1973 Turfgrass Research Summary
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(Not for Publication)

A. 3. a. Kentucky bluegrass Variety Evaluations. A. J. Turgeon

Kentucky bluegrass is a general purpose turfgrass throughout Illinois. It is a grass species with considerable variation in density, texture, color, growth habit, disease susceptibility and tolerance of environmental and mowing stresses. Presently, there are 51 varieties under test at this station. Of these, approximately 16 are commercially available. In addition, there are 10 blends (combinations of varieties) and 4 mixtures (combinations with other species) under evaluation. The varieties were planted in April, 1972. 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 1,000 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.

Many of the varieties have shown fair to good Helminthosporium leaf spot resistance during a spring in which leaf spot incidence was quite severe (Table 1). Notable exceptions were Kenblue (common), Park and three experimental selections - Kl-157, Kl-158 and RAM #1.

Most varieties greened up fairly well in early spring except Nugget, which is slow to come out of winter dormancy. Seedhead production in May varied substantially among varieties. Seedheads were especially abundant in Baron, Victa, Ba 61-91 and Ba 62-55, followed by Adelphi, Parade, P-59, Kl-132 and Kl-155. These parameters are useful when evaluating blends of several varieties to determine which varieties have become dominant. For example, the Merion-Kenblue blend rated G (good) on spring green-up and 1 (low) in seedhead production. In comparison, Merion ranked only F (fair) and Kenblue G (good) in spring green-up; and Merion ranked low in seedhead production while Kenblue had no seedheads. Also, the leaf spot rating was 1.7 for Merion, 5.7 (poor) for Kenblue, and 3.0 for the Merion-Kenblue blend. Hence, the Merion-Kenblue combination appears to be a fairly stable blend in its second year.

Another interesting blend is the Nugget-Pennstar combination. The blend ranked fair in spring green-up while Nugget, alone, was poor and Pennstar was good. The Nugget-Park blend ranked good in leaf spot resistance and good in spring green-up. In comparison, Nugget was poor in spring green-up and good in leaf spot resistance while Park was poor in leaf spot resistance and good in spring green-up.

The Fylking Kentucky bluegrass-red fescue (Pennlawn, Jamestown) mixtures ranked poor in turfgrass quality during the summer due to the brown out of the fescue. These mixtures would be expected to perform better in a moderately shaded environment. In contrast, the Fylking-C-26 hard fescue mixture held up fairly well under summer stress. This is consistent with results from the fine-leaf fescue evaluation results.

Table 1. Turfgrass varietal evaluation results with Kentucky bluegrass varieties, blends and mixtures, planted April, 1972.

	VARIETY	SPRING GREEN-UP[1]	FALL COLOR[1]	LEAF SPOT RATING[2]	RUST DISEASE[3]	SEEDHEAD PRODUCTION[4]	Quality Rating[5]		
							6/29/73	8/26/73	11/16/73
1	A-20	F	F	2.0		1	2.7	3.3	3.3
2	A-34	G	F	2.0		1	2.0	2.7	3.0
3	ADELPHI (P-69)	G	G	2.3		3	2.7	2.7	2.3
4	BARON	F	F	3.3		4	2.7	3.0	3.0
5	BONNIEBLUE (P-106)	G	G	2.0	*	1	2.3	4.0	3.0
6	BRUNSWICK (P-57)	G	F	1.7		0	2.3	2.3	3.3
7	CAMPINA	G	F	4.3	*	2	3.0	3.7	3.3
8	DELFT	G	F	3.3	*	0	3.0	4.0	4.7
9	FYLKING	F	G	2.7		1	2.0	4.0	2.7
10	GALAXY (P-27)	G	G	1.7	*	2	2.3	3.7	3.0
11	GERONIMO	F	P	1.7	*	1	3.0	3.7	4.3
12	KENBLUE	G	F	5.7	*	0	5.0	5.0	3.7
13	MERION	F	P	1.7	**	1	2.3	3.7	3.7
14	MONOPOLY	F	F	2.7		2	3.0	2.7	3.7
15	NUGGET	P	P	2.0		1	1.7	4.0	3.7
16	PARADE	G	G	2.0		3	2.7	3.0	2.7
17	PARK	G	F	6.0		0	4.7	5.3	4.7
18	PENNSTAR	G	G	2.0	*	1	2.7	3.7	3.0
19	SODCO	G	G	3.0		1	3.0	3.3	2.7
20	SYDSPORT	F	G	2.0		0	1.7	3.3	3.0

Table 1 (continued)

21	VANTAGE	G	F	4.0	*	2	3.3	3.0	3.7
22	VICTA	F	F	2.7		4	3.0	3.0	3.0
23	WINDSOR	G	G	3.0		0	2.7	2.7	3.7
24	P-29	F	P	3.0		0	2.3	3.0	3.0
25	P-59	F	F	2.0		3	2.7	3.7	3.7
26	P-84	G	G	1.0	*	1	3.0	3.3	2.7
27	P-133	F	F	2.7		0	2.7	2.7	3.3
28	P-140	G	G	3.7	*	0	2.0	3.3	3.3
29	P-142	F	P	2.0	**	1	2.3	2.7	4.0
30	PSU-150	F	F	2.0		1	3.0	3.3	4.0
31	PSU-169	F	F	2.3		1	3.3	3.3	3.3
32	PSU-190	F	G	2.0		0	2.3	3.3	3.0
33	PSU-197	F	P	2.0	**	1	3.0	3.3	4.3
34	EVB-282	F	F	2.0		2	2.7	3.0	3.0
35	EVB-305	F	F	2.3	*	2	3.0	3.3	4.0
36	EVB-307	F	G	2.7		2	3.0	2.7	3.3
37	EVB-391	F	F	2.0	**	1	2.7	3.0	3.3
38	Ba 61-91	F	G	2.3		4	2.7	3.3	3.0
39	BA 62-55	F	G	3.0		4	2.7	2.7	3.3
40	K1-131	F	G	2.0		1	3.0	3.7	3.3
41	K1-132	F	G	2.0		3	3.0	3.3	3.0
42	K1-133	F	G	2.3		1	3.3	4.3	3.0
43	K1-138	F	P	3.3	**	4	4.0	5.0	4.0

Table 1 (continued)

