the possible influence of season of production and geographic location on intake and digestibility of dehydrated, pelleted clippings and the effectiveness of ensiling fresh turfgrass clippings with corn as a method preserving clippings for subsequent feeding to ruminants.

Clippings obtained from Wisconsin and harvested in late-season (17.5°C mean daily temperature) as compared to mid-season (26.7°C mean daily temperature) did not differ in digestibility or voluntary intake. The dry matter digestibilities of clippings were higher than previous values obtained from the same location (65% vs. 55 and 56%). In discussion with the manager of the turf farm, it is apparent that the initial samples studied did not represent normal, vegetative material, but contained considerable mature and dead material. This depressed the digestibility of previous samples of clippings and emphasizes the necessity of a proper management and clipping schedule for the production of high quality clippings.

Comparing high quality clippings from Wisconsin with similar clippings from California, it is apparent that clippings from Wisconsin were superior to those from California in dry matter digestibility (65% vs 61% respectively). Thus, previous data that suggested a geographic influence on clipping quality probably reflect more the influence of management and clipping schedule than geographic location.

Studies on the composition and utilization of dehydrated, pelleted turfgrass clippings reflect the fact that clippings can be a very good supplemental protein source in ruminant diets. The amino acid composition of the protein in clippings is in many respects equal or superior to that of soybean meal. Very little (13% of the total nitrogen) of the crude protein in clippings is in the form of non-protein nitrogen. Metabolism studies with lambs comparing clippings and soybean meal as protein supplements indicate the apparent digestibility of the crude protein from dehydrated clippings was the same as that from soybean meal. The amount and percent of the absorbed nitrogen retained by the animal were also similar. Thus, except for lower levels of crude protein (25-29% vs 44-50%) in dehydrated clippings as compared to soybean meal it would appear that dehydrated, pelleted turfgrass clippings from properly managed turf areas are an excellent source of crude protein for the ruminant, and essentially equivalent to soybean meal on a unit of protein basis.

Because pelleting and dehydration are energy-intensive processes and the initial investment of developing facilities for dehydration and pelleting is high it is important that alternate methods of preservation be studied. Ensiling is frequently used to preserve high to medium moisture-level materials for future feeding to ruminants.

Because high-moisture forages sometimes do not make high quality silage our studies included the addition of various levels (10, 20 and 40% on a dry matter basis) of available energy (ground, shelled corn) to fresh clippings at the time of ensiling. The silages produced were analyzed for organic acids as well as fed to lambs in a growth study. The silages prior to feeding were all brought to the same (50%) overall level of ground, shelled corn on a dry matter basis by the addition of ground, shelled corn.

Data from analysis of silage samples indicate all of the silages had low enough pH and adequate levels of lactic acid to adequately preserve the clippings. The corn-supplemented silages were readily consumed by growing finishing lambs. When gains of lambs fed the silages were compared to gains of lambs on a standard, high-concentrate finishing diet, there were no differences. Also there were no differences in gains of lambs receiving any of the supplemented silages. From the foregoing, it is apparent that ensiling fresh turfgrass clippings, with small additions of ground,shelled corn is a very acceptable method of preserving clippings if they are to be fed to ruminants. Lamb gains and efficiency of gains indicate diets containing 50% ensiled turf clippings and 50% ground, shelled corn on a dry matter basis are equivalent to a diet containing 80% concentrates. This indicates the very high availability of energy in turf clippings.

Future work will include trial studies on the influence of season on digestibility and intake of dry matter in dehydrated, pelleted turfgrass clippings scheduled for early 1979.

C. 1. Evaluation of turfgrass clippings in diets for the growing chick.
G. M. Willis and D. H. Baker.

The extent to which rations are able to impart the characteristic yellow color to egg yolk or to the skin of broilers is important in determining the overall value of a ration for poultry. There are several feedstuffs added to poultry rations for just this purpose. Among the most common are corn gluten meal, dehydrated alfalfa meal and marigold meal. These feedstuffs supply xanthophylls which are the primary compounds that supply the egg yolk and the skin the yellow pigments necessary for their bright yellow color. Recently another feedstuff, dried trufgrass clippings (TGC), has been suggested as a source of xanthophyll for poultry diets. To study this possibility, two groups of 168 male crossbred chicks were fed 23% crude protein corn-soybean meal diets with and without 5% TGC from hatching to 23 days of age. Visual appraisal indicated considerably greater pigmentation of the skin and shanks in chicks fed TGC. Weight gains were not reduced by the TGC addition, but gain/feed ration was reduced slightly. Subsequent chick bioassays of pigmentation value indicated that TGC contains approximately four times the bioavailable xanthophyll of corn gluten meal. In addition to the high level of xanthophyll, nutrient analysis of TGC also indicates a crude protein of 22% and a total sulfur amino acid content of .45% (.35%

methionine and .10% cystine). The true metabolizable energy value of TGC has also been determined, by bioassay, to be 1928 kcal/kg.

Since TGC contained a moderate quantity of protein, studies were undertaken to evaluate the protein quality of TGC. Ninety male crossbred chicks were fed isonitrogenous, isocaloric diets (10% CP; 3100 kcal ME/kg) containing either methionine-supplemented soybean meal (SBM) or TGC as the sole source of protein. The SBM diet was used as a positive control since this diet is one of excellent protein quality for the chick. Weight gain and feed consumption were significantly greater in chicks fed SBM than in those fed TGC, but gain/feed and protein efficiency ratio (PER; gain/protein intake) were uninfluenced by source of protein. Supplementation of TGC with the two amino acids (methionine and lysine) most likely to improve protein quality did not enhance chick performance or improve gain per unit of protein intake. This indicates that neither of these amino acids were deficient in TGC for the chick. Similar studies have confirmed that the protein quality of TGC is indeed on a par with soybean meal. It is apparent, therefore, that TGC has potential in poultry diets, not only for its xanthophyll content but also for its contribution of high-quality protein.

Further studies are planned to determine the value of TGC in swine diets. The chick data thus far collected, when extended to swine, indicate that TGC could supply most, if not all, of the protein needs of the gestating gilt. It also appears that the energy value of TGC is adequate for gestating swine with perhaps only minor additional energy from a cereal grain required. Thus, the value of TGC as a source of protein and energy for gestating swine will be determined in the near future.

C. 3. Nitrogen fertilizer materials and program evaluation.
J. R. Street and J. E. Haley.

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 number of nitrogen-containing fertilizers are presently available on the market for turfgrass fertilization: water-soluble, slowly-soluble, and slow release. These materials vary considerably in their chemical and physical properties. Slow-release products such as urea-formaldehyde (UF) and milorganite (natural organic) have been available for years. Others such as isobutylidene diurea (IBDU) and methylene ureas are newer, while sulfur-coated ureas are just now becoming important in the industry. Since slow-release and slowly-soluble 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 slowly-soluble and slow-release nitrogen sources on a mature 'Pennstar-Fylking-Prato' Kentucky bluegrass turf (Table 11). The Kentucky bluegrass area was maintained at 4 lb N/1000 sq. ft./yr. and a 1.5-in. mowing height prior to initiation of treatments on April 28, 1978. Treatments consist of 14 nitrogen carriers applied at various rates and application frequencies. Each treatment was replicated three times with 5 x 6 ft plots in a completely randomized block design. Mowing is performed 2 or 3 times weekly at 0.75 in and clippings are returned. Irrigation is performed as needed to prevent wilt.

Table 11. Nitrogen sources, rates, and application frequencies.

Fertilizer	Analysis	lb N/M	Application Dates
1. Scotts 1.9/1 Methylene Urea	39-0-0	1.0	April, May, Aug., Sept.
		2.0	April, August
		4.0	April
2. Swifts IBDU Coarse	31-0-0	"	April, May, Aug., Sept.
3. Hercules UF	38-0-0	"	" " " "
4. Milorganite	6-2-0	"	" " " "
5. Canadian Industries Limited - SCU	32-0-0	"	" " " "
6. Tennessee Valley Authority - SCU	36-0-0	"	" " " "
7. Scotts - SCU	38-0-0	"	" " " "
8. Urea	45-0-0	"	" " " "
9. Swifts KH Expt.	10-4-5	"	" " " "
10. Swifts Azumin Expt.	15-3-9	"	" " " "
11. Swifts Kedlor Expt.	37-0-0	"	" " " "
12. Swifts IBDU Coarse (NM)	31-0-0	"	" " " "
13. Lakeshore SCU	36-0-0	"	" " " "
14. Lakeshore SCU Complete	23-5-5	"	" " " "

Fertilizer materials are evaluated on the basis of color and visual density ratings and plant height measurements at 2-week intervals during the growing season. Plant height measurements are made 3 to 4 days following mowing. All nitrogen fertilizers showed improved color and overall quality with Programs II and III compared to Program I three to four weeks following initial applications (Tables 12 & 13). With the second 1 lb N application under Program I, color and overall quality were comparable with Programs II and III with most nitrogen sources at 8 weeks. UF produced a low quality turf compared to other treatments through the spring under Programs I and II. UF applied at the 4 lb N rate under Program III was comparable in quality to other treatments throughout the growing season. Single spring applications showed slightly greater growth responses with many sources as indicated by plant height measurements (Table 14). Swifts Kedlor experimental caused severe yellowing for several weeks following application at all fertilizer rates in the spring.

All nitrogen fertilizers showed improved color and overall quality with Program I and II compared to Program III 10 days following the August applications (Tables 12 & 13). Except for UF, no major differences were evident in color or overall quality between fertilizer sources under Program I or II following August applications. Programs I and II showed superior quality to Program III for all fertilizer sources during the late summer-fall period. Kedlor, as in the spring, caused severe yellowing with more moderate temperatures in the fall.

Table 12. Color ratings for various slowly-soluble and slow-release nitrogen fertilizers on Kentucky bluegrass.[1]

	Program I					
	1 lb N/M					
	Apr.		May	Aug.		Sept.
	5/23/78	6/31/78	8/5/78	9/5/78	10/13/78	11/1/78
Scotts 1.9/1 Methylene Urea	4.0	2.7	4.0	3.3	3.3	4.0
Swifts IBDU Coarse	4.3	2.3	4.0	3.5	3.3	4.0
Hercules UF	5.3	4.0	4.3	4.0	4.3	4.3
Milorganite	4.7	3.0	4.0	3.2	4.0	4.5
CIL - SCU	4.7	2.7	4.0	3.0	3.0	3.3
TVA - SCU	4.3	3.0	4.0	3.0	3.0	3.7
Scotts SCU	4.0	3.0	4.0	3.0	2.8	3.7
Urea	4.0	2.7	4.0	3.0	3.0	4.0
Swifts KH Expt.	4.7	3.0	4.0	4.0	4.0	5.3
Swifts Azumin Expt.	4.3	2.7	4.0	3.0	3.0	3.7
Swifts Kedlor Expt.	5.0	3.3	4.0	5.3	3.3	7.0
Swifts IBDU Coarse (NM)	4.3	2.3	4.0	3.3	3.0	3.3
Lakeshore SCU	4.3	3.0	4.0	3.0	3.0	3.7
Lakeshore SCU Complete	--	--	--	3.0	3.0	3.3
Check	6.0	5.0	4.5	4.5	5.0	6.0

[1] Color ratings were made on a scale of 1 through 9 with 1 representing best and 9 representing poorest.

Table 12. (Cont'd.)

Fertilizer	Program II 2 lb N/M Apr. Aug.					
	5/23/78	6/31/78	8/5/78	9/5/78	10/13/78	11/1/78
Scotts 1.9/1 Methylene Urea	3.0	3.0	4.0	3.3	3.0	3.7
Swifts IBDU Coarse	3.3	2.3	4.0	3.0	3.0	3.3
Hercules UF	4.7	3.3	4.0	3.3	3.0	4.0
Milorganite	3.7	3.3	4.0	3.0	3.7	4.7
CIL - SCU	3.3	2.7	4.0	3.0	3.0	3.7
TVA - SCU	3.3	3.0	4.0	3.0	3.0	3.7
Scotts SCU	3.0	2.7	4.0	2.8	3.0	4.0
Urea	3.0	3.0	4.0	3.0	3.0	4.3
Swifts KH Expt.	3.7	3.0	4.0	3.7	3.0	4.3
Swifts Azumin Expt.	3.3	3.0	4.0	3.2	3.0	4.0
Swifts Kedlor Expt.	6.7	3.3	4.0	5.7	3.0	4.3
Swifts IBDU Coarse (NM)	3.7	2.7	4.0	3.0	3.0	3.5
Lakeshore SCU	3.3	2.7	4.0	3.3	3.0	4.0
Lakeshore SCU Complete	--	--	--	2.8	3.0	4.0
Check	6.0	5.0	4.5	4.0	3.5	5.5

[1] Color ratings were made on a scale of 1 through 9 with 1 representing best and 9 representing poorest.

