1977 TURFGRASS RESEARCH SUMMARY

UNIVERSITY OF ILLINOIS

AT URBANA-CHAMPAIGN

(NOT FOR PUBLICATION)

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A. 3. a. Water requirement of selected turfgrass species.
L. Art Spomer

Turfgrass contains and uses more water than any other raw material required for their growth and activity. This water is more than an inert filler, probably every plant function is affected directly or indirectly by water, and a lack of water (water deficit) always reduces growth. Unlike other nutrient deficiencies, a water deficit affects growth immediately. Very little is known, however, at exactly what degree and/or duration of water deficit that growth is significantly affected. Very little is also known about the levels of water stress typically experienced by turfgrass plants.

This project is trying to establish the physical and physiological water requirement of selected turfgrass species or answer the three questions: How much water? What degree of water stress is detrimental? What degree of water stress do turfgrasses typically experience? The answer to the first question is relatively simple; however, the answer to the second question requires the examination of the effect of water deficit on several physiological processes. The last question is straightforward but, as with the second question, requires the use of very difficult, sophisticated techniques to obtain the answer.

The main progress on this project so far has been to develop some of the difficult techniques required for measuring plant water status. To date, these techniques include plant water stress, water stress and expansion growth (including determination of the tissue permanent wilting point), and water stress and dry matter growth measurement (photosynthesis-respiration). Work is in progress on laboratory and field measurement of plant water use (evapotranspiration).

This project has been supported, in part, by a research grant from the U.S.G.A. Green Section.

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

Last year data indicated specific samples of dehydrated, pelleted turf clippings were highly digested and readily consumed by sheep. Subsequent research indicated lower than expected performance when additional samples of clippings were used in lamb growing and finishing studies. Additional studies were conducted to further evaluate samples of dehydrated, pelleted turf clippings from the Midwest.

Two digestion studies using mature wether sheep were conducted on two different samples of dehydrated, pelleted turf clippings from the same Midwest source. A lamb feeding study using six lambs in each of five lots evaluated lamb performance when fed a standard finishing diet as compared to a diet composed of 90, 80, 70 or 60% finishing diet and 10, 20, 30 or 40% dehydrated, pelleted turf clippings. To avoid the possibility of lambs sorting during eating, the pellets were ground when added to the finishing diet.

Results: Both samples of dehydrated, pelleted turf clippings were less well digested than the previous sample studied. Dry matter digestibility averaged 56.6% and 56.2% as compared to 69.3% in previous work. The intake of samples from the Midwest was higher (95.8 and 99.4 grams of dry matter consumed per day per kilogram of body weight $^{3/4}$) than that for the previous sample studied (92.2). From these studies it is apparent that differences in digestibility did exist between samples used in our first digestion study and samples used in subsequent growing-finishing studies. It is interesting that although Midwest samples were less digestible, they were consumed as well or better than the more highly digested material. This is not generally the case.

Data from the growing-finishing study are presented in the following table:

	Control	10%	20%	30%	40%
Average daily gain (lbs)	0.79	0.64	0.63	0.63	0.68
Daily Feed intake (lbs)	3.62	3.81	3.70	3.86	3.82
Feed required per unit gain (lbs)	4.61	6.25	6.81	6.28	5.72

It is apparent that none of the diets containing clippings supported as high a performance as the control diet. Of interest is the fact that the addition of clippings, regardless of level of addition, allowed for essentially the same level of gain. Intake was increased by the addition of clippings, but again, increases in intake were not related to level of clippings added. The feed required per unit of gain largely reflects gain in that the more rapid the gain the less feed required. These results demonstrate that when over half the diet is a high-concentrate mixture and the remainder clippings, lamb performance is very good (from 0.63 to 0.68 lbs per day). Why the lamb gains are not more related to level of clippings added is not known and was not expected.

Summary: It is apparent that dehydrated, pelleted turf clippings vary in their nutritive quality. The reason for this variability is not apparent. Ground, dehydrated clippings when supplemented with reasonably high levels of grain allow lambs to gain at a rapid rate although not as rapidly as a high concentrate diet.

Present and future research:

1. Studies are presently underway comparing the protein in dehydrated, pelleted turfgrass clippings to that in soybean meal. This comparison is being made with lambs.