44	K1-143	F	G	2.7		1	3.3	3.0	3.0
45	K1-155	F	G	2.0		3	3.0	3.0	3.3
46	K1-157	G	G	5.0		0	4.7	3.7	3.3
47	K1-158	G	P	6.0		0	4.3	2.3	4.3
48	K1-187	F	F	2.3	*	1	3.0	3.0	3.3
49	RAM #1	F	G	5.0		0	3.7	3.3	3.3
50	RAM #2	F	P	3.0	*	1	3.0	3.7	3.3
51	MLM-18001	F	F	2.7		2	3.3	3.0	3.3
			BLENDS						
52	MERION + KENBLUE	G	F	3.0	*	1	3.0	4.0	3.3
53	MERION + PENNSTAR	F	F	2.0		1	3.0	4.0	3.0
54	MERION + BARON	F	F	2.0	*	3	3.0	3.0	3.7
55	NUGGET + PENNSTAR	F	G	2.0		0	3.0	4.0	3.0
56	NUGGET + PARK	G	P	2.3		0	3.3	5.0	4.3
57	NUGGET + P-29	F	G	2.3		0	2.7	3.3	3.0
58	NUGGET + ADELPHI	F	G	2.0		3	2.7	4.0	2.3
59	VICTA + VANTAGE	F	F	2.7	*	4	3.0	3.0	2.7
60	P-59 + BRUNSWICK	G	F	2.0		3	3.0	2.3	3.0
61	BLEND 38	F	F	3.0		2	3.3	3.0	3.7
			MIXTURES						
62	FYLKING + JAMESTOWN	G	P	1.7		0	4.3	6.0	5.0
63	FYLKING + PENNLAWN	G	G	2.0		1	3.3	4.3	3.3

Table 1 (continued)

64	FYLKING + C-26	F	F	2.3		1	2.7	3.0	3.3
65	FYLKIÑG + PENNFINE	G	F	1.0		1	3.3	3.3	3.0

[1]Spring green-up and fall color ratings are: P = poor; F = fair; and G = good.

[2]Leaf spot ratings were made on 4/25/73 using a scale of 1 through 9 with 1 representing no evidence of disease; 2 and 3 indicate some thinning of the turf; 4 to 6 indicates some blighting of the turf; and 7 to 9 indicates severe blighting of the turf.

[3]Rust disease rating is * for moderate incidence and ** for severe incidence.

[4]Seedhead production was rated on a scale of 0 to 4 with 0 indicating no seedheads and 4 as heavy seedhead production.

[5]Visual quality was measured on a scale of 1 through 9 with 1 representing best quality and 9 representing poorest quality.

A. 3. b. Fine-Leaf Fescue Variety Evaluations. A. J. Turgeon

Fine-leaf fescues (creeping red, chewings, hard, and sheep) have traditionally found use as shade grasses or for drouthy, sandy sites. In the past, their performance in sunny locations on fine-textured Illinois soils has generally been less than satisfactory. Helminthosporium leaf spot and other diseases have been responsible for the typical summer brown out of these species.

The fine-leaf fescue varieties were planted in April, 1972. Plots measure 6 x 8 ft. and each is replicated three times. Fertilizer is applied twice yearly to supply a total of 2 pounds of nitrogen per 1,000 sq. ft.

The best varieties this year were the two hard fescues: Scaldis and C-26 (Table 2). Their fine texture and summer color make them promising for use as low-maintenance turfs along highways and other areas where these qualities may be desirable.

Table 2. Fine-leaf fescue varietal evaluation results.

	VARIETY	Quality Rating[1]				VARIETY	Quality Rating[1]		
		6/29/73	8/26/73	11/16/73			6/29/73	8/26/73	11/16/73
1	BARFALLA	5.7	4.0	3.7	15	POLAR	4.3	4.3	4.0
2	BAROK	5.0	3.3	4.7	16	RODA	6.3	4.3	5.7
3	DAWSON	4.0	6.0	4.3	17	SCALDIS	3.7	2.3	3.7
4	DURLAWN	6.0	4.7	4.7	18	SCARLET	6.0	6.3	7.0
5	ENCOTA	7.0	5.7	6.3	19	WALDORF	4.3	5.0	4.3
6	FLAVO	5.0	4.0	4.7	20	C-26	4.0	2.3	3.0
7	HIGHLIGHT	6.7	5.7	7.7	21	CEBECO S70-2	7.0	5.7	7.0
8	HORRITINE	4.7	4.3	3.7	22	CEBECO Hz71-4	7.0	8.0	7.7
9	JAMESTOWN	5.0	4.3	4.7	23	ERG-11	6.7	5.0	6.3
10	KOKET	5.7	5.3	5.0	24	F-84	5.3	4.7	4.3
11	MENUET	5.7	5.3	6.0	25	HF-11	6.3	6.7	7.3
12	NOVARUBRA	4.7	4.0	3.0	26	RU-45C	5.0	4.7	5.0
13	OREGON-K	5.0	3.7	4.7	27	C-26 + JAMESTOWN	4.3	3.7	4.3
14	PENNLAWN	4.3	4.0	4.3					

[1] Visual quality was measured on a scale of 1 through 9 with 1 representing best quality and 9 representing poorest quality.

A. 3. c. Creeping Bentgrass Variety Evaluations. A. J. Turgeon

A total of seventeen varieties and selections of creeping bentgrasses were planted in 10 x 6 ft. plots, in three replications, on May 18, 1973. Included in this series are: Seaside, Penncross, Washington, Toronto, Cohansey, Pennpar, Pennlu, Arlington, Congressional, Old Orchard, Metropolitan, Collins, Nimisilla, a Loft's selection and three selections from Michigan: MSU-Ap-18, MSU-Ap-28 and MSU-Ap-38.

A. 3. d. Perennial Ryegrass Variety Evaluations. A. J. Turgeon

Perennial ryegrass is usually considered a temporary lawn grass, or a 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.

Through the spring of 1973, the varieties NK-200, Manhattan and Pennfine appeared superior in density, color and mowing quality (Table 3). As the season progressed, Pennfine held its color somewhat better than Manhattan or NK-200. By late August, Manhattan and NK-200 regained their color and appeared comparable to Pennfine. As the season progressed into the fall, Manhattan improved further to become the best variety of those under test. Pennfine was fair while NK-200 deteriorated appreciably.