Table 12. (Cont'd.)

Fertilizer	Program III 4 lb N/M Apr.					
	5/23/78	6/31/78	8/5/78	9/5/78	10/13/78	11/1/78
Scotts 1.9/1 Methylene Urea	3.3	2.7	4.0	3.3	4.3	5.3
Swifts IBDU Coarse	3.7	3.0	4.0	3.7	4.0	5.0
Hercules UF	3.3	2.3	3.7	3.0	4.3	3.7
Milorganite	3.0	3.0	4.0	3.0	4.0	4.3
CIL - SCU	2.7	2.7	4.0	3.7	4.0	5.3
TVA - SCU	2.7	2.7	4.0	3.7	4.3	5.3
Scotts SCU	3.0	2.7	3.7	4.0	5.0	6.0
Urea	2.7	2.7	4.0	3.7	4.0	5.0
Swifts KH Expt.	3.3	2.7	4.0	3.3	4.0	5.7
Swifts Azumin Expt.	3.3	2.7	4.0	3.3	4.3	5.3
Swifts Kedlor Expt.	7.7	3.0	4.0	4.0	4.3	5.7
Swifts IBDU Coarse (NM)	3.0	2.0	3.7	3.3	4.0	5.3
Lakeshore SCU	2.7	2.0	4.0	4.0	4.0	5.0
Lakeshore SCU Complete	--	--	--	3.7	3.3	4.3
Check	6.0	5.0	4.5	5.0	5.0	6.0

[1] Color ratings were made on a scale of 1 through 9 with 1 representing best and 9 representing poorest.

Table 13. Density ratings for various slowly-soluble and slow-release nitrogen fertilizers on Kentucky bluegrass.[1]

Fertilizer	Program I, 1 lb N/M: Apr.		May		Aug.	Sept.
	5/23/78	6/31/78	8/5/78	9/5/78	10/13/78	11/1/78
Scotts 1.9/1 Methylene Urea	3.7	2.3	2.3	2.3	3.3	3.3
Swifts IBDU Coarse	4.7	2.0	2.0	2.3	3.0	3.0
Hercules UF	4.7	3.0	2.3	3.0	3.3	3.3
Milorganite	4.7	2.7	1.7	2.3	3.0	3.0
CIL - SCU	4.3	2.0	1.7	2.7	3.0	2.7
TVA - SCU	4.3	2.0	2.0	2.0	3.0	2.3
Scotts SCU	3.7	2.0	2.0	2.3	3.0	2.7
Urea	3.3	2.0	2.0	2.0	3.0	2.3
Swifts KH Expt.	3.3	2.0	2.3	2.7	3.3	3.7
Swifts Azumin Expt.	4.0	2.3	2.0	2.3	3.0	2.7
Swifts Kedlor Expt.	4.0	2.3	2.0	2.0	3.0	3.0
Swifts IBDU Coarse (NM)	3.7	2.0	2.0	2.0	3.0	2.3
Lakeshore SCU	4.0	2.3	2.3	2.3	3.0	3.0
Lakeshore SCU Complete	--	--	--	2.3	3.0	2.3
Check	5.5	4.0	3.0	2.5	4.0	4.0

[1] Density ratings were made on a scale of 1 through 9 with 1 representing best and 9 representing poorest.

Table 13. (Cont'd.)

Fertilizer	Program II 2 lb N/M Apr.			Aug.		
	5/23/78	6/31/78	8/5/78	9/5/78	10/13/78	11/1/78
Scotts 1.9/1 Methylene Urea	2.7	2.0	1.7	2.3	3.0	3.0
Swifts IBDU Coarse	3.7	2.0	1.7	2.3	3.0	2.0
Hercules UF	3.7	2.3	2.0	3.3	3.0	3.0
Milorganite	4.0	2.3	3.0	2.3	3.7	3.0
CIL - SCU	3.0	2.0	2.0	2.7	3.0	2.7
TVA - SCU	3.3	2.0	2.0	2.3	3.0	2.3
Scotts SCU	2.7	2.0	2.0	2.0	3.0	2.7
Urea	3.0	2.0	2.0	2.0	3.0	2.7
Swifts KH Expt.	3.0	2.0	2.0	2.7	3.0	3.0
Swifts Azumin Expt.	3.0	2.0	2.0	2.3	3.0	2.7
Swifts Kedlor Expt.	4.3	2.0	2.0	2.7	3.0	2.7
Swifts IBDU Coarse (NM)	3.3	2.0	1.7	2.0	3.0	2.3
Lakeshore SCU	3.0	2.3	2.3	2.7	3.0	2.7
Lakeshore SCU Complete	--	--	--	2.7	3.0	2.3
Check	5.5	4.0	3.0	3.0	3.5	4.0

[1] Density ratings were made on a scale of 1 through 9 with 1 representing best and 9 representing poorest.

Table 13. (Cont'd.)

Fertilizer	Program III 4 lb N/M Apr.					
	5/23/78	6/31/78	8/5/78	9/5/78	10/13/78	11/1/78
Scotts 1.9/1 Methylene Urea	2.7	2.0	2.0	2.0	4.0	3.3
Swifts IBDU Coarse	4.0	2.0	2.0	2.7	3.0	3.7
Hercules UF	3.7	2.3	2.0	3.0	3.7	4.0
Milorganite	3.0	2.0	2.0	2.3	3.3	3.7
CIL - SCU	3.0	2.0	2.0	2.7	3.3	3.7
TVA - SCU	3.0	2.0	2.0	2.7	3.7	4.0
Scotts SCU	2.7	2.3	2.0	2.7	4.3	3.7
Urea	3.3	2.0	2.0	2.7	3.7	3.7
Swifts KH Expt.	2.7	2.0	2.0	2.3	3.7	3.7
Swifts Azumin Expt.	2.7	2.3	2.0	2.3	3.7	3.7
Swifts Kedlor Expt.	5.3	2.0	2.3	2.7	3.7	3.7
Swifts IBDU Coarse (NM)	3.0	2.0	2.0	2.3	3.7	3.7
Lakeshore SCU	3.0	2.0	2.0	2.7	3.0	3.7
Lakeshore SCU Complete	--	--	--	2.3	3.0	3.0
Check	5.5	4.0	3.0	3.5	4.0	4.0

[1] Density ratings were made on a scale of 1 through 9 with 1 representing best and 9 representing poorest.

Table 14. Plant height for various slowly-soluble and slow-release nitrogen fertilizers on Kentucky bluegrass.[1]

Fertilizer	Program I				
	1 lb N/M				
	Apr.	May		Aug.	Sept.
	5/25/78	6/29/78	8/7/78	9/22/78	10/20/78
Scotts 1.9/1 Methylene Urea	1.9	2.0	1.8	2.0	2.5
Swifts IBDU Coarse	1.8	2.0	1.8	2.2	2.4
Hercules UF	1.8	1.9	1.8	2.1	2.6
Milorganite	2.0	2.1	1.8	2.2	2.4
CIL - SCU	1.9	2.2	1.8	2.1	2.5
TVA - SCU	1.8	2.0	2.0	2.1	2.5
Scotts SCU	1.8	2.1	1.8	2.1	2.5
Urea	1.9	2.1	1.8	2.1	2.6
Swifts KH Expt.	2.0	2.0	1.9	2.1	2.5
Swifts Azumin Expt.	1.8	2.1	1.8	2.1	2.3
Swifts Kedlor Expt.	1.8	2.3	1.8	2.1	2.6
Swifts IBDU Coarse (NM)	1.8	2.1	1.9	2.2	2.5
Lakeshore SCU	1.6	2.2	1.8	2.0	2.5
Lakeshore SCU Complete	--	--	--	2.2	2.4
Check	1.6	1.8	1.8	2.2	2.5

[1] Plant height measurements are given in centimeters. Values taken 3 to 4 days following mowing.

Table 14. (Cont'd.)

Fertilizer	Program II 2 lb N/M Apr.			Aug.	
	5/25/78	6/29/78	8/7/78	9/22/78	10/20/78
Scotts 1.9/1 Methylene Urea	2.1	2.1	1.9	2.2	2.4
Swifts IBDU Coarse	2.0	2.0	1.8	2.3	2.6
Hercules UF	2.0	1.9	1.8	2.0	2.4
Milorganite	1.9	2.0	1.8	2.0	2.4
CIL - SCU	2.0	2.1	1.8	2.1	2.5
TVA - SCU	1.9	2.0	1.8	2.4	2.5
Scotts SCU	1.9	2.1	1.8	2.3	2.5
Urea	1.8	2.2	1.8	2.0	2.5
Swifts KH Expt.	2.0	2.0	1.8	2.1	2.3
Swifts Azumin Expt.	1.8	2.1	2.0	2.1	2.5
Swifts Kedlor Expt.	1.8	2.1	1.8	2.2	2.5
Swifts IBDU Coarse (NM)	1.9	2.2	1.9	2.1	2.5
Lakeshore SCU	1.9	2.0	1.8	2.1	2.5
Lakeshore SCU Complete	--	--	--	2.1	2.4
Check	1.7	1.8	1.8	2.2	2.4

[1] Plant height measurements are given in centimeters. Values taken 3 to 4 days following mowing.

Table 14. (Cont'd.)

Fertilizer	Program III 4 lb N/M Apr.				
	5/25/78	6/29/78	8/7/78	9/22/78	10/20/78
Scotts 1.9/1 Methylene Urea	2.2	2.3	1.9	2.0	2.4
Swifts IBDU Coarse	2.1	2.2	1.8	2.0	2.4
Hercules UF	2.0	2.1	1.8	2.0	2.4
Milorganite	2.0	2.2	1.9	2.0	2.4
CIL- SCU	1.9	2.2	1.8	2.0	2.5
TVA - SCU	2.0	2.1	1.9	2.2	2.4
Scotts SCU	2.0	2.1	1.8	2.0	2.4
Urea	2.2	2.2	1.8	2.0	2.4
Swifts KH Expt.	2.1	2.1	1.9	2.1	2.5
Swifts Azumin Expt.	1.8	2.1	1.7	2.2	2.5
Swifts Kedlor Expt.	1.8	2.2	1.8	1.9	2.5
Swifts IBDU Coarse (NM)	1.9	2.3	1.8	2.1	2.4
Lakeshore SCU	1.8	2.2	1.8	2.2	2.4
Lakeshore SCU Complete	--	--	--	2.3	2.4
Check	1.6	1.7	1.7	2.1	2.4

1 Plant height measurements are given in centimeters. Values taken 3 to 4 days following mowing.

C. 3. Nitrogen fertilizer evaluation on creeping bentgrass.
J. R. Street and J. E. Haley.

Methylene urea, IBDU (isobutylidene diurea), sulfur-coated urea, and several experimental nitrogen fertilizers were evaluated on a mature 'Penncross' creeping bentgrass turf. The creeping bentgrass area was maintained at 4 lb N/m/yr and 0.25 in. mowing height prior to initiation of treatments on May 12, 1978. Treatments consist of 7 nitrogen carriers applied at various rates and application frequencies (Table 15). Each treatment was replicated 3 times with 5 x 6 ft plots in a completely randomized block design. Mowing is performed 3 or 4 times weekly at 0.25 in. and clippings are removed. Irrigation is performed as needed to prevent wilt.

Unfertilized check plots consistently showed poorer color and density throughout the growing season than fertilized plots. Most nitrogen fertilizers showed improved color and overall quality with Program II compared to Program I at two weeks following initial applications (Table 16 & 17). At the 1 lb N rate, Swifts KH expt., Scotts methylene urea, CIL-SCU and urea showed the most rapid response from initial applications (May 12). IBDU color and overall quality appeared to be favored by Program II compared to Program I. Except for initial green-up rates, Program I and II were comparable for each fertilizer and residual lasted for 8-10 weeks with the spring treatments. However, it appeared that overall quality was slightly better under Program I during the fall with most fertilizer sources.

Table 15. Nitrogen sources, rates and application frequencies.