2. Fresh turfgrass clippings have been ensiled (in small silos) with 10, 20 or 40% added ground, shelled corn added on a dry matter basis.

Specific characteristics of these materials will be determined when the silos are opened. When the silos are opened, the ensiled material will be fed to growing lambs in rations containing 50% total corn on a dry matter basis.

3. Several samples of dehydrated, pelleted turfgrass clippings are presently on hand to be used in a digestion study evaluating season of harvest and geographical location of production as possible variables influencing quality of the clippings. If sufficient clippings are available, growth studies will also be conducted.

B. 1. Dried bluegrass clippings as a source of protein and xanthophyl for broiler chicks. D. H. Baker, G. M. Willis and K. R. Robbins

A dried bluegrass product containing 22% crude protein was finely ground and fed to young chicks as a source of both protein and readily available xanthophyl. Growth performance and skin color measurements indicated good potential for inclusion of the product in corn-soybean meal diets at levels of 2 to 5% of the diet. At levels of 5% or higher, feed efficiency (gain per unit of feed intake) can be expected to be reduced as a result of the fiber content of the clippings.

Preference studies indicated that chicks found dried grass clippings every bit as acceptable as dehydrated alfalfa meal. Protein quality assessment of the product is under investigation currently. Preliminary indications reveal that the protein quality (i.e., amino acid balance) of dried grass clippings is vastly superior to alfalfa meal. Sulfur amino acids (methionine and/or cystine) is the first-limiting amino acid in each product.

B. 3. Impact of thatch on the residual activity of non-selective herbicides used in turfgrass renovation. K. A. Hurto and A. J. Turgeon

An effective turfgrass renovation program involves the eradication of undesired species and the immediate reestablishment of turf in the treated area. This practice often involves the use of an herbicide which will eliminate the existing vegetation without any residual activity which delays or prevents reestablishment. Herbicides used for this purpose include: paraquat, a contact non-selective herbicide, and glyphosate, a systemic non-selective herbicide.

Paraquat and glyphosate are reported to be rapidly inactivated in the soil, thus allowing for immediate replanting of the treated site. However, the impact of thatch on the residual activity of these herbicides has not been investigated. Since thatch is often a component of deteriorated turf, studies were initiated to assess its impact on the residual activity of paraquat and glyphosate.

Field Studies: Field studies were initiated April 29, and August 3, 1976 to determine the effects of thatch and reestablishment method on herbicide residual activity as it affects germination and subsequent growth of 'Pennfine' perennial ryegrass. April studies consisted of herbicide applications to a mature Kentucky bluegrass turf growing on a Flanagan silt loam soil at two sites: one site had a thatch layer 3-cm thick and the other site was thatch-free. Appications of paraquat at 1.1 and 2.2 kg/ha and glyphosate at 2.2, 4.5, and 9.0 kg/ha were made to 1.5 x 1.8 m plots with a CO_2-propelled small plot sprayer. Spray volume was 267 liter/ha. Four days later, the treated sites were planted as follows: core cultivated, vertically mowed (to break up the soil cores) and then broadcast seeded at 3 kg/are; vertically mowed to the 4-cm depth, and broadcast seeded at 3 kg/are; or disc-seeded at 1 kg/are with a Rogers 824 seeder. Prior to seeding, the treated sites were swept free of loose debris. Irrigation was provided as needed to promote germination. Mowing was performed two or three times a week at 3.8 cm after the seedlings had reached sufficient height.

August studies were initiated on sites adjacent to earlier studies. At the time of treatment it was assumed that sites were identical to April sites; however, it was later observed that a 1-cm thick layer of organic debris had accumulated at the soil surface of previously thatch-free-sites. Subsequent observations of this site indicated this layer to be transitory; during the summer, a shallow layer developed but was broken down presumably by macro-fauna in spring and fall when conditions for its disappearance were favorable.

A split-plot experimental design was used to compare the effects of reestablishment method (whole-plot treatment) on herbicide residual activity (sub-plot treatment). Treatment combinations were replicated three times in a randomized complete block design within reestablishment method. Plots were monitored for injury, and percent cover was visually estimated.