These improved ryegrasses used alone or in blends offer promise for use on athletic fields and other turfs where their rapid establishment rate may be of importance in quickly repairing wear injury.

Table 3. Turfgrass quality of perennial ryegrasses planted August, 1972.

VARIETY	QUALITY RATINGS[1]		
	6/29/73	8/26/73	10/26/73
1 PELO	5.0	4.3	5.3
2 NK-100	5.0	4.3	5.0
3 NK-101	5.3	4.0	6.3
4 NK-200	3.7	3.0	6.3
5 MANHATTAN	3.7	3.0	2.0
6 PENNFINE	3.7	2.3	3.3

Table 3. (Continued) Turfgrass quality of perennial ryegrasses planted August, 1972.

VARIETY	QUALITY RATINGS[1]		
	6/29/73	8/26/73	10/26/73
7 COMMON	6.3	5.7	7.0
8 K8-137	4.7	4.3	3.3
9 K8-142	5.0	4.3	5.7

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

B. 5. a. Slowly-Soluble Fertilizer Study in Turf. T. D. Hughes

Several factors are known to affect the rate of nitrogen release from slowly soluble fertilizer materials. One factor, namely soil temperature, does not have a pronounced effect on IBDU mineralization. Soil pH may be important and particle size is of primary importance. We are currently conducting extensive laboratory investigations to accurately describe these effects.

The importance and exact effects of soil pH are still questionable. Our investigations to date tend to indicate some small effects for 2 or possibly 3 weeks following application in that release rates are slower at high soil pH. The practical significance of these effects is still undetermined. It appears doubtful that in a range of soil pH from 5.5 to 7.5 that the effects are of much practical significance. Hopefully, most turfgrass soils in Illinois fall within this pH range.

Particle size is extremely important and must be considered in determining both frequency and rate of application. Our studies have shown that within a .7 to 2.0 mm material that the release of nitrogen may occur for only 6 weeks or up to 14 weeks depending on the particle size. We are currently developing mathematical equations which will predict rates and frequency of application given that particle size and rate of nitrogen release are known. Likewise, particle size and rate of nitrogen release may be determined at given frequency and rates of application.

B. 5. b. Fertilization and Mowing Effects on Several Kentucky bluegrasses. A. J. Turgeon

Five varieties of Kentucky bluegrass, including: Nugget, Merion, Fylking, Pennstar and Kenblue, were planted in 1972 and maintained at 1 3/4 inch height through the season. In April of 1973, each variety was clipped at 1 1/2 or 3/4 inch, three times per week, and fertilized at an annual rate of 2, 4, 6 or 8 pounds of nitrogen per 1,000 sq. ft., applied in one or two pound increments in May, June, August and September. The nitrogen source was a 10-6-4 water-soluble fertilizer. Each treatment combination (mowing height x fertility level) was replicated three times with 4 x 6 ft. plots within each variety.

Results have shown a relationship between high spring fertilization and the incidence of *Fusarium* blight disease in August (Table 4). This occurred with all varieties except Kenblue, which was seriously diseased at all fertility levels. Nugget was the least affected of the five varieties, with high mowing and the two highest fertility levels apparently being conducive to *Fusarium* blight.

The incidence of *Sclerotinia* dollar spot occurred in late September in all varieties subjected to close mowing and the lowest fertility level (Table 5). It was slight, however, in all but Nugget which is apparently highly susceptible to this disease. The severity of dollar spot decreased with higher mowing and increased fertilization.

E. 2. Effects of Various Aquatic Herbicides on Putting Green Turf When Used in Irrigation Water. R. C. Hiltibran and A. J. Turgeon

Aquatic weeds can present serious problems in irrigation ponds by clogging irrigation lines and pumps, interfering with play on golf courses and detracting from the aesthetic value of the landscape. Attempts at controlling aquatic weeds with herbicides are limited by the subsequent use of the water for irrigating putting greens and other turfs. This experiment was designed to evaluate the suitability of various aquatic herbicides in terms of their safety to intensively cultured turf.

The herbicides were added to barrels of water at normal treatment concentrations of 1 to 2 ppm; the water was then applied to one-quarter inch Seaside creeping bentgrass at the rate of 19.5 gallons per 30 sq. ft. plot (equivalent to one inch of irrigation). Applications were made on June 26, August 17 and September 14 to plots measuring 5 x 6 ft. with three replications.

Substantial browning of the turf was observed in plots treated with diquat (1 ppm) in June. This effect was short-lived and was associated with high temperatures immediately following application. The same treatment in August caused no observable effects. Apparently, injury from this herbicide, applied in irrigation water, occurs primarily when the application is made during periods of high climatic stress. Little or no injury was observed from applications of endothall, Hydrathol-47, dichlobenil, Aquathol Plus, 2,4-D, Cutrine or fenac. Some injury occurred following the June application of silvex; however, this herbicide was mistakenly applied at 9.3 ppm rather than

Table 4. Effects of various spring fertilization rates and mowing heights on the incidence of Fusarium blight in five Kentucky bluegrass varieties.[1]

lb. Nitrogen/M		Mowing Height (in.)	Kentucky Bluegrass Variety				
May	June		Nugget	Merion	Fylking	Pennstar	Kenblue
1	0	0.75	1.0	1.3	2.3	1.7	4.7
1	0	1.5	1.0	1.3	2.3	1.0	4.0
1	1	0.75	1.0	2.0	1.7	2.7	4.0
1	1	1.5	1.7	3.0	2.0	2.0	4.0
2	1	0.75	1.0	2.3	3.7	4.3	4.0
2	1	1.5	3.0	3.7	4.0	4.0	4.0
2	2	0.75	2.3	3.0	5.7	5.3	4.7
2	2	1.5	3.7	5.3	6.0	3.7	4.3

[1]Table data are the means of three replications. Observations were made using a scale of 1 through 9 with 1 representing no apparent disease, and 9 representing complete blighting of the turf.