Fertilizer	Analysis	lb N/M	Application Dates
1. Swifts Azumin Expt.	15-3-9	1.0	April, May, Aug., Sept.
		2.0	April, August
2. Swifts KH Expt.	10-4-5	"	" "
3. Swifts IBDU Fine	31-0-0	"	" "
4. Scotts 1.9/1 Methylene Urea	39-0-0	"	" "
5. Canadian Industries Limited - SCU	32-0-0	"	" "
6. Lakeshore Greens	25-5-5	"	" "
7. Urea	45-0-0	"	" "

Table 16. Color ratings for various slowly-soluble and slow-release nitrogen fertilizers on creeping bentgrass.[1]

Fertilizer	Program I[2] 1 lb N/M								Program II 2 lb N/M							
	Apr.		May		Aug.		Sept.		Apr.				Aug.			
	5/23	6/16	7/15	8/5	8/30	9/20	10/14	11/1	5/23	6/16	7/15	8/5	8/30	9/20	10/14	11/1
Swifts Azumin Expt.	4.0	3.3	3.0	5.0	5.0	4.3	4.0	4.5	3.6	3.0	3.0	5.7	4.7	4.0	4.0	4.7
Swifts KH Expt.	2.3	2.7	2.7	5.7	5.0	4.0	4.7	5.3	2.0	4.0	3.0	5.7	4.7	4.7	5.0	5.3
Swifts IBDU fine	4.0	4.0	3.0	5.7	4.7	4.0	3.7	4.2	3.7	2.3	3.3	6.3	5.0	3.7	3.3	4.5
Scotts Methylene Urea	3.0	3.3	3.0	5.0	4.7	3.0	3.0	4.2	2.6	4.0	2.7	5.3	5.0	3.0	4.3	4.7
CIL - SCU Fine	3.3	3.3	2.7	5.7	5.0	4.0	3.3	4.7	3.0	3.7	3.0	5.7	4.7	4.0	4.0	4.8
Lakeshore Greens	4.0	4.0	2.7	5.3	4.7	4.0	4.0	4.5	3.0	4.7	3.0	5.0	4.7	4.0	5.0	5.3
Urea	3.0	3.0	2.7	5.7	5.0	3.0	3.0	4.0	2.3	4.3	3.0	5.3	4.7	3.0	4.0	5.3
Check	5.0	6.0	5.0	5.0	4.3	5.7	6.0	6.0	4.3	6.0	4.0	4.7	4.0	5.7	5.3	6.0

1 Color ratings were made on a scale of 1 through 9 with 1 representing best and 9 representing poorest.

2 Fertilizer applications were made on May 12, June 7, Sept. 5 and Sept. 20 for Program I, and May 12 and Sept. 7 for Program II.

Table 17. Density ratings for various slowly-soluble and slow-release nitrogen fertilizers on creeping bentgrass.[1]

Fertilizer	Program I 1 lb N/M								Program II 2 lb N/M							
	Apr.		May		Aug.		Sept.		Apr.				Aug.			
	5/23	6/16	7/15	8/5	8/30	9/20	10/14	11/1	5/19	6/16	7/15	8/5	8/30	9/20	10/14	11/1
Swifts Azumin Expt.	2.0	1.3	2.0	2.0	3.3	2.0	2.0	3.3	2.0	1.7	1.7	2.0	3.3	2.0	2.0	3.8
Swifts KH Expt.	2.0	1.3	2.0	2.0	4.0	2.0	2.0	4.3	2.0	1.7	2.0	2.0	3.7	3.0	3.0	4.7
Swifts IBDU Fine	2.0	2.0	2.0	2.0	3.3	2.0	2.0	3.3	2.0	1.7	2.0	2.0	3.0	2.0	2.0	3.3
Scotts Methylene Urea	3.0	2.7	2.0	1.7	3.3	2.0	2.0	3.0	3.0	2.7	1.7	2.0	3.0	2.3	2.0	4.0
CIL - SCU Fine	2.0	1.7	2.0	2.0	3.3	2.0	2.0	3.5	2.0	2.0	2.0	2.0	4.3	2.0	2.0	3.8
Lakeshore Greens	2.0	2.3	2.0	2.0	3.0	2.0	2.0	3.0	2.0	2.3	2.0	1.7	3.3	2.3	2.7	4.3
Urea	2.0	1.7	2.0	2.3	3.7	2.0	2.0	3.0	2.0	2.0	2.0	2.0	3.3	2.3	3.3	5.7
Check	4.0	3.0	3.0	2.3	3.3	2.7	3.7	4.8	3.0	2.7	3.0	2.0	3.0	3.7	3.7	4.8

[1] Density ratings were made on a scale of 1 throug 9 with 1 representing best and 9 representing poorest.

C. 3. Effect of nitrogen rate and form under liquid application for Kentucky bluegrass. J. R. Street.

The predominant forms of nitrogen fertilizer used by the liquid lawn care industry today are urea, ureaformaldehyde and IBDU. The most economic material strictly from a cost analysis standpoint is urea. The burn potential, surge growth, and short residual can create several problems for liquid lawn care operations. The short residual of urea can result in a substantial reduction in lawn color and overall quality between treatment periods. Thus, various ratios of IBDU to urea were evaluated for improving turfgrass quality and residual response.

Various combination ratios of urea and IBDU (isobutylidene diurea) applied under liquid application were evaluated on a mature "Common-type" Kentucky bluegrass turf (Table 18). The Kentucky bluegrass area was maintained at 4 lb N/1000 sq ft/yr and a 1.5 in. mowing height prior to initiation of treatments on July 13, 1978. Each treatment was replicated three times with 5 x 6 ft plots in a completely randomized block design. Mowing was performed once weekly at 2 in. and clippings were removed. Clipping yields were taken at weekly intervals by making a single swath across the center of each plot using a Scott's silent (push) mower. Foliar burn was evaluated several days after fertilization (7-16-78) and overall quality ratings were made at weekly intervals.

Foliar burn was moderate to severe where the fertilizer treatment consisted of 1 lb or more of nitrogen as urea (Table 18). In general, urea rates at less than 1 lb N/1000 sq ft resulted in only a tip burn. Initial green-up following fertilizer application was similar for IBDU and urea. Also, dry weight yields on IBDU-treated plots were usually similar or higher than urea-treated plots during the first several weeks after fertilization (Table 19). The more rapid release rate of IBDU is most likely the result of a breakdown of the granule as it circulates through the Hypo centrifugal pump. IBDU at no less than 1/2 lb N/1000 sq ft was necessary in order to gain any substantial increase over urea in residual response under the conditions of this experiment.

Clipping yields were higher from IBDU-treated plots as compared to urea-treated plots indicating a more efficient use of IBDU (Table 19). The lower efficiency of urea on a clipping yield basis may be due to greater leaching and volatilization losses of urea than IBDU. Volatilization losses have been shown to be a significant pathway for potential loss of nitrogen from granular, surface applied urea in previous studies by Nelson, Turgeon and Street(M.S. thesis, University of Illinois, 1978).

Table 18. Effect of liquid fertilization on quality and foliar burn of Kentucky bluegrass.

Fertilizer Treatment	Rate lb N/M	Foliar Burn[1]	Quality[2]								
			7/24/78	7/31/78	8/8/78	8/17/78	8/30/78	9/10/78	9/21/78	10/5/78	10/13/78
Urea	2	7	3.7	3.0	4.0	3.0	3.0	4.0	4.5	5.0	5.0
Urea - IBDU	1 + 1	6	2.0	2.3	2.3	2.0	2.0	3.0	3.3	4.0	4.5
Urea	1 1/2	7	3.7	2.7	2.7	3.0	2.3	3.7	4.2	4.5	6.0
Urea - IBDU	1 + 1/2	5.3	2.0	2.0	2.3	2.7	2.3	3.0	4.1	4.6	5.7
Urea - IBDU	3/4 + 3/4	3	2.0	2.0	2.3	2.0	2.0	3.0	4.0	4.5	5.3
Urea	1	4	2.0	2.7	3.7	3.0	3.3	4.0	4.6	5.0	6.0
Urea - IBDU	1/4 + 3/4	1	2.3	2.3	2.0	2.0	2.5	3.0	4.1	4.5	5.7
Urea - IBDU	1/2 + 1/2	2.7	2.3	2.0	2.0	2.0	2.0	3.0	4.1	4.5	5.0
Urea - IBDU	3/4 + 1/4	4	2.0	2.7	3.0	3.0	3.0	4.0	4.6	5.0	5.7
IBDU	1	1	3.0	2.0	2.0	2.7	2.2	3.0	4.0	4.0	4.5
Urea - IBDU	1/2 + 1	3	2.0	2.0	2.0	2.0	2.0	3.0	3.0	4.0	4.5
IBDU	1 1/2	1	2.3	2.0	2.0	2.0	2.0	2.0	3.0	3.0	4.0
IBDU	2	1	2.7	2.0	1.3	2.0	1.7	2.0	3.0	3.0	4.2
UNTREATED		1	6.0	5.0	5.0	4.7	5.0	5.0	6.0	6.0	6.0

1 Foliar burn was measured using a scale of 1 through 9 with 1 representing no injury and 9 representing complete necrosis of the plot.

2 Quality was rated using a scale of 1 through 9 with 1 representing the best and 9 representing the poorest.

Table 19. Effect of liquid fertilization on clipping yield of Kentucky bluegrass.

Fertilizer Treatment	Rate lb N/M	Clipping yield[1] grams dry wt/plot												
		7/24	8/1	8/10	8/17	8/24	8/30	9/6	9/13	9/20	9/27	10/4	10/11	TOTAL
Urea	2	26.0	43.6	24.8	29.2	18.9	26.2	15.7	24.4	17.7	10.6	6.9	3.5	247.5
Urea - IBDU	1 + 1	33.0	47.1	33.7	38.2	29.2	32.5	20.0	24.9	20.9	11.7	8.4	4.1	303.7
Urea	1 1/2	19.0	39.3	32.5	33.8	23.6	28.8	17.0	24.2	21.4	12.9	7.1	4.2	263.8
Urea - IBDU	1 + 1/2	27.8	45.6	33.8	30.1	25.1	28.4	16.4	23.0	19.0	11.4	7.6	3.9	272.1
Urea - IBDU	3/4 + 3/4	30.1	47.6	32.3	32.8	26.9	28.2	16.8	24.6	20.2	12.0	6.6	3.4	281.5
Urea	1	27.5	41.1	27.1	23.9	17.6	23.4	13.8	21.3	18.7	11.1	6.8	3.4	237.5
Urea - IBDU	1/4 + 3/4	23.9	40.9	30.4	28.4	21.5	27.5	16.7	25.2	18.6	7.6	6.6	3.5	250.8
Urea - IBDU	1/2 + 1/2	31.7	46.0	34.5	30.4	23.7	29.2	18.7	24.9	20.4	12.0	7.1	3.8	282.4
Urea - IBDU	3/4 + 1/4	29.4	44.7	31.3	26.0	22.2	25.9	15.9	25.6	20.5	11.0	7.4	3.8	263.7
IBDU	1	27.1	44.6	34.3	32.7	25.4	30.3	15.1	28.5	20.9	11.0	7.6	4.3	281.8
Urea - IBDU	1/2 + 1	30.4	47.9	34.8	35.2	27.7	31.7	18.6	24.6	21.2	11.7	7.8	3.8	295.4
IBDU	1 1/2	25.7	48.7	35.2	35.9	28.2	32.8	20.3	27.3	21.7	11.4	8.5	4.2	299.9
IBDU	2	27.0	44.4	36.8	38.8	30.5	35.4	21.1	30.1	22.9	11.7	8.6	4.1	311.4
UNTREATED		10.5	18.4	16.3	14.9	12.5	21.5	14.5	24.8	18.1	9.7	7.4	3.5	172.1

[1] Clipping yield based on one complete swath across the center of each plot with a Scotts silent mower.

C. 6. Annual bluegrass cultural studies.
A. J. Turgeon and J. E. Haley.

Many intensively cultured golf turfs have 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. Recently, 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 Tersan 1991 @ 1 oz/M and Daconil 2787 @ 3 oz/M versus no fungicides) 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 phosphorus fertilization with a uniform treatment of urea (3 lb N/M/yr) and KCl (1.5 lb K_2O/M/yr) across the plot area. The third experiment involved applications of several fertilizer materials at different rates to annual bluegrass receiving the weekly Tersan 1991-Daconil 2787 fungicide rotation. In all experiments, plots measured 6 x 5 ft with three replications per treatment. Mowing was performed three times per week at 0.75 in. and the turf was irrigated as needed to prevent wilting.