Greenhouse studies: The effects of herbicide residues in turfgrass clippings on percent germination of two turfgrass species were studied. Twenty seeds of 'Kenblue-type' Kentucky bluegrass of 'Epic' perennial ryegrass were surface sown in 190-ml styrofoam cups filled with potting soil. Potting soil was a mixture of silica sand and Flanagan silt loam soil (70:30,v/v). A 2-cm-deep layer of air-dried clippings removed three days after herbicide treatment from the August field study was placed on the soil surface. The pots were placed under a mist irrigation system for three days to promote germination and then moved to an adjacent bench where they were irrigated daily by hand. Each treatment was replicated four times in a completely randomized design. Clippings removed from untreated plots served as a control. Percent germination was recorded four weeks after seeding. Data presented are the means of two separate experiments.

An additional study was initiated to determine the effects of incorporating soil into thatch on the residual activity of paraquat and glyphosate. Petri dishes were filled with thatch ground to pass a 4 mesh screen and sieved Flanagan silt loam in the following proportions: 100:0, 95:5, 90:10, 75:25, 50:50, 25:75, and 0:100 (thatch:soil, v/v). The petri dishes were then sprayed with glyphosate and paraquat at 0, 0.6, 1.1, and 2.2 kg/ha in a spray volume of 267 liter/ha. Fifty seeds of 'Pennfine' perennial ryegrass were sown in each dish, moistened, covered, and placed in the dark at 25 C. Ten days later, percent germination was determined. Each herbicide treatment was replicated three times in a completely randomized factoral design. Data presented are the means of two experiments.

Laboratory Studies: Adsorption of paraquat and glyphosate by thatch and soil was studied by adding 5 cc of ground thatch or sieved silt loam soil to each of four flasks containing 100 ml of 1 ppm 14-C labeled herbicide. Flasks were sealed and equilibrated for 3 days at 25 C. The effect of time on adsorption of herbicide from solution was determined by assaying the herbicide solution at 0, 1, 2, 4, 8, 12, 24, 48, and 72 hours after addition of adsorbants to each flask.

Reestablishment of thatch-free Kentucky bluegrass sites four days after herbicide treatment resulted in comparable coverage of plots that were vertically mowed and broadcast seeded, or core cultivated, vertically mowed, and broadcast seeded, while disc seeding resulted in significantly less ground cover (Figure 1). Effects of establishment method on percent cover of thatchy sites were similar to thatch-free sites (Figure 2). However, percent cover of plots treated with 2.2 kg/ha paraquat was significantly less than was observed with other herbicide treatments. Disc-seeding resulted in greater suppression of perennial ryegrass emergence, than plots core cultivated, vertically mowed and broadcast seeded, or vertically mowed and broadcast seeded. Observation of plots 15 weeks after seeding showed percent cover of disc seeded thatchy sites, sprayed with 2.2 kg/ha paraquat were significantly less than other treated plots (Table 1).

Studies were initiated in August at two sites to determine if the residual effects of paraquat was inhibitory to seedling emergence or seedling development. Measurement of seedling numbers 11 days after planting showed a significant interaction between establishment method and herbicide treatment as illustrated in Figure 3. These results suggest that paraquat residues affected seedling emergence.

Observations of ground cover six weeks later are reported in Figures 4 and 5. These results differ from spring studies (Figure 2) with respect to paraquat residual activity. In these summer studies, application of paraquat to thatchy sites suppressed perennial ryegrass development at both 1.1 and 2.2 kg/ha. This difference between spring and summer treatment suggests that climatic factors may have an impact on paraquat inactivation. Another important finding of these summer studies, was that sites assumed thatch-free were not; rather a transitory thatch layer had developed during the summer which significantly affected paraquat residual activity. There, a shallow surface litter layer was just as inhibitory to ryegrass development as was a deep layer. Observations of treated sites the following spring showed little ground cover in disc seeded, paraquat-treated plots (Table 2).

Placement of paraquat-treated grass clippings on top of surface seeded Kentucky bluegrass or perennial ryegrass suppressed seedling emergence (Table 3). Comparable results were obtained between glyphosate-treated clippings and untreated clipping studies.

Complete adsorption of paraquat by thatch and soil was rapid, while glyphosate adsorption by thatch and soil was