Table 5. Effects of various fertilization ratio and mowing heights on the incidence of <u>Sclerotinia</u> dollar spot in five Kentucky bluegrass varieties.[1]

lbs. Nitrogen/M			Mowing Height (in.)	Kentucky Bluegrass Variety				
May	June	August		Nugget	Merion	Fylking	Pennstar	Kenblue
1	0	0	0.75	7.7	2.0	2.0	2.0	1.0
1	0	0	1.5	3.7	1.0	1.0	1.0	1.0
1	1	1	0.75	3.0	1.0	1.0	1.0	1.0
1	1	1	1.5	1.7	1.0	1.0	1.0	1.0
2	1	1	0.75	2.0	1.0	1.0	1.0	1.0
2	1	1	1.5	1.0	1.0	1.0	1.0	1.0
2	2	2	0.75	1.3	1.0	1.0	1.0	1.0
2	2	2	1.5	1.0	1.0	1.0	1.0	1.0

[1] Table data are the means of three replications. Observations were made using a scale of 1 through 9 with 1 representing no apparent disease and 9 representing 50% blighting of the turf.

the normal rate of 2 ppm. Some injury occurred in plots following the third application of dichlobenil, but recovery was evident within three weeks. It is not known whether the injury was due to a build-up of the herbicide in the soil or to reduced volatility loss under the cooler temperatures of September.

E. 3. Effect of Insecticides on Thatch Accumulation and Location of Residues in the Soil. Roscoe Randell

Dieldrin and chlordane applied three times a year over a five-year period resulted in a build-up of thatch on the soil surface in bluegrass turf. One inch of thatch was present in all replicates of chlordane and dieldrin. No build-up occurred in plots treated with carbaryl (Sevin) three times yearly for the past five years. Untreated plots exhibited no thatch accumulation.

The thatch build-up in the dieldrin and chlordane plots had an effect on the location of insecticides in the soil. Almost all of the insecticide residue had accumulated in the thatch layer (Table 6).

Table 6. Insecticide residue levels in insecticide-thatch plots, April, 1972.

Site of residue sample	Chlordane, ppm[1]	Dieldrin, ppm[1]
Thatch layer	980.1	291.7
0-1-inch depth	5.28	2.47
4-5-inch depth	.61	0.38

[1] Average of 3 replicates.

After 14 applications of insecticides in the spring of 1972, the 10 ft. by 10 ft. plots were divided in half in one direction with one-half dethatched and the other half, the thatch was left. Also, each 10 by 10 plot was divided in half the other direction with one-half of the plot continuing to receive insecticide treatments and the other half, the insecticide was not applied. In summary then each 10 by 10 foot plot was divided into 4, 5 by 5 foot plots. On one plot the thatch remained and insecticide treatments continued, another the thatch was removed and the treatments continued. Thatch was removed on the third plot and the treatments continued, while on the fourth plot, the thatch was removed and treatments were stopped. Table 7 shows the average level of chlordane and dieldrin residues in the four plots in June, 1973, or 14 months after dethatching one-half of each plot.

Table 7. Insecticide residue levels in insecticide-thatch plots, June, 1973.

Site of residue sample	Chlordane, ppm				Dieldrin, ppm			
Plot:	A[1/]	B[2/]	C[3/]	D[4/]	A[1/]	B[2/]	C[3/]	D[4/]
Thatch layer	520.1	--	333.3	--	222.6	--	90.48	--
0-1-inch depth	9.87	23.83	8.72	11.83	7.42	13.27	7.33	12.83
4-5-inch depth	1.29	1.09	1.0	0.63	1.70	0.88	1.15	0.83

1/ Plot A - Insecticide chlordane applied at 5 lb/A, 2 applications in 1967, 3 applications per year 1968 through 1972 plus 1 application in 1973. (18 applications, thatch not removed)

2/ Plot B - Same as A above except thatch removed from plots prior to 3 applications in 1972. (14 applications before dethatching and 4 afterward)

3/ Plot C - Same as A above except applications ceased after 1971. (14 applications, thatch not removed)

4/ Plot D - Same as B above except applications ceased after 1971. (14 applications, thatch removed 1972)

Insecticide levels were highest in the top one inch of soil where thatch was removed and treatments continued. There was very little difference in residue amounts in the 4- to 5-inch layer. Thatch continued to contain high amounts of insecticide even where treatments had ceased for 14 months.

E. 3. Effects of Repeated Treatments of Preemergence Herbicides on Kentucky bluegrass Turf. A. J. Turgeon

Several preemergence herbicides were applied to Kentucky bluegrass in mid-spring of 1970, 1971, 1972 and 1973. The turf was mowed two or three times per week at 1.5 inches, fertilized with a total of 4 pounds of nitrogen per 1,000 sq. ft. per year, and watered as needed to prevent wilt. Plots measured 10 x 10 ft. and each treatment was replicated three times.

The applications of calcium arsenate (Chip-cal) and bandane were associated with thatch development, the absence of earthworms in the upper three inches of soil, and shallow rooting into the underlying soil (Table 8). In July, the calcium arsenate and bandane-treated plots were highly prone to wilt and some subsequent loss of turf did occur, especially in plots receiving the calcium arsenate treatments. No such effects were observed from the other treatments.

E. 4. Comparison of Coring and Subsurface Cultivation for Improving Putting Green Turf. A. J. Turgeon and J. C. Siemens

The traditional means of alleviating soil compaction under an established turf has been through core cultivation techniques. Whether labeled aeration, aerification, hole punching, coring or mini-cultivation, this involves the removal of small cores of soil which are either removed, or broken up and dragged back into the holes. When cores are removed, topdressing with a prepared soil mixture is sometimes practiced immediately after core cultivation.

A new approach to reducing soil compaction is called subsurface cultivation. A machine is used to penetrate the soil to a depth of approximately five inches to lift and shatter the compacted soil mass. As little experience has been accumulated with this method of cultivation, an experiment was initiated to compare the effects of core versus subsurface cultivations, with and without topdressing.

Although it is too early in the experiment to draw any definite conclusions, several observations are worth reporting: topdressing following subsurface cultivation is very important in reducing desiccation injury along lines of soil penetration, especially where thatch depth is substantial; the time requirement for subsurface cultivation is considerably less than for core cultivation due to the relatively rapid forward speed of the Sub-Air

Table 8. Effects of three annual applications of preemergence herbicides on the growth of Kentucky bluegrass turf.