Results to date indicate that the fungicide program is essential for sustaining the annual bluegrass at an acceptable level of quality (Table 20). Deterioration of the plots not receiving fungicides appeared to be due to climatic stress as the typical anthracnose disease symptoms were not always evident. There was some indication that the nitrogen-treated plots were better than the unfertilized plots; however, no consistent beneficial effect from potassium fertilization has been observed to date. The phosphorus fertilization experiment has not shown any difference among phosphorus treatments to date but, as in the first experiment, fungicide treatment clearly resulted in superior turfgrass quality (Table 21). Some differences among fertilizer materials were evident in experiment 3; Country Club 18-5-9 has generally resulted in slightly better turf during the summer months, but results are rather inconclusive at this time (Table 22). These experiments will be continued through 1979 and, possibly, beyond, and additional field studies are planned.

Table 20. Effects of different nitrogen and potassium fertilization levels on the quality of an annual bluegrass turf sustained with and without weekly fungicide treatments.[1]

Treatment	Rate lb/M/Yr N or K_2O	Fungicide[2]							No Fungicide[2]						
		6/13	7/18	7/27	8/7	8/11	10/11	10/31	6/13	7/18	7/27	8/7	8/11	10/11	10/31
Urea	3	3.0	4.0	5.0	3.3	3.7	4.3	4.0	3.0	4.3	5.7	4.3	5.7	4.3	4.3
Urea + K	3 + 1.5	3.0	3.3	3.7	3.0	3.7	3.7	3.7	3.3	4.3	4.7	4.3	5.0	4.0	4.0
Urea + K	3 + 3	3.0	3.3	3.3	3.7	3.7	4.0	3.3	3.0	4.3	5.0	4.3	5.3	4.7	4.0
Urea	6	2.0	3.3	4.0	3.3	4.3	3.3	3.0	2.0	5.0	5.7	4.3	5.7	3.7	2.3
Urea + K	6 + 3	2.3	4.0	4.7	3.7	3.7	3.3	2.0	2.0	4.0	5.0	5.0	6.7	4.3	3.3
Urea + K	6 + 6	2.3	3.7	4.7	4.0	4.7	3.7	1.3	2.0	5.0	5.0	4.0	5.0	4.7	2.0
K	3	4.7	3.7	4.7	4.7	4.3	6.3	6.3	5.0	5.0	6.0	5.3	5.0	6.3	7.0
Untreated	0	4.0	4.0	4.0	4.7	4.7	6.3	6.0	4.3	5.0	4.7	5.7	5.7	6.7	6.0

1 Quality ratings were made using a scale of 1 to 9 with 1 representing best quality and 9 representing poor quality.

2 Fungicide treatments included a weekly rotation of Tersan 1991 @ 1 oz/M and Daconil @ 3 oz/M.

Table 21. Effects of phosphorus fertilization levels on the quality of an annual bluegrass turf with and without weekly fungicide treatments.[1]

Treatment	Rate lb/M/Yr	Fungicide[2]					No Fungicide[2]				
		7/18	7/27	8/7	8/11	10/11	7/18	7/27	8/7	8/1	10/11
0-46-0	1	3.8	3.8	3.5	4.3	4.5	5.5	5.3	5.8	5.8	6.5
0-46-0	2	4.0	4.0	3.5	4.3	4.8	5.0	5.3	6.0	6.0	6.5
0-46-0	4	3.0	4.0	3.3	4.3	4.8	5.0	5.3	6.0	6.0	6.5
Control	0	3.5	4.0	3.5	4.3	4.8	5.0	5.3	5.3	6.3	6.5

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

[2] Fungicide treatments included a weekly rotation of Tersan 1991 @ 1 oz/M and Daconil @ 3 oz/M.

Table 22. Effects of different nitrogen fertilizer carriers on the quality of an annual bluegrass turf.[1]

Fertilizer	Rate lb N/M/Yr	Quality[2] 5/17	6/6	7/18	7/27	8/9	10/11	10/31
IBDU	3.0	5.3	4.3	4.0	5.3	5.7	4.0	4.3
IBDU	6.0	4.0	3.0	4.3	6.3	5.7	3.3	3.0
UF	3.0	5.7	5.3	4.7	4.7	4.3	5.0	5.3
UF	6.0	4.3	4.0	3.7	4.7	.0	4.0	4.0
SCU 32-0-0	3.0	4.0	4.0	3.7	5.0	5.0	3.7	4.0
SCU 32-0-0	6.0	4.0	3.3	4.7	6.0	6.7	3.0	2.7
Urea	3.0	4.3	3.7	4.3	6.0	6.7	3.0	3.7
Urea	6.0	4.0	4.3	4.7	6.3	6.3	2.3	2.0
Urea	2.0	3.7	4.3	4.3	5.3	5.7	3.7	3.7
Urea	4.0	3.7	4.0	4.3	5.7	5.7	2.3	2.3
SCU 20-5-10	2.0	4.7	4.0	4.0	5.0	4.7	5.3	4.3
SCU 20-5-10	4.0	4.0	3.3	4.0	6.0	5.7	3.3	3.0
Milorganite	2.0	6.0	4.7	4.0	5.0	4.7	5.0	5.3
Milorganite	4.0	5.0	3.7	3.3	5.3	5.7	4.3	4.0
Country Club 18-5-9	2.0	4.7	4.0	3.0	4.3	3.7	4.0	5.0
Country Club 18-5-9	4.0	3.3	3.0	3.7	4.7	5.0	3.0	3.7
Par Ex 27-3-9	2.0	6.0	4.7	4.3	4.7	5.0	4.7	5.0
Untreated	0	7.0	5.7	5.7	5.7	5.0	6.0	6.7

[1] Plots were maintained under a weekly rotation of Tersan 1991 @ 1 oz/M and Daconil @ 3 oz/M.

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

C. 6. Kentucky bluegrass cultivar management.
J. E. Haley and A. J. Turgeon.

Twenty-one cultivars of Kentucky bluegrass were planted in 15 replicate plots in September, 1974. Twelve replications of the cultivars were planted in the northwest section of the OHRC turfgrass experimental site and 3 replications were located north of the east-west road leading into the OHRC. In 1975, five different cultural intensities were imposed so that 3 replications of each cultivar were maintained under one of the following programs: 0.75-in mowing with 4 lb N/1000 sq ft/yr, 0.75-in mowing with 8 lb N/1000 sq ft/yr, 1.5-in mowing with 4 lb N/1000 sq ft/yr, 1.5-in mowing with 8 lb N/1000 sq ft/yr, and 3-in mowing with 1 lb N/1000 sq ft/yr. Mowing was performed 2 or 3 times per week at 0.75 or 1.5 in, and once per week at 3 in. Fertilization was performed in 1 or 2 lb N increments in April, May, August and September. The 3-in plots were fertilized in April. Irrigation was performed as needed to prevent wilting to the .75-in and 1.5-in plots. Plots measured 5 by 6 ft and cultivars within cultural level were arranged in a randomized complete block design.

Consistent with reports from observations made during the previous three growing seasons, three of the cultivars (Brunswick, A-34, Touchdown) sustained at the highest cultural intensity (mowing at 0.75 in; 8 lb N/M/yr) have resisted invasion by annual bluegrass while nearly all of the other cultivar plots had converted to predominantly annual bluegrass (Table 23). Based upon measurements of thatch depth, no consistent relationship between thatching tendency and resistance to annual bluegrass invasion can be established. Spring greenup differences observed among the plots were consistently associated with nitrogen fertilization level; presumably, the higher rates of nitrogen supplied in late summer account for faster greenup in March.

Incidence of dollar spot disease was also associated with nitrogen fertilization levels. The plots maintained at 4 lb N/1000 sq ft/yr showed more evidence of the disease than did the plots receiving 8 lb N/1000 sq ft/yr.

General quality of the turf varied with cultivar, time of year, fertilization rate, mowing height, and amount of annual bluegrass within the plots.

It is clear that the cultivars vary widely in their adaptation to different cultural intensities. Although Brunswick, A-34, and Touchdown are superior at the highest intensity of culture, Aquilla and Vantage appear to be generally better adapted to the lowest cultural intensity employed in this study. At the intermediate intensity of culture (mowing at 1.5 in; 4 lb N/M/yr) which is characteristic of lawn turf, most of the cultivars performed well.

Table 23. Kentucky bluegrass cultivar management study.

Cultivar	Cultural Intensity[1]	Annual Bluegrass % 6/30/78	Thatch Depth, cm 8/8/78	Dollar Spot[2] 8/29/78	Spring Greenup[3] 3/31/78	Quality[3]					
						10/11/77	5/24/78	6/21/78	8/16/78	10/11/78	10/31/78
A-20	M .75, F4	13.3	0.9	2.7	5.0	5.0	5.7	4.7	5.0	5.0	4.3
	M .75, F8	83.3	1.0	1.0	4.3	7.0	4.7	6.0	7.0	6.0	6.7
	M 1.5 , F4	0	0.5	1.3	5.0	3.3	3.7	3.0	3.0	3.7	3.3
	M 1.5 , F8	20.7	0.8	1.0	4.3	4.3	4.0	3.3	5.0	4.7	5.3
	M 3.0 , F1	0			4.7	5.0	5.0	4.7	6.3	6.3	5.7
A-34	M .75, F4	5.7	0.8	2.0	5.3	4.3	5.0	4.0	4.0	4.7	3.3
	M .75, F8	8.3	0.9	1.0	3.3	5.0	3.3	3.0	5.0	3.3	2.7
	M 1.5 , F4	0.7	0.4	1.3	5.7	2.7	3.0	2.7	3.3	2.7	3.3
	M 1.5 , F8	0.3	0.8	1.3	4.3	3.0	3.0	4.0	4.0	3.0	4.3
	M 3 , F1	0			3.3	4.0	4.0	4.0	6.3	5.3	5.0
Adelphi	M .75, F4	21.7	1.0	2.3	4.3	5.0	5.0	5.3	5.3	5.7	6.0
	M .75, F8	46.7	0.9	1.3	3.7	7.0	4.0	5.3	7.3	6.7	7.3
	M 1.5 , F4	11.7	1.0	1.0	4.3	4.3	3.7	3.7	4.3	4.0	4.0
	M 1.5 , F8	21.7	0.7	1.0	4.3	4.3	4.3	4.7	4.3	4.7	5.3
	M 3 , F1	0			4.7	4.0	5.0	4.3	7.0	6.7	6.0
Aquilla	M .75, F4	11.7	0.8	6.7	6.0	5.3	5.7	5.0	5.7	5.3	4.3
	M .75, F8	88.3	1.3	1.7	5.7	7.3	3.7	5.3	7.7	6.7	7.3
	M 1.5 , F4	11.7	0.7	3.0	6.0	5.0	4.0	4.3	4.3	4.3	4.3
	M 1.5 , F8	23.3	0.7	1.0	5.3	5.0	4.3	4.3	5.3	5.0	5.0
	M 3 , F1	0			5.7	4.0	3.3	4.7	5.0	4.0	3.7
Baron	M .75, F4	15.0	1.0	4.0	6.0	5.7	6.0	5.3	5.3	5.7	5.0
	M .75, F8	90.0	1.0	1.0	5.0	7.3	5.0	6.0	8.0	7.0	7.3
	M 1.5 , F4	9.0	0.8	2.3	5.3	4.7	3.7	4.0	3.3	4.0	4.7
	M 1.5 , F8	20.0	0.9	1.0	5.0	4.0	4.0	5.0	5.7	4.3	4.3
	M 3 , F1	0			5.7	4.0	5.0	5.7	6.7	5.7	5.0

Table 23. (Continued)