Treatment	Form	Rate, lb/A	Plant weights, g/plug[1]		
			Shoots	Thatch	Roots and Rhizomes
Bandane	10 G	35	0.84	5.40	0.24
Benefin	2.5 G	2	0.76	0	1.83
Bensulide	12.5 G	15	1.04	0	1.49
Calcium arsenate	48 G	392	0.85	6.86	0.23
DCPA	5 G	15	0.71	0	0.98
Siduron	50 WP	8	1.06	0	2.55
Control	--	--	0.97	0	2.58

[1] Table values are the means of six replications. Each plug measured 4 x 1 in. on the surface and was extracted to a depth of approximately 4 inches.

machine, the absence of tines that may clog and require cleaning, and the absence of soil cores that must be picked up or decimated following core cultivation; and the smoothness of the bentgrass putting surface appeared to be reduced more by subsurface cultivation than by core cultivation, indicating a greater need for topdressing and perhaps rolling following subsurface cultivation.

F. 1. Comparison of Air-Inlet and Conventional Nozzles for Herbicide Application to Turf. A. J. Turgeon and M. D. McGlamery

Air-inlet or "foaming" nozzles are a new development in herbicide-application technology. They provide for substantially reduced spray-drift potential and, hence, greater safety in spraying herbicides to turfs located near susceptible crops. There has been some concern, however, that the spray pattern from air-inlet nozzles would not provide the uniformity and completeness of cover necessary for effective weed control in turf. This study was designed to evaluate air-inlet nozzles and conventional nozzles, with and without foaming agent, by spraying herbicides at standard, half-standard and quarter-standard rates to a Kentucky bluegrass turf infested with various broadleaf weeds.

The use of air-inlet nozzles resulted in reduced weed control, compared to conventional nozzles, when spray volume and herbicide rate were kept constant (Tables 9 and 10). This difference did not occur when white clover was treated in August at standard rates of the herbicides. Hence, the air-inlet nozzle may be used satisfactorily providing the timing of the herbicide application is optimum with respect to susceptibility of a specific weed species. Inclusion of a foaming agent in the herbicide spary partially compensated for the loss in effacacy from the air-inlet nozzle. The foaming agent also provided for better visualization of the spray.

Table 9. Effects of herbicide rate, nozzle type and foaming agent on the control of broadleaf weeds in Kentucky bluegrass turf treated August 17, 1973 and evaluated three weeks later.

	Treatment rates, lb/A		Nozzle[1]	Foam[2]	Weed control rating[3]	
	2,4-D	dicamba	type	used	Clover	Plantain
1.	1	1/4	conv.	yes	10	9.3
2.	1	1/4	del.	yes	10	8.7
3.	1	1/4	conv.	no	10	9.3
4.	1	1/4	del.	no	10	9.0
5.	1/2	1/8	conv.	yes	10	7.0
6.	1/2	1/8	del.	yes	9	7.7
7.	1/2	1/8	conv.	no	10	7.3
8.	1/2	1/8	del.	no	9.7	8.0
9.	1/4	1/16	conv.	yes	8.3	5.3
10.	1/4	1/16	del.	yes	7.0	5.7

Table 9. (Continued) Effects of herbicide rate, nozzle type and foaming agent on the control of broadleaf weeds in Kentucky bluegrass turf treated August 17, 1973 and evaluated three weeks later.

	Treatment rates, lb/A		Nozzle[1]	Foam[2]	Weed control rating[3]	
	2,4-D	dicamba	type	used	Clover	Plantain
11.	1/4	1/16	conv.	no	9.0	8.0
12.	1/4	1/16	del.	no	5.3	5.7
13.	--	--	--	--	1.0	1.0

[1] The two nozzles used were: a Sprayer Systems 8004 (conv.) and a Delavan air-inlet D-4 (del.) both of which were calibrated to deliver 22 gallons per acre.

[2] Foaming agent used was Colloidal Products.

[3] Weed control rating was based on a scale of 1 through 10 with 1 representing no control and 10 for complete weed control.

Table 10. Effects of herbicide rate, nozzle type and foaming agent on the control of broadleaf weeds in Kentucky bluegrass turf treated September 28, 1973 and evaluated three weeks later.

	Treatment rates, lb/A		Nozzle[1]	Foam[2]	Weed control rating[3]
	2,4-D	dicamba	type	used	Clover
1.	1	1/4	conv.	yes	8.7
2.	1	1/4	del.	yes	6.0
3.	1	1/4	conv.	no	6.3
4.	1	1/4	del.	no	5.0
5.	1/2	1/8	conv.	yes	7.7
6.	1/2	1/8	del.	yes	5.7
7.	1/2	1/8	conv.	no	4.7
8.	1/2	1/8	del.	no	3.0
9.	1/4	1/16	conv.	yes	6.3
10.	1/4	1/16	del.	yes	5.0
11.	1/4	1/16	conv.	no	4.3
12.	1/4	1/16	del.	no	2.7
13.	--	--	--	--	1.0

[1] The two nozzles used were: a Sprayer Systems 8004 (conv.) and a Delavan air-inlet D-4 (del.) both of which were calibrated to deliver 22 gallons per acre.

[2] Foaming agent used was Colloidal Products.

[3] Weed control rating was based on a scale of 1 through 10 with 1 representing no control and 10 for complete weed control.

F. 1. Effects of Various Spray Volumes and Herbicide Formulations for Broadleaf Weed Control in Turf. A. J. Turgeon and M. D. McGlamery

The spray volume (amount of solution applied per unit area) used in applying herbicides has been recognized as an important factor in the effectiveness of weed control in turf. Generally, higher spray volumes result in greater weed control at the same herbicide application rate. In recent years, however, very high spray volumes have been used by custom spray applicators in applying combinations of fertilizers, herbicides and other pesticides. This study was initiated on August 17, 1973 to determine the spray volume effect, on herbicide efficacy, over a range of 13 to 680 gallons per acre. In addition, 2,4-D Lithate, 2,4-D Dicamine and two 2,4-D plus mecoprop combinations were applied to a Kentucky bluegrass turf infested with a variety of broadleaf weeds for evaluation.

The highest spray volume of 680 gallons per acre did result in a reduction in broadleaf plantain control at the lower rates of the herbicides (Table 11). Apparently, spray volume is of importance at marginally effective rates of postemergence herbicides.

The 2,4-D + mecoprop combination was not as effective in controlling white clover as 2,4-D + dicamba. The lithate formulation of 2,4-D was apparently more effective in controlling broadleaf plantain than Dacamine.

Table 11. Effects of herbicide combinations, formulations and spray volumes on the control of broadleaf weeds in Kentucky bluegrass turf treated August 17, 1973 and evaluated three weeks later.

Treatments	Rate, lb/A	S.V.[1]	Weed control rating[2] Clover	Plantain
1. 2,4-D + dicamba	1 + 1/4	13	10	9.3
2. "	1/2 + 1/8	13	10	9.0
3. "	1 + 1/4	28	10	9.7
4. "	1/2 + 1/8	28	10	9.3
5. "	1 + 1/4	50	10	9.7
6. "	1/2 + 1/8	50	10	8.3
7. "	1 + 1/4	680	10	7.3
8. "	1/2 + 1/8	680	9.3	5.3
9. 2,4-D + mecoprop	1 + 1/2	28	7.5	8.0
10. "	1 + 1/3	28	7.7	9.3
11. 2,4-D lithate	1	28	3.7	9.7
12. 2,4-D Dacamine	1	28	4.0	7.7
13. control	--	--	1.0	1.0
LSD @ .05			1.0	1.7
LSD @ .01			1.3	2.3

[1] S.V. equals spray volume in gallons per acre.

[2] Weed control rating was based on a scale of 1 through 10 with 1 representing no control and 10 for complete weed control.

F. 1. b. Preemergence Crabgrass Herbicide Evaluation. A. J. Turgeon

Preemergence herbicides were applied in April to established Kentucky bluegrass that had been vertical mowed and overseeded with crabgrass. Plots measured 5 x 6 ft. and each treatment was replicated three times. The plots were monitored for crabgrass germination and turfgrass injury, and control data was taken on July 29, 1973. A similar study was initiated May 9, 1973, on a new stand of Kentucky bluegrass that was seeded last September (1972), to determine the phytotoxic effects of these herbicides on young turf.

In established turf, complete control of crabgrass was obtained with Pre-San (emulsifiable concentrate of bensulide) and nearly complete control with the granular form of the same chemical - Betasan, with no apparent turfgrass injury (Table 12). On fall-seeded turf, Pre-San caused substantial injury estimated at 18 percent one month after treatment, and 5 percent nearly three months after treatment (Table 13). No injury was observed with Betasan. Another emulsifiable concentrate (EC) formulation that caused considerable injury on fall-seeded turf was Ronstar (Table 13). The granular formulation of the same (experimental) herbicide caused only slight injury to the young turf (Table 13) and provided 94 percent control of crabgrass in established turf when applied at 4 lb/A.

Dacthal wettable powder (WP) provided excellent crabgrass control while the granular (G) and new flowable (F) formulations gave fair to good control (Table 12). No turfgrass injury was observed from Dacthal in either study. The December application of Dacthal WP was not as effective in controlling crabgrass as the spring treatment.

Crabgrass control from benefin (Balan granular and Emblem wettable powder) was fair, averaging 85 percent from the granular and 78 percent from the wettable powder, at the higher application rates of 4 lbs/A (Table 12). Turfgrass injury was slight on fall-seeded turf where the benefin formulations were applied at 4 lb/A (Table 13).

An experimental herbicide - Tolban (GA 2-481) - provided good crabgrass control (Table 12) but was slightly to moderately injurious to fall-seeded turf (Table 13). Another experimental material - R-24191 - caused an increase in crabgrass, from the higher application rate of 2 lb/A, due to its injurious effects on both established and fall-seeded turfs. Crabgrass control from other materials was unsatisfactory at the rates applied in this experiment.

Table 12. Crabgrass control from preemergence herbicides applied April 27, 1973.

Treatment	Form	Rate, lb. a.i./A	Estimated % crabgrass	
			7/29/73	11/16/73
1. Dacthal	WP	10.5	4	9
2. Dacthal	WP	15	1	2

Table 12. (Continued) Crabgrass control from preemergence herbicides applied April 27, 1973.

Treatment	Form	Rate, lb. a.i./A	Estimated % crabgrass 7/29/73	Estimated % crabgrass 11/16/73
3. Dacthal	G	10.5	8	22
4. Dacthal	G	15	9	12
5. Dacthal	F	10.5	12	7
6. Dacthal	F	15	17	11
*7. Dacthal (fall appl.)	WP	10.5	22	20
*8. Dacthal (fall appl.)	WP	15	18	17
9. Balan	G	2	25	25
10. Balan	G	4	10	10
11. Emblem	WP	2	28	25
12 Emblem	WP	4	15	17
13. Betasan	G	15	3	3
14. Pre-San	EC	15	0	0
15. A-820	G	4	18	15
16. A-820	G	6	13	18
17. Ronstar	G	2	13	10
18. Ronstar	G	4	4	3
19. Tupersan	WP	8	25	40
20. Modown	WP	0.75	25	18
21. Modown	WP	1.5	47	45
22. Tolban	G	1.5	7	5
23. Tolban	G	3	3	3
24. R-24191	G	1	43	42
25. R-24191	G	2	82	70
26. PPG-139	F	10	20	23
27. PPG-139	GV	10	32	22
28. PPG-139	GC	10	30	22
29. Control	-	-	67	73

*Applied December 2, 1972

Table 13. Phytotoxicity from preemergence herbicides applied to fall-seeded Kentucky bluegrass.

Treatment	Form	Rate, lb. a.i./A	% Injury 6/8/73	% Injury 7/29/73
1. Dacthal	WP	15	0	0
2. Dacthal	F	15	0	0

Table 13. (Continued) Phytotoxicity from preemergence herbicides applied to fall-seeded Kentucky bluegrass.

Treatment	Form	Rate, lb. a.i./A	% Injury 6/8/73	% Injury 7/29/73
3. Balan	G	2	0	0
4. Balan	G	4	0	5
5. Emblem	WP	2	0	0
6. Emblem	WP	4	0	5
7. A-820	G	4	0	0
8. Betasan	G	15	0	0
9. Ronstar	G	3	0	5
10. Ronstar	EC	3	57	20
11. Tupersan	WP	8	0	0
12. Pre-San	EC	15	18	5
13. Modown	WP	0.75	0	0
14. Modown	WP	1.5	0	0
15. Tolban	G	1.5	7	5
16. Tolban	G	3.0	20	13
17. PPG-139	F	10	0	0
18. PPG-139	GC	10	0	0
19. R-24191	WP	2	25	0
20. Control	-	-	0	0

F. 1. b. Effects of Various Herbicides for Annual Bluegrass Control. A. J. Turgeon

Various herbicides were applied to a mixed stand of approximately 60 percent Merion Kentucky bluegrass and 40 percent annual bluegrass in: April 1972, September 1972, April 1973 and August 1973. Plots measured 5 x 6 ft. and each treatment was replicated three times. The turf is mowed three times per week at 3/4 inch and the total annual fertilizer application rate is equivalent to 4 pounds of nitrogen per 1,000 sq. ft. In August, 1973, the study was expanded to include an adjacent area with a mixed stand of creeping bentgrass and annual bluegrass. The same treatments and cultural conditions were imposed on this area as on the Kentucky bluegrass - annual bluegrass area.