Cultivar	Cultural Intensity[1]	Annual Bluegrass % 6/30/78	Thatch Depth, cm 8/8/78	Dollar Spot[2] 8/29/78	Spring Greenup[3] 3/31/78	Quality[3] 10/11/77	5/24/78	6/21/78	8/16/78	10/11/78	10/31/78
Birka	M .75, F4	18.3	1.0	4.0	6.0	6.7	6.3	5.7	5.0	6.3	5.3
	M .75, F8	93.3	1.2	1.0	5.7	7.7	4.0	5.3	8.0	7.0	7.3
	M 1.5 , F4	0.3	0.9	3.3	5.0	6.3	3.7	3.0	3.3	4.3	4.7
	M 1.5 , F8	13.7	0.8	1.0	5.0	4.0	4.3	4.3	4.7	4.0	4.7
	M 3 , F1	0			5.7	3.7	4.0	4.7	6.0	4.7	3.7
Bonnieblue	M .75, F4	10.7	0.8	2.3	4.3	4.7	4.7	4.7	5.3	4.7	4.7
	M .75, F8	63.3	0.9	1.3	3.0	6.7	4.7	5.0	7.3	5.3	7.0
	M 1.5 , F4	4.0	0.4	1.0	5.0	4.3	3.7	2.7	3.3	4.3	4.0
	M 1.5 , F8	21.7	0.9	1.0	4.3	4.3	3.3	4.7	5.3	4.7	4.3
	M 3 , F1	0			4.0	3.7	4.0	5.0	6.3	6.7	5.3
Brunswick	M .75, F4	1.0	1.3	1.3	5.3	4.3	4.3	3.3	4.0	3.0	2.7
	M .75, F8	6.7	1.1	1.0	3.3	4.3	2.3	3.0	5.7	3.3	2.3
	M 1.5 , F4	0.3	0.9	1.0	4.3	3.0	3.0	3.0	3.3	2.3	3.0
	M 1.5 , F8	0.7	1.2	1.0	3.3	3.0	4.0	2.7	4.7	2.7	3.0
	M 3 , F1	0			4.7	4.7	4.0	4.3	5.7	4.7	5.3
Cheri	M .75, F4	10.0	1.0	4.7	5.3	5.7	5.7	5.0	5.0	5.0	5.7
	M .75, F8	81.7	1.3	1.0	4.3	7.3	4.3	5.3	7.7	6.3	7.7
	M 1.5 , F4	5.3	1.1	2.3	5.3	4.7	3.7	3.0	3.3	3.7	3.7
	M 1.5 , F8	5.0	0.9	1.0	5.0	4.0	5.7	3.7	5.0	4.0	3.7
	M 3 , F1	0			5.3	4.3	4.7	4.3	6.3	6.3	6.0
Code 95	M .75, F4	21.7	0.6	2.7	5.3	7.0	6.7	6.0	5.3	7.0	6.3
	M .75, F8	81.7	0.8	1.0	4.7	8.0	5.3	5.3	8.3	7.0	8.0
	M 1.5 , F4	2.7	1.0	1.3	4.7	4.7	5.0	4.0	4.0	4.7	5.0
	M 1.5 , F8	23.3	1.0	1.0	4.0	5.0	5.3	5.3	6.0	5.0	5.0
	M 3 , F1	0			2.3	5.0	4.7	5.0	4.3	4.7	4.3

Table 23. (Continued)

Cultivar	Cultural Intensity[1]	Annual Bluegrass % 6/30/78	Thatch Depth, cm 8/8/78	Dollar Spot[2] 8/29/78	Spring Greenup[3] 3/31/78	Quality[3] 10/11/77	5/24/78	6/21/78	8/16/78	10/11/78	10/31/78
Glade	M .75, F4	7.0	1.2	4.0	6.0	6.0	5.7	5.0	4.3	4.7	4.0
	M .75, F8	78.3	1.4	1.0	4.7	7.0	4.7	5.3	7.7	6.3	6.7
	M 1.5 , F4	0	0.9	1.0	5.7	5.0	4.3	3.3	3.3	2.7	4.3
	M 1.5 , F8	8.7	1.3	1.0	4.7	4.7	4.3	4.0	4.3	4.3	5.0
	M 3 , F1	0			5.7	4.0	5.0	5.3	6.0	4.7	5.0
Rugby	M .75, F4	18.3	0.9	2.0	4.3	5.0	5.0	5.0	5.7	5.3	7.0
	M .75, F8	83.3	0.9	1.3	3.3	7.0	4.3	5.7	7.7	7.7	7.0
	M 1.5 , F4	5.3	0.6	1.0	4.0	3.3	3.0	3.3	3.0	4.0	3.7
	M 1.5 , F8	11.7	0.9	1.0	3.0	3.7	3.3	3.7	4.7	4.0	4.3
	M 3 , F1	0			4.7	5.0	4.3	4.3	7.3	6.3	6.3
Majestic	M .75, F4	20.0	1.0	3.7	4.3	6.3	6.3	6.0	6.3	6.3	6.0
	M .75, F8	81.7	1.2	1.0	4.0	8.0	4.3	5.7	8.3	6.3	6.7
	M 1.5 , F4	5.3	0.7	1.7	4.3	5.7	4.0	5.0	4.3	5.7	5.7
	M 1.5 , F8	33.3	0.8	1.0	4.0	5.0	5.3	4.7	5.7	5.7	5.0
	M 3 , F1	0			4.3	5.0	4.0	4.7	6.7	5.7	5.7
Merion	M .75, F4	13.3	0.8	1.3	6.0	5.3	4.7	5.3	5.0	5.3	5.7
	M .75, F8	70.0	1.1	1.7	5.0	5.7	4.0	5.3	7.0	6.0	7.0
	M 1.5 , F4	3.3	0.9	1.3	5.7	5.7	3.3	4.0	4.3	4.0	4.3
	M 1.5 , F8	8.7	0.8	1.0	5.0	4.7	4.3	3.7	4.7	3.3	4.3
	M 3 , F1	0			5.0	6.0	5.3	5.3	7.0	7.0	7.0
Nugget	M .75, F4	21.7	0.9	4.0	6.3	7.0	5.7	5.7	6.0	5.0	4.7
	M .75, F8	83.3	1.1	1.0	5.0	7.7	5.0	5.7	8.7	7.0	7.7
	M 1.5 , F4	10.0	1.1	3.7	7.0	5.7	3.3	4.7	4.3	4.7	5.7
	M 1.5 , F8	13.3	1.5	1.0	5.0	5.3	6.0	4.7	6.0	5.0	4.7
	M 3 , F1	0			5.0	6.0	5.0	5.3	7.0	6.7	6.7

Table 23. (Continued)

	Cultural Intensity[1]	Annual Bluegrass % 6/30/78	Thatch Depth, cm 8/8/78	Dollar Spot[2] 8/29/78	Spring Greenup[3] 3/31/78	Quality[3]					
						10/11/77	5/24/78	6/21/78	8/16/78	10/ /78	10/31/78
Touchdown	M .75, F4	0.7	1.4	2.0	7.0	5.7	4.7	3.7	3.3	3.0	2.3
	M .75, F8	10.0	1.4	1.3	5.7	5.7	4.0	3.7	5.7	4.3	3.7
	M 1.5 , F4	0	1.0	1.7	6.7	5.3	3.0	2.7	3.0	2.7	3.0
	M 1.5 , F8	3.7	1.0	1.0	5.7	2.7	4.0	3.0	4.0	2.3	3.3
	M 3 , F1	0			6.0	4.0	4.3	4.7	5.3	4.7	4.0
Yorktown	M .75, F4	31.7	0.8	4.0	6.3	6.7	6.0	5.7	6.7	7.3	7.0
	M .75, F8	63.3	0.6	1.0	5.0	6.3	5.7	6.0	8.0	7.0	7.0
	M 1.5 , F4	18.3	0.5	3.0	5.0	5.0	3.7	5.7	5.7	6.0	6.3
	M 1.5 , F8	11.7	0.3	1.0	7.0	4.0	4.3	5.7	5.3	5.7	4.7
	M 3 , F1	0			2.7	6.0	3.7	5.7	6.3	7.7	7.0
Parade	M .75, F4	8.3	0.6	2.7	4.0	4.7	5.3	5.3	5.7	6.7	6.0
	M .75, F8	46.7	1.0	1.3	2.3	6.3	3.7	5.0	7.0	6.0	7.7
	M 1.5 , F4	0.3	0.8	1.3	5.0	4.3	3.3	4.0	3.7	5.0	4.7
	M 1.5 , F8	2.3	0.9	1.0	3.0	4.3	3.3	4.0	4.3	4.7	4.7
	M 3 , F1	0			4.3	4.0	3.0	4.3	5.7	4.7	5.0
Pennstar	M .75, F4	23.3	0.9	3.7	5.7	6.7	5.3	5.7	5.3	6.0	6.3
	M .75, F8	91.7	0.7	1.3	5.0	8.0	4.7	5.7	8.0	7.0	8.0
	M 1.5 , F4	18.3	0.6	2.0	5.3	5.7	4.7	4.0	5.0	5.7	5.0
	M 1.5 , F8	35.0	0	1.0	4.7	5.0	4.3	5.7	6.3	5.0	5.3
	M 3 , F1	0			6.3	4.3	3.3	5.0	6.3	4.3	6.0
Sydsport	M .75, F4	7.0	0.9	3.7	5.3	6.0	5.0	4.3	4.3	5.0	4.3
	M .75, F8	48.3	0.9	1.3	3.3	6.7	4.3	4.7	7.0	6.3	6.7
	M 1.5 , F4	0	0.9	1.3	5.0	4.3	3.0	3.0	3.7	3.7	3.7
	M 1.5 , F8	8.3	0.3	1.0	4.0	4.3	3.3	4.3	4.0	4.3	5.0
	M 3 , F1	0			6.0	5.0	4.0	4.3	6.3	6.0	6.3

Table 23. (Continued)

	Cultural Intensity[1]	Annual Bluegrass % 6/30/78	Thatch Depth, cm 8/8/78	Dollar Spot[2] 8/29/78	Spring Greenup[3] 3/31/78	Quality[3] 10/11/77	5/24/78	6/21/78	8/16/78	10/11/78	10/31/78
Vantage	M .75, F4	21.7	0.9	2.7	5.7	6.7	5.7	5.7	5.3	6.3	7.0
	M .75, F8	88.3		1.0	5.3	8.0	5.0	5.7	8.7	7.0	7.7
	M 1.5 , F4	18.3	1.0	1.3	6.7	4.3	4.7	4.3	4.0	5.0	4.0
	M 1.5 , F8	31.7	0.9	1.0	6.0	5.3	4.7	5.3	5.7	5.7	5.7
	M 3 , F1	0	0		3.0	4.3	2.7	4.3	4.7	4.0	4.7
Victa	M .75, F4	21.7	1.1	2.3	5.7	5.7	5.3	4.7	5.7	5.0	5.3
	M .75, F8	56.7	1.1	1.3	5.3	7.0	4.0	5.0	8.3	7.0	7.0
	M 1.5 , F4	8.3	1.0	2.7	6.7	5.3	3.7	4.0	3.3	4.3	4.3
	M 1.5 , F8	18.3	1.2	1.0	6.0	4.0	5.0	4.7	5.3	4.7	4.3
	M 3 , F1	0	0		5.7	4.7	4.0	4.7	6.0	4.7	6.0

[1] Cultural intensities: mowing at 0.75 in (M .75), 1.5 in (M 1.5), and 3.0 in (M3); fertilization with 10-6-4 to supply an annual total of 4 lb N/1000 sq ft (F4), or 8 lb N/1000 sq ft (F8), with equal increments applied in April, May, August and September. F1 equals 1 lb N/1000 sq ft applied in May.

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

[3] Spring greenup and quality ratings were made using a scale of 1 through 9, with 1 representing perfect quality and 9 representing very poor quality.

D. 1. b. <u>Development of microecosystems for studying the fate of pesticides in turf</u>. B. E. Branham and A. J. Turgeon.

Microecosystems have been shown to be effective tools for testing the fate of agricultural chemicals in closed, controlled environments. Using these systems enables the investigator to develop a "balance sheet" giving the distribution of a pesticide and its derivatives in the air, soil profile, leachate, and plant community. Metabolism rate for the pesticide can also be determined.

The U. of I. Turf Microecosystem consists of a media base, atmospheric chamber, automatic irrigation, various trapping flasks, sensors, and a data logger for monitoring environmental data. The media base is constructed of brass and includes a sintered bronze filter to support a turf slab measuring approximately 12 x 12 x 2 (l x w x d) inches. A drainage tube connects the one-eighth inch free space beneath the filter to a leachate flask and suction pump. Under continuous suction, water movement through the turf slab will be approximately that occurring in field turf. Periodic sampling of the turf slab followed by sectioning and analysis will enable us to monitor the movement and metabolism of topically applied pesticides. Analysis of the leachates will determine the movement of the pesticide and its metabolites out of the turf slab.