Results to date have varied depending upon climatic conditions. In the untreated plots, the percent annual bluegrass increased from approximately 40 percent in April 1972, to 98 percent in June 1973 (Table 14). During this period, rainfall was abundant and summer stress (1972) was not severe. In July 1973, substantial loss of annual bluegrass occurred in all plots for the first time in the experiment.

The same trend observed in the untreated plots occurred in plots receiving Balan, Emblem, Dacthal, Po-San, Ronstar and A-820. Assuming that these preemergence herbicides did preclude new annual bluegrass from seed germination, vegetative growth of annual bluegrass under favorable climatic and cultural conditions was adequate to explain its dominance in these treated turfs.

Betasan caused slightly different results. Although annual bluegrass did increase sharply in Betasan-treated plots, both Kentucky bluegrass and annual bluegrass were noticeably injured in June when other plots appeared healthy. The phytotoxic effects of Betasan on closely-clipped Kentucky bluegrass make it a risky choice for chemically controlling annual bluegrass in this type of turf.

The endothall formulations substantially injured annual bluegrass after each application; however, annual bluegrass quickly recovered during favorable climatic conditions, especially where granular endothall was used. The August 1973 applications appeared to be much more injurious to annual bluegrass, presumably due to the high climatic stress occurring at that time.

Chip-cal most decisively controlled annual bluegrass; however, creeping bentgrass largely replaced it. This is probably due to the combination of abundant moisture and close mowing that characterized most of the experimental period.

Table 14. Effects of various herbicides on the percent of annual bluegrass in closely-clipped Kentucky bluegrass turf.

	Treatment	Form	Rate, (lb a.i./A)	% annual bluegrass			
				7/23/72	1/25/73	5/11/73	11/15/73
1.	Betasan	12.5 G	15	61	75	88	27
2.	Balan	2.5 G	3	48	80	96	67
3.	Emblem	24 WP	3	33	87	98	78
4.	Dacthal	75 WP	15	60	87	98	80
5.	Chip-cal	48 G	261	18	18	17	1
6.	Po-San	A - 1 lb/gal	1/2	34	75	96	68
		B - 2 lb/gal	1				
7.	Endothall - G	2.5 G	4	13	62	82	48
8.	Endothall - G	2.5 G	8	15	48	55	50
9.	Endothall - K	3 lb/gal	4	12	25	37	20
10.	Endothall - K	3 lb/gal	4 +	10	23	35	27
	plus Dacthal	+ 75 WP	15				
11.	Ronstar	2 G	4	80	88	99	78
12.	A-820	2.3 G	3	63	82	96	63
13.	Control	--	--	52	85	98	83

F. 1. c. Comparison of Paraquat and Glyphosate for Turfgrass Renovation. D. Black and A. J. Turgeon

Paraquat is a contact herbicide that has been used to kill an existing stand of vegetation in preparation for seeding turfgrass. Although it has no residual toxicity that would preclude planting shortly after treatment as does dalapon or amitrole, paraquat is not effective in controlling all types of vegetation. Quackgrass and bermudagrass quickly recover after treatment with paraquat and bentgrass is not always completely controlled.

An experiment was initiated to evaluate paraquat and a new herbicide glyphosate in controlling bentgrass prior to seeding Kentucky bluegrass with a Rogers seeder. Each chemical was applied once versus twice at a 2-week interval at 1 lb/A rate beginning July 16, 1973. Plots measured 6 x 9 ft. and each was replicated four times. (This experiment was repeated in early October.)

Results to date suggest that glyphosate is much more effective in controlling bentgrass than is paraquat. For best results, however, two applications will probably be necessary.

F. 2. b. *Fusarium* Blight Control Study. T. H. Bowyer, A. J. Turgeon and M. C. Shurtleff

A severe incidence of *Fusarium* blight was observed on a Kenblue Kentucky bluegrass turf in late August, 1973. Seven commercially available and experimental fungicides were applied on August 22 to evaluate their effectiveness in controlling the disease. In addition, a Jacobsen Sod-Master Sub-Air with nematocide injection apparatus was used to apply Fumazone into the soil, for nematode control. Evidence obtained over the last several years has shown that *Fusarium* blight incidence is frequently associated with high soil nematode populations. The Sub-Air was also used without injecting the nematocide for comparison with the subcultivation effect.

Specific treatments included: Toban @ 2 oz/1000 sq. ft., Fore @ 8 oz/1000 sq. ft., Fungo 50 @ 4 oz/1000 sq. ft., Tersan 1991 @ 8 oz/1000 sq. ft., Tersan LSR @ 8 oz/1000 sq. ft., Baydam @ 4 oz/1000 sq. ft., R-24952 @ 4 oz/1000 sq. ft., Sub-Air, Sub-Air + Fumazone, and Control.

Only Tersan 1991 provided complete control of the disease with complete recovery of the turf within a few weeks. The lack of comparable control from Fungo 50 was attributed to an insufficient rate of application. The total lack of effectiveness of the injected nematocide (Fumazone) suggested that nematode control was not an appropriate method for controlling *Fusarium* blight after disease symptoms have occurred.

F. 2. b. Fungicide Evaluation Results. T. H. Bowyer and M. C. Shurtleff

Sclerotinia dollar spot and Rhizoctonia brown patch are commonly occurring diseases of Illinois bentgrass greens. This experiment was designed to compare the ability of several commercial and research chemicals at various rates and frequencies of application to control these diseases.

Those companies contributing chemical and professional assistance are: Chemagro (BayDam 18654 and Dyrene), Diamond Shamrock Chem. Co. (Daconil 6F), E. I. DuPont De Nemours & Co. (Tersan 1991 and LSR), Mallinckrodt Chem. Co. (MF 568, Fungo 50, Koban), Rhodia Inc. (RP 26071), Rohm & Haas (RH 3928).