The atmospheric chamber, constructed from plate glass and measuring approximately one cubic foot, sits atop the media base. Holes drilled near its base and at the top allow air movement into and out of the chamber. A series of tubes and trapping flasks leading to a suction pump provide for capturing and measuring volatilized materials and CO_2 from complete metabolism of the pesticide. A solid-cone irrigation nozzle positioned in the topmost portion of the chamber allows irrigation at predetermined frequencies.

Thermocouples positioned within the atmospheric chamber and turf slab continuously sense temperature, atmospheric relative humidity and soil matric potential (soil water). All thermocouple wires lead to a Fluke datalogger where measurements are made and recorded.

A total of eight systems will be completed by late winter, 1979. Each will be placed within a large controlled-environment chamber so that temperature and light can be controlled for each experiment. The U. of I. Turf Microecosystem represents a significant advance in systems for monitoring the environmental fate of pesticides and other agricultural chemicals used in turfgrass culture. Initial studies to determine the fate of DCPA and other preemergence herbicides will begin in the spring of 1979.

D. 1. c. Effects of irrigation regime and mowing height on preemergence herbicide activity. B. E. Branham and A. J. Turgeon.

Three herbicides, DCPA, Benefin and Bensulide, were applied to 4 x 8 ft plots in granular form at the standard rates of 12, 3, and 10 lbs/acre,respectively,on May 1, 1978. Seven irrigation regimes, and mowing heights of 1.5 and 0.75 inches, were selected with each treatment combination being replicated three times. All plots were mowed three times per week and fertilized at a rate of 1 lb N/M in April, May, August and September. Crabgrass was overseeded on May 15 and June 15 at a rate of 0.5 lb/M. All data is reported as percent crabgrass cover.

Crabgrass infestation was much less severe in the 1.5-in-mowed plots than in the 0.75-in plots (Table 24). Herbicide performance followed the same trend at both mowing heights with Bensulide providing the highest level of control. It should be noted that while DCPA was applied as a granular form, best control has been achieved using a wettable powder formulation. Manufacturers of DCPA and Benefin both recommend a supplemental application in late May if crabgrass pressure is severe.

The seven watering regimes were divided into three daily rates twice a week, once a week, once every two weeks and no irrigation. The most crabgrass was found in the plots receiving a light, daily watering. The crabgrass infestation decreased with increasing daily watering rate. Small amounts of water applied frequently seem to stimulate crabgrass germination but are not very favorable for Kentucky bluegrass turf. As more water is applied (.04 and .08 inches/day) the turf is apparently better able to resist crabgrass invasion. Within limits, the more infrequently water is applied, the better the turf performs. This can be attributed to two factors: First, moisture stimulates crabgrass germination and the greater the watering frequency the greater the chance of severe crabgrass infestation; second, the increased moisture stimulates chemical and microbial decomposition of the herbicide thus reducing the effective residual activity of the herbicide.

These results emphasize the importance of adjusting herbicide applications to compensate for higher weed pressures encountered under close mowing and frequent irrigation of Kentucky bluegrass.

Table 24 Effects of mowing height and irrigation regime on the percent crabgrass cover in overseeded Kentucky bluegrass turf.[1]

Irrigation Treatment	Mowing Height, in. 1.5 in.				.75 in.			
	Herbicide Treatment							
	Benefin	DCPA	Bensulide	Untreated	Benefin	DCPA	Bensulide	Untreated
				July 13, 1978				
.02 in/day	3.0[1]	1.0	1.3	21.6	16.0	3.0	1.3	55.0
.04 in/day	3.0	1.6	1.0	18.3	7.6	3.0	1.0	36.6
.08 in/day	2.0	1.6	1.3	16.6	9.6	3.0	1.6	43.3
.14 in/3.5 days	1.6	1.0	1.0	25.0	11.0	2.3	1.0	46.6
.29 in/7 days	3.0	1.0	1.0	18.3	11.6	1.6	1.0	58.3
.59 in/14 days	1.0	1.0	1.0	13.3	12.3	1.0	1.0	35.0
Unirrigated	1.0	1.0	1.0	6.0	2.3	1.0	1.0	16.6
				July 28, 1978				
.02 in/day	13.3	5.3	2.3	60.0	46.6	31.6	8.6	86.6
.04 in/day	8.3	4.3	1.6	38.3	35.0	23.3	6.0	73.3
.08 in/day	8.3	3.6	2.3	41.6	31.6	21.6	3.6	80.0
.14 in/3.5 days	7.6	3.6	1.0	58.3	36.6	18.3	4.3	80.0
.29 in/7 days	5.0	2.3	1.0	56.6	36.6	16.6	2.3	81.6
.59 in/14 days	3.0	1.6	1.0	46.6	30.0	5.3	1.0	65.0
Unirrigated	1.6	1.0	1.0	18.3	4.3	2.3	1.0	36.6

Table 24. (Continued)

				August 11, 1978				
.02 in/day	26.6	11.3	4.6	71.6	60.0	38.3	10.3	83.3
.04 in/day	15.6	9.3	3.0	45.0	40.0	30.0	6.3	78.3
.08 in/day	10.6	5.0	3.0	40.0	41.6	28.3	5.0	80.0
.14 in/3.5 days	15.0	8.0	3.0	75.0	61.6	27.6	6.3	86.6
.29 in/day	15.0	6.3	2.3	70.0	40.0	21.6	3.6	90.0
.59 in/day	7.6	4.6	1.0	46.6	45.0	8.0	2.3	75.0
Unirrigated	2.3	1.0	1.0	26.0	4.3	2.3	1.0	43.3
				September 11, 1978				
.02 in/day	66.6	43.3	15.3	90.0	80.0	71.6	20.6	91.6
.04 in/day	53.3	40.0	6.6	86.6	73.3	68.3	10.6	91.6
.08 in/day	50.0	38.3	4.3	80.0	81.6	76.6	11.6	91.6
.14 in/3.5 days	50.0	35.0	12.6	88.3	76.6	61.6	12.6	91.6
.29 in/7 days	48.3	31.6	8.3	88.3	81.6	68.3	13.3	95.0
.59 in/14 days	23.3	7.0	2.3	70.0	63.3	33.3	7.3	90.0
Unirrigated	11.0	3.0	2.3	66.6	16.6	10.3	3.0	83.3
				October 26, 1978				
.02 in/day	43.3	23.3	5.3	76.6	58.3	48.3	9.0	86.6
.04 in/day	36.6	23.3	3.0	66.6	51.6	56.6	3.0	81.6
.08 in/day	40.0	36.6	2.3	71.6	65.0	45.0	3.0	81.6

Table 24. (Continued)

.14 in/3.5 days	35.0	25.0	3.6	73.3	58.3	43.3	5.0	86.6
.29 in/7 days	38.3	31.6	5.3	78.3	51.6	51.6	4.3	88.3
.59 in/14 days	20.0	15.6	2.3	58.3	45.6	18.3	2.3	81.6
Unirrigated	9.6	9.3	2.3	56.6	8.3	9.3	1.0	58.3

[1] All values are expressed as percent crabgrass cover and are the means of three replications.

D. 1. c. Controlled-release preemergence herbicide formulations for annual grass control in Kentucky bluegrass. David Chalmers and A. J. Turgeon.

Results from 1977 field research with controlled-release herbicide formulations suggested that some of these materials can provide effective control of crabgrass while reducing the potential for phytotoxicity to Kentucky bluegrass. These results are dependent upon a release rate, under field conditions, which is sufficient to control target weed species, but not so fast that marginally safe herbicides cause injury to desired turfgrasses. The development of controlled-release pesticide formulations is exciting because of the potential for controlling the bio-available concentration of a pesticide to conform to periods of pest activity.

The formulations used for these studies were provided by USDA formulation chemists, B. Shaska and W. Roth, from the Northern Regional Office in Peoria. The two formulations are starch xanthate, a granular material formed from corn starch, and sludge polymer, a viscous liquid formed from organic sludge and dialdehyde starch. The starch xanthate formulation entraps pesticides within the porous matrix of the granules; release is due to diffusion through the pores and decomposition of the starch matrix. The sludge polymer formulation embeds the pesticide within the organic material; release is somewhat affected by the stability of the embedding material against microbial decomposition.

For the 1978 field study, three preemergence herbicides (benefine, oxadiazon, and prosulfalin) were encapsulated within three formulations of starch xanthate (SX) of varying release properties (fast, medium, and slow). The resulting granules were screened to separate them into three mesh sizes, including 14-20 mesh (coarse), 20-40 mesh (medium), and 40-60 mesh (fine). Three sludge polymer (SP) formulations and the commercial formulations (CF) of each herbicide were also included in the study.

Plots measured 6 x 10 ft. for the medium-textured SX granules, SP and commercial formulations. The fine- and coarse-textured SX granules were applied to 6 x 10-ft plots. Each treatment plus control were replicated three times in a randomized complete block design. The turf was a Kenblue-type Kentucky bluegrass maintained at a mowing height of 1.5 inches, fertilized with a 10-6-4 ($N:P_2O_5:K_2O$) water-soluble fertilizer, and irrigated as needed to prevent wilting of the untreated (control) plots. The plot area was overseeded twice with crabgrass to ensure weed pressure. The herbicide formulations were applied at the rate of 3 lb a.i./acre on May 10, 1978. One-half of the 10 x 6-ft. plots received a second treatment of the herbicides on September 1, 1978 when annual bluegrass was overseeded. Data were collected periodically during the season to evaluate phytoxicity to the turfgrass and weed control.

Results from the benefin-treated plots did not vary appreciably in phytotoxicity or crabgrass control with the different formulations; however, the SP formulations of oxadiazon and prosulfalin caused more substantial phytotoxicity to Kentucky bluegrass than either the SX or commercial formulations (Table 25). Presumably, this was due to the adherence of the SP formulations to the turfgrass foliage and, thus, greater foliage absorption of the herbicide. SP formulations of oxadiazon and prosulfalin produced less phytotoxicity from fall applications as compared with spring. While crabgrass control did not appear to correlate with projected controlled-release properties, SX formulations of oxadiazon and prosulfalin reduced and delayed phytotoxicity respectively. Comparisons of phytotoxicity for different mesh sizes of the SX formulations indicated that the finer-textured materials release active ingredient faster than the coarser-textured materials (Table 26).

In future research, experiments will be conducted to study factors affecting herbicide release rates of the SX granule. Studies will include a large screening test of SX-type formulations to determine the influence of formulation variables upon release properties and an analysis of the herbicide concentration necessary to achieve maximum efficacy while providing optimum safety to turfgrasses throughout the growing season.

Current research also includes micromorphological investigations to determine relationships between internal and external SX structure, and release properties.

Table 25. Performance of controlled release preemergence herbicide carriers in a Kentucky bluegrass turf.

Herbicide Formulation	Release Property	Phytotoxicity[1] 5/19	6/1	6/13	7/12	7/26	8/9	8/26	9/26[2]	10/26[2]	% Crabgrass 8/18	8/26	9/26[3]	10/26
Benefin														
CF		1.0	1.7	1.3	1.7	1.3	1.0	1.0	1.0	1.0	5.0	8.3	20.0	5.8
SX_1	Fast	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.3	11.7	23.3	8.3
SX_2	Medium	1.0	1.0	1.0	1.7	1.0	1.0	1.0	1.0	1.0	6.7	10.0	19.2	8.3
SX_3	Slow	1.0	1.0	1.3	1.3	1.0	1.0	1.0	1.0	1.0	5.0	8.3	15.8	4.3
SP_1	Fast	1.0	1.3	1.3	2.0	1.0	1.0	1.0	1.0	1.0	7.7	11.7	15.8	15.0
SP_2	Medium	1.0	1.0	1.3	1.3	1.0	1.0	1.0	1.0	1.0	10.0	20.0	18.3	5.8
SP_3	Slow	1.0	1.0	1.7	1.3	1.0	1.0	1.0	1.0	1.0	6.7	16.7	20.8	7.5
Oxadiazon														
CF		2.3	2.7	2.3	1.0	1.0	1.0	1.0	1.0	1.7	2.3	5.0	8.3	2.3
SX_1	Fast	1.0	1.0	1.3	1.3	1.0	1.0	1.0	1.0	1.0	10.0	13.3	17.5	7.7
SX_2	Medium	1.0	1.0	1.7	1.3	1.0	1.0	1.0	1.3	1.0	5.3	10.0	14.2	3.7
SX_3	Slow	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.0	6.7	11.7	15.0	3.3
SP_1	Fast	5.3	6.0	6.7	5.0	3.3	1.3	1.0	3.0	1.0	0.7	0.7	0.3	0.2
SP_2	Medium	5.3	5.7	5.7	4.0	1.3	1.0	1.0	2.7	1.0	0.7	0.7	1.2	0.0
SP_3	Slow	5.3	6.0	7.0	5.7	4.3	3.0	1.7	3.0	1.0	0.0	0.3	0.2	0.0
Prosulfalin														
CF		1.0	2.3	3.7	2.7	1.3	1.0	1.0	1.3	1.0	20.0	25.0	47.5	10.8
SX_1	Fast	1.0	2.3	2.3	3.3	2.3	1.0	1.0	1.0	1.0	10.0	13.3	20.0	12.7
SX_2	Medium	1.0	1.0	1.3	3.0	1.3	1.0	1.0	1.3	1.0	10.0	10.0	17.5	5.8
SX_3	Slow	1.0	1.0	2.7	3.0	2.0	1.0	1.0	1.0	1.0	10.0	25.0	26.7	10.2
SP_1	Fast	1.0	4.3	6.7	8.0	8.0	6.0	3.3	3.0	1.0	7.0	18.3	27.7	10.2
SP_2	Medium	1.0	4.0	7.0	8.0	7.7	6.7	3.3	2.7	1.0	6.0	8.3	20.0	6.8
SP_3	Slow	1.0	4.0	6.7	8.0	7.7	5.3	2.0	3.0	1.0	3.0	5.0	16.3	5.0
Untreated Check		1.0	1.0	1.0	1.0	1.0	1.3	1.0	1.0	1.7	36.7	43.3	50.8	24.2

1 Phytotoxicity ratings were made using a scale of 1 through 9 with 1 representing no injury and 9 representing complete necrosis of the turf.

2 Values are for second applications (Sept. 1) on 1/2 of plots. Data for spring treatments only = 1.0 for all formulations.

3 Values are averages of spring application only and spring + fall applications.

Table 26. Performance of preemergence herbicides encapsulated in starch xanthate as influenced by mesh size.

Herbicide Formulation	Release Property	Mesh Size	Phytotoxicity[1] 6/13	7/12	7/26	8/9	8/26	9/26	10/26	% Crabgrass 8/18	8/26	9/26	10/26
Benefin													
SX_1	Fast	14-20	1.7[2]	1.0	1.0	1.0	1.0	1.0	1.0	6.7	11.7	16.5	5.0
SX_1	Fast	40-60	2.0	1.7	1.0	1.0	1.0	1.0	1.0	6.0	11.7	16.5	3.7
SX_2	Medium	14-26	1.3	2.5	1.5	1.0	1.0	1.0	1.0	4.7	6.7	15.0	2.0
SX_2	Medium	40-60	1.3	3.0	1.3	1.0	1.0	1.0	1.0	4.3	6.7	11.7	3.7
SX_3	Slow	14-20	1.3	1.0	1.0	1.0	1.0	1.0	1.0	6.7	11.7	21.7	5.3
SX_3	Slow	40-60	1.7	1.3	1.0	1.0	1.0	1.0	1.0	3.0	6.7	10.0	2.3
Oxadiazon													
SX_1	Fast	14-20	2.3	1.3	1.0	1.0	1.0	1.0	1.0	8.3	16.7	21.7	3.7
SX_1	Fast	40-60	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	8.3	13.3	3.7
SX_2	Medium	14-20	1.3	1.0	1.0	1.0	1.0	1.0	1.0	7.7	10.0	13.3	3.7
SX_2	Medium	40-60	1.7	1.7	1.0	1.0	1.0	1.0	1.0	4.3	6.7	15.0	1.0
SX_3	Slow	14-20	1.3	1.3	1.0	1.0	1.0	1.0	1.0	6.0	8.3	13.3	5.3
SX_3	Slow	40-60	1.3	1.0	1.0	1.0	1.0	1.0	1.0	6.7	10.0	15.5	5.0
Prosulfalin													
SX_1	Fast	14-20	3.0	3.3	2.3	1.3	1.0	1.0	1.0	21.7	33.3	36.7	11.7
SX_1	Fast	40-60	4.3	4.3	3.3	1.3	1.0	1.0	1.0	8.3	10.0	15.0	5.3
SX_2	Medium	14-20	2.3	2.0	1.3	1.0	1.0	1.0	1.0	10.0	10.0	16.7	3.7
SX_2	Medium	40-60	4.0	3.7	3.0	1.0	1.0	1.0	1.0	8.3	15.0	21.7	6.7
SX_3	Slow	14-20	3.0	2.7	1.7	1.0	1.0	1.0	1.0	8.3	15.0	21.7	8.3
SX_3	Slow	40-60	4.7	5.0	4.0	1.7	1.0	1.0	1.0	9.3	10.0	20.0	5.7
Untreated Check			1.0	1.0	1.0	1.0	1.0	1.0	1.0	56.7	58.3	57.0	18.3

[1] Phytotoxicity ratings were made using a scale of 1 through 9 with 1 representing no injury and 9 representing complete necrosis of the turf.

D. 1. c. Selective control of creeping bentgrass in Kentucky bluegrass turf. J. E. Haley and A. J. Turgeon.

Creeping bentgrass can be a desirable turf when kept under a high cultural intensity; however, when found in Kentucky bluegrass, it poses a serious weed problem. In past studies, endothall and silvex were found to provide some selective control of creeping bentgrass. Previous research has indicated that combinations of the two herbicides might prove to be more effective in controlling the bentgrass than either endothall or silvex used alone. In an experiment performed in 1976, the combination of endothall at 1 lb/acre and silvex at 2 lb/acre controlled bentgrass most effectively with minor damage to the Kentucky bluegrass turf. The experiment was repeated in 1977 with little control to the bentgrass or damage to Kentucky bluegrass by any of the treatments. Cold, wet weather followed the 1977 applications which indicated that the environment was an important factor in the successful use of these herbicides.

On June 14, 1978, three creeping bentgrass plugs (4-in diam.) were established in a total of 90 Kentucky bluegrass plots measuring 5 x 6 ft. On July 11, 60 of the Kentucky bluegrass plots were sprayed with endothall and silvex alone and in combinations, at various rates and proportions using a spray volume of 28.8 gallons per acre. The plots were monitored for injury to bentgrass plugs and the existing Kentucky bluegrass turf. On August 23, the remaining plots were treated along with one-half of the plots previously treated in July. In this manner, we could determine any importance that timing of herbicide application might have as well as the importance of a second application to the same area.

The results were similar to previous trials; both endothall and silvex alone at low rates provided little control of the bentgrass (Table 27). Silvex at 4 lb/acre was highly injurious to bentgrass; however, it was the combination of endothall and silvex which best controlled the bentgrass with only minor injury to the Kentucky bluegrass turf. In all cases, injury to the bentgrass and the Kentucky bluegrass was less severe than the trials in 1976 but more damaging than during the cool, wet weather of 1977.

It did not appear that control was better in plots receiving treatment in both July and August than in plots treated only in August. When combinations of the herbicide were used, treatment in August appeared to provide better control than the earlier July treatment.

Table 27a. Effectiveness of endothall and silvex in selectively controlling creeping bentgrass in Kentucky bluegrass turf.

Treatment	Time of Treatment	Rate lb/A	Days after treatment												
			3	6	10	15	20	27	35	6	10	15	28	35	52
			Bentgrass control[1]												
Endothall[2]	July	1	1.0	2.0	1.7	1.3	1.0	1.0	1.0						
"	"	2	1.0	3.7	3.7	2.7	1.0	1.0	1.0						
"	"	4	1.0	5.3	5.0	3.7	2.7	2.0	1.0						
Endothall	July & Aug.	1	1.0	2.3	1.7	1.0	1.0	1.0	1.0	2.0	2.3	1.7	2.3	1.7	1.0
"	"	2	1.0	4.3	3.3	2.0	1.7	1.0	1.0	4.3	6.0	5.7	4.7	3.0	1.7
"	"	4	1.0	5.3	4.0	3.3	2.3	1.7	1.3	5.0	5.7	6.0	4.7	4.3	1.7
Endothall	Aug	1								4.3	3.0	3.3	4.0	2.0	2.7
"	"	2								4.3	5.7	5.7	5.3	1.7	2.0
"	"	4								6.0	6.0	6.3	6.7	3.3	4.0
Silvex[3]	July	1	1.0	2.3	4.3	4.7	5.0	2.7	3.3						
"	"	2	1.0	4.0	5.0	5.7	5.3	3.7	3.0						
"	"	4	1.0	6.3	6.0	7.3	7.3	7.7	7.0						
Silvex	July & Aug.	1	1.0	2.3	3.0	4.3	2.0	2.3	1.0	4.7	5.7	6.0	6.7	5.0	3.3
"	"	2	1.0	3.7	4.7	5.7	5.3	3.0	4.0	7.3	6.7	7.0	7.3	8.0	5.7
"	"	4	1.0	5.3	6.3	5.3	5.3	5.7	4.3	6.0	7.3	7.7	7.7	7.0	6.3
Silvex	Aug	1								4.3	3.7	5.3	7.0	4.3	3.7
"	"	2								4.7	5.7	6.7	5.7	6.0	4.3
"	"	4								5.3	6.0	7.7	7.3	6.3	6.7
Endothall + Silvex	July	1 + 1	1.0	6.3	6.7	7.0	6.0	6.3	3.7						
	"	2 + 2	1.0	8.0	7.7	8.7	8.3	8.0	7.3						
	"	1 + 2	1.0	8.0	8.3	8.0	8.0	7.3	7.0						
	"	2 + 1	1.0	8.0	8.0	8.0	8.0	8.0	6.3						
Endothall + Silvex	July & Aug.	1 + 1	1.0	6.7	7.0	7.0	5.7	6.3	4.3	6.7	7.3	7.3	7.3	6.7	5.0

Table 27a. (Cont'd.)

Treatment	Time of Treatment	Rate lb/A	Days after treatment												
			3	6	10	15	20	27	35	6	10	15	28	35	52
			Bentgrass control[1]												
Endothall + Silvex	July & Aug.	2 + 2	1.0	8.0	8.0	8.3	8.0	8.0	7.7	8.7	9.0	9.0	9.0	9.0	9.0
	"	1 + 2	1.0	7.7	8.0	8.3	7.7	7.7	6.3	8.7	8.7	8.7	9.0	9.0	9.0
	"	2 + 1	1.0	7.7	7.7	7.0	6.3	7.0	4.7	8.0	8.7	8.7	8.7	8.7	7.7
Endothall + Silvex	Aug	1 + 1								6.3	7.7	8.0	7.7	8.0	7.7
	"	2 + 2								7.3	9.0	8.7	8.7	8.7	8.3
	"	1 + 2								7.0	8.0	8.3	8.3	8.3	8.0
	"	2 + 1								7.7	8.7	8.7	8.0	8.7	7.7
Untreated			1.0	1.0	1.0	1.0	1.0	1.0							

1 Bentgrass control and turfgrass injury were rated using a scale of 1 through 9 with 1 representing no injury or control, and 9 representing complete control or necrosis of the turf.

2 The endothall formulation was a 1.5 lb/gallon disodium salt.

3 The silvex formulation was 4 lb/gallon low volatile ester.

Table 27b. Effectiveness of endothall and silvex in selectively controlling creeping bentgrass in Kentucky bluegrass turf.