Dollar spot control was good to excellent with all fungicides (Table 15).

Brown patch incidence was comparable to that of untreated turf in plots receiving Koban or RP-26071. However, Koban is a highly specific fungicide used primarily for Pythium control; its effectiveness in controlling dollar spot is an important added benefit since Pythium and dollar spot diseases are sometimes confused.

The lower rate of Daconil 6F applied at 10-day intervals was apparently insufficient to control brown patch while the closer application frequency of Daconil (9 days), or the higher application rate (1/4 pt./1000 sq. ft.) completely controlled brown patch.

F. 3. Insecticide Evaluation for Cutworm Control on Putting Green Turf. R. Randell

A Pennpar creeping bentgrass turf was selected for successive applications of various insecticides for controlling cutworms and other destructive insects. Insecticides under evaluation include: carbaryl (Sevin), trichlorfon (Proxol), diazinon (Spectracide), Dursban and chlordane.

Results to date suggest that effective cutworm control is achieved by timely applications of all materials. The results from work with chlordane on Kentucky bluegrass turf have caused concern over whether alternative materials should be used on bentgrass.

G. 4. Effects of Various Herbicides on the Vegetative Establishment of Kentucky bluegrass. E. G. Solon and A. J. Turgeon

A continuation of previous work done in the field and the greenhouse, this study was undertaken to observe the effects of herbicides on the spread of A-20 Kentucky bluegrass plugs while evaluating their ability to control annual bluegrass.

Table 15. Fungicide Control of Sclerotinia Dollar Spot and Rhizoctonia Brown Patch on Penncross Creeping Bentgrass. (Individual Plots 7 x 10 Ft. with a Total Plot Area of 5,600 Sq. Ft.)

Fungicides	Rate[1] (oz./1000 sq. ft.)	Application interval (days)[1]	Sclerotinia D.S.[2]			Rhizoctonia B.P.[3]
			6/4	6/22	7/31	7/31
RP-26071[4]	1.5	14	.02	.02	.22	21.0
RP-26071	3.0	14	.00	.00	.02	5.2
Daconil 6F	1/8 pt.	7	.02	.02	.10	00.0
Daconil 6F	1/8 pt.	10	.00	.00	.20	9.2
Daconil 6F	1/4 pt.	7	.00	.00	.10	00.0
Daconil 6F	1/4 pt.	10	.00	.00	.80	00.0
RH 3928	.5	14	.00	.00	.00	2.0
MF 568	4	14	.00	.00	.00	00.2
Tersan 1991	2	14	.00	.00	.00	00.2
Fungo 50	2	14	.00	.00	.00	00.2
Koban	4	14	.00	.00	.00	16.0
BayDam 18654	2	14	.00	.00	.00	03.0
BayDam 18654 & Dyrene	2/2	14	.00	.00	.00	01.4
Tersan 1991 & Tersan LSR	1/3	14	.00	.00	.00	03.0
Fungo 50 & Koban	2/4	14	.00	.00	.00	00.0
Check	-	-	.34	.86	2.40	20.0

[1]Rate of application and application intervals were determined by label instructions or manufacturer's suggestion.

[2]Dollar spot ratings were based on a scale of 0 - 5. (0-no dollar spot; 5-severe dollar spot)

[3]Brown patch ratings were based on percent plot area diseased.

[4]Because of a chemical shortage RP 26071 was last applied on May 17.

On May 21, 1973, one pound of annual bluegrass seed was broadcast over prepared ground measuring 1000 sq. ft. The following day, A-20 Kentucky bluegrass plugs, approximately 2 square inches in size, were planted using a plugging machine set to space the plugs six inches apart. Five preemergence herbicides: Dacthal - 12 lb/A, Betasan - 12 lb/A, Balan - 3 lb/A, Chip Cal - 261 lb/A, and Ronstar - 2 lb/A, were applied after planting. Post emergence applications of endothall were made starting 8 weeks after planting using the granular formulation at 4 lb/A and the liquid (potassium salt) formulation at 1 lb/A. Four applications of the endothall formulations were made over the following five weeks.

Each of the preemergence and post emergence treatments were replicated 3 times in 5 x 6 ft. plots. Fertilizer was applied at a rate of 1 lb. of N per 1000 square feet every 3 weeks. The turf was maintained at a mowing height of 2 1/2 inches and irrigation was provided as necessary to prevent wilting of the turf.

A second application of Chip Cal at 261 lb/A was made on August 28, 1973 to see if the arsenic toxicity level could be reached for the annual bluegrass.

Results to date indicate that Ronstar is superior to the other herbicides. The plots treated with Ronstar had no weeds present while allowing the greatest percentage of cover of the A-20 Kentucky bluegrass plugs (Table 16). The percentage of weeds remaining at 14 weeks was predominantly annual bluegrass. Betasan and Balan provided good control of the annual bluegrass, but they were more inhibitory to the spread of the A-20 plugs than Dacthal which gave poorer control of annual bluegrass. Post emergence applications of endothall provided relatively poor weed control and may have been inhibitory to the spread of the A-20 plugs.

Table 16. Effects of various herbicides on annual bluegrass control in a vegetative planting of A-20 Kentucky bluegrass.

Trt	Rate(lb/A)	Weeks after planting date of May 22, 1973							
		4	8	14	25	4	8[1]	14	25
		Estimated % Cover of A-20				% Weeds			
Dacthal	12	5	15	23	39	10	29	15	42
Betasan	12	5	5	7	33	5	19	5	25
Balan	3	5	9	15	45	3	13	3	17
Chip Cal	261	5	7	14	43	35	80	46	13
Ronstar	2	5	17	36	74	0	0	0	1
Endothall-K[2]	1	5	6	7	24	-	-	6	40
Endothall-G[2]	4	5	6	8	20	-	-	33	60
Control	-	5	6	10	27	79	94	68	47

[1]Entire plot area was sprayed with a mixture of MAMA, 2,4-D and dicamba to control crabgrass and broadleaved weeds that developed in the plots. Three applications of MAMA were applied over the following 3 weeks.

[2]Endothall formulations were applied post-emergence to the mixed community of A-20 Kentucky bluegrass and annual bluegrass.