Treatment	Time of Treatment	Rate lb/A	Days after treatment													
			3	6	10	15	20	27	35	6	10	15	24	28	35	52
			Turfgrass injury[1]													
Endothall[2]	July	1	1.7	2.0	2.3	1.7	1.7	1.0	1.0							
"	"	2	2.0	3.3	3.0	2.0	2.0	1.0	1.0							
"	"	4	3.3	4.3	4.7	3.3	2.7	1.0	1.0							
Endothall	July & Aug.	1	1.3	2.0	2.3	1.7	1.7	1.0	1.0	2.0	2.3	1.7	1.3	1.7	1.0	1.0
"	"	2	2.3	3.0	2.7	1.7	1.7	1.0	1.0	3.7	3.7	2.7	1.7	2.7	1.3	1.0
"	"	4	2.3	3.7	3.7	2.3	2.3	1.0	1.0	3.7	5.3	4.3	2.7	3.7	2.3	1.0
Endothall	Aug	1								3.3	2.7	2.3	2.3	1.7	1.3	1.0
"	"	2								3.0	4.3	2.3	2.0	2.0	1.0	1.0
"	"	4								4.0	5.7	4.7	4.0	3.7	2.3	1.0
Silvex[3]	July	1	1.3	1.3	2.7	2.0	2.0	1.0	1.0							
"	"	2	1.7	1.7	3.3	2.3	2.3	1.0	1.0							
"	"	4	1.7	2.0	4.3	3.7	3.7	1.0	1.0							
Silvex	July & Aug.	1	1.7	1.3	2.3	2.3	2.3	1.0	1.0	2.3	2.7	3.0	3.3	4.0	4.0	1.0
"	"	2	1.3	1.3	3.0	2.3	2.3	1.0	1.0	2.3	4.0	4.3	4.3	4.0	4.3	1.0
"	"	4	1.7	2.0	4.0	3.0	3.0	1.0	1.0	3.3	4.7	5.0	6.3	6.3	6.3	4.0
Silvex	Aug	1								2.7	3.3	3.0	2.3	4.3	3.0	1.0
"	"	2								2.3	4.0	4.0	3.3	4.0	3.7	1.0
"	"	4								3.3	5.0	5.7	5.3	6.0	5.3	2.3
Endothall + Silvex	July	1 + 1	2.0	2.3	4.3	2.0	2.0	1.0	1.0							
	"	2 + 2	3.3	4.7	5.7	3.0	3.0	1.0	1.0							
	"	1 + 2	2.3	3.0	5.0	3.0	3.0	1.0	1.0							
	"	2 + 1	3.0	4.0	5.7	2.7	2.7	1.0	1.0							
Endothall + Silvex	July & Aug.	1 + 1	2.3	2.7	4.0	2.0	2.0	1.0	1.0	4.3	5.7	5.3	4.0	3.7	3.3	1.0

Table 27b. (Cont'd.)

Treatment	Time of Treatment	Rate lb/A	Days after treatment													
			3	6	10	15	20	27	35	6	10	15	24	28	35	52
			Turfgrass injury[1]													
Endothall + Silvex	July & Aug.	2 + 2	3.7	4.7	5.7	3.3	3.3	1.0	1.0	5.3	6.7	6.7	6.0	6.0	5.3	3.3
	"	1 + 2	2.7	3.3	5.3	3.0	3.0	1.0	1.0	5.3	6.7	6.7	6.3	6.3	6.0	4.6
	"	2 + 1	3.7	3.7	5.3	3.7	3.7	1.0	1.0	5.7	7.0	6.7	6.3	6.0	6.0	4.0
Endothall + Silvex	Aug	1 + 1								4.0	5.7	6.0	5.3	5.7	5.7	2.3
	"	2 + 2								5.7	7.7	7.3	7.0	7.0	6.3	5.0
	"	1 + 2								4.7	5.7	5.7	6.3	5.7	5.0	3.0
	"	2 + 1								5.0	7.0	6.0	5.7	6.0	5.0	1.7
Untreated																

[1] Bentgrass control and turfgrass injury were rated using a scale of 1 through 9 with 1 representing no injury or control, and 9 representing complete control or necrosis of the turf.

[2] The endothall formulation was a 1.5 lb/ gallon disodium salt.

[3] The silvex formulation was 4 lb/gallon low volatile ester.

D. 2. c. Fungicide evaluation for control of Sclerotinia dollar spot and Rhizoctonia brown patch on Seaside creeping bentgrass. Malcolm C. Shurtleff and Thomas M. Sjulin.

Commercial and expermental turfgrass fungicides were again evaluated for their effectiveness in controlling natural outbreaks of Sclerotinia dollar spot and Rhizoctonia brown patch. The fungicides were tested on Seaside creeping bentgrass at the Ornamental Horticulture Research Center in Urbana. A total of 29 chemical treatments plus two unsprayed treatments were included in a completely randomized design. Each treatment was replicated four times, using 4 ft. x 6 ft. plots. Fungicides were applied in 5 gallons of water per 1000 sq. ft. at 30 psi using a CO_2 pressurized, 2-nozzle boom sprayer.

Fungicide applications began on June 8, 1978 when Sclerotinia dollar spot was active and continued at weekly intervals (except for the Chipco RP-26019 treatments) through mid-August. The plots were rated visually for the percentage of the total area diseased each week, just prior to spraying. Initial dollar spot ratings before starting the fungicide applications on June 8 averaged 8.31 percent for all plots.

The results giving the fungicides, rates, spray intervals and weekly mean dollar spot ratings, June 8 to July 21, are given in Table 28. There were no more active attacks of Sclerotinia dollar spot or Rhizoctonia brown patch after July 21.

The better fungicides at the rates used (e.g., Spectro, Bromosan, Cleary's 3336, Daconil 2787, DPX 4424, BTS 40-542, Fungo, and Kromad) brought the mean dollar spot rating to 1.0 percent or less within two weeks. The less effective compounds -- mancozeb [Tersan LSR (not recommended for the control of this disease], Chipco RP-26019, Acti-dione TGF and RZ -- took several weeks longer and the amount of disease actually increased in the RP-26019 plots sprayed at 3-week intervals and in the Acti-dione TGF plots until the rate was doubled after July 7.

Rhizoctonia brown patch appeared during the week of June 30 to July 7. The readings taken on July 7 are given in the last paragraph after the table.

It is interesting to note that the experimental SN 66752 (active against Pythium) largely nullified the dollar spot activity of Daconil 2787 and Dyrene when applied in combination with these standard fungicides.

For some unknown reason Acti-dione and Chipco RP-26019 were not as effective against dollar spot as other investigators have reported.

Table 28. Control of Sclerotinia dollar spot on Seaside creeping bentgrass by fungicide treatment.

Fungicide[1/]	Spray Interval (days)	Product Rate/1000 sq ft	Mean Dollar Spot Rating[2/]					
			June 8	June 15	June 23	July 7	July 14	July 21
Spectro 50 WP	7	3	9.6	8.75	1.1	0.05	0.0	0.05
Bromosan 67 WP	7	3	11.1	9.9	0.1	0.0	0.0	0.0
Bromosan Fl	7	4 fl	6.9	4.75	0.05	0.05	0.05	0.8
Cleary's 3336 50 WP	7	2	8.5	5.4	0.1	0.05	0.0	0.07
Cleary's 3336 Fl	7	2 fl	6.9	6.5	0.05	0.05	0.05	0.05
Daconil 2787 Fl	7	4 fl	13.5	12.5	3.12	2.25	0.4	0.07
Daconil 2787 75 WP	7	4	5.75	6.25	2.15	4.5	2.65	0.7
Tersan 1991	7	1	5.1	5.3	0.2	0.15	0.1	0.07
Daconil 2787 Fl + Tersan 1991	7	3 fl + 1	13.25	10.75	0.1	0.0	0.0	0.0
Tersan LSR[4/]	7	3→6	13.25	12.0	13.27	22.25	28.0	27.5
DPX 4424 50 WP	7	2	9.25	6.9	0.32	0.05	0.05	0.7
DPX 4424 50 WP	7	4	4.9	4.5	0.1	0.0	0.05	0.0
Daconil 2787 Fl + SN 66752	7	4 fl + 1.5 fl	8.75	5.0	3.52	3.94	7.0	2.1
Daconil 2787 Fl + SN 66752	7	4 fl + 2.5 fl	10.75	8.75	2,75	0.4	0.07	0.0
Dyrene 50 WP + SN 66752	7	4 + 1.5 fl	6.0	3.6	0.8	9.02	6.1	3.4
Dyrene 50 WP + SN 66752	7	4 + 2.5 fl	5.12	6.1	2.9	19.5	22.0	16.75
Dyrene 50 WP + BTS 40-542 25 WP	7	4 + 5	8.3	5.3	0.3	0.15	0.8	0.15
Daconil 2787 Fl + BTS 40-542 25 WP	7	4 fl + 5	5.5	4.1	0.1	0.0	0.0	0.05
BTS 40-542 25 EC	7	7.5 fl	8.4	5.75	0.1	0.0	0.0	0.0
BTS 40-542	7	7.5	1.3	1.0	0.1	0.05	0.0	0.0
Fungo	7	2	5.6	3.8	0.15	0.05	0.0	0.0
Kromad	7	4	2.1	1.2	0.8	0.5	0.05	0.07
Fungo & Kromad	7	1 + 2	12.75	10.4	0.2	0.0	0.1	0.0
Fungo & Kromad	7	1 + 5	11.25	7.8	0.2	0.0	0.0	0.05

Table 28. (Cont'd.)

Fungicide[1/]	Spray Interval (days)	Product Rate/1000 sq ft	Mean Dollar Spot Rating[2/]					
			June 8	June 15	June 23	July 7	July 14	July 21
Chipco RP-26019 50 WP	14	1	7.25	6.6	9.55	6.78	0.3	0.65
Chipco RP-26019 50 WP	21	2	7.25	8.1	3.3	11.25	12.5	19.6
Acti-dione TGF[3/]	7	1→2	2.75	1.9	2.52	8.25	1.0	0.7
Acti-dione TGF + Fe $SO_4 \cdot 7H_2O$	7	1→2 + 1	11.75	10.5	15.0	22.0	2.4	5.0
1% Cycloheximide/$FeSO_4 \cdot 7H_2O$	7	2→4	7.9	4.4	6.96	7.78	0.05	3.0
Acti-dione RZ	7	1.5→3	12.6	8.13	6.18	12.0	3.0	7.65
unsprayed controls	--	--	11.4	10.93	15.35	20.58	34.9	38.75

1/ Fungicides were applied to 4 x 6 ft plots with a CO_2 pressured, 2-nozzle boom sprayer at 30 psi at the rate of 5 gal water per 1,000 qu ft. Fungicides were applied at weekly intervals starting June 8, 1978 when Sclerotinia dollar spot was active. Four replications per fungicide treatment, with either unsprayed check plots (Nos. 31-32).

2/ Dollar spot ratings based on average percent of plot area showing symptoms. The first rating was made on June 8, 1978 just prior to applying the first treatment. Subsequent readings were taken as weekly or bi-monthly intervals just prior to spraying. Initial dollar spot ratings before the start of fungicide applications averaged 8.31 percent for all plots. In the July 14 and 21 ratings, traces of dollar spot could easily be confused with bird injury.

3/ The rates of all cycloheximide (Acti-dione) products were doubled after the July 7 treatment.

4/ The rate of Tersan LSR was doubled starting July 21.

Rhizoctonia brown patch appeared during the week of June 1 to July 7. As expected, it was erratic. Here are the readings taken on July 7, given as percent of the plot area showing symptoms: Plot 1 (1.25%), 2 (5.25%), 3 (3.0%), 5 (0.5%), 12 (1.5%), 17 (1.25%), 19 (5.12%), 21 (2.75%), 23 (2.5%), 24 (1.5%), 27 (10%), 28 (7.9%), 30 (6.25%), and the unsprayed controls 3.75%. Brown patch was again active just before the July 21 spraying. Here are the readings taken on July 21, given as percent of the plot area showing symptoms. Plot 2 (3.75%), 3 (0.25%), 5 (1.25%), 10 (1.25%), 12 (1.25%), 19 (7.75%), 22 (2.5%), 23 (2.5%), 25 (5.5%), 26 (1.5%), 27 (7.5%), 28 (18.75%), 29 (3.75%), 20 (16.25%), and 31-32 (11.87%).

D. 3. c. Insecticide evaluation for black cutworm control.
R. Randell.

Black cutworm feeding, and the birds feeding on the cutworms causing holes, can damage golf greens. This year an especially high number of black cutworms were present in Illinois corn fields in May and early June. Estimates range up to about 1 million infested acres.

Replicated plots of 30 square feet each were established in a bentgrass plot on the University of Illinois turfgrass plots. Insecticide applications were made beginning in May and continuing on a monthly basis. Cutworm counts were taken just prior to treatments each month.

Results observed in July show that the most effective treatment was Dursban while Dylox and Ficam were completely ineffective (Table 29).

Table 29. Effects of various insecticides in controlling black cutworms in creeping bentgrass turf.

Treatment	No. Cutworms/ft^2
Dursban	0.3
Dylox	5.3
Ficam	5.6
Pounce	3.0
Lannate	1.3
Untreated	4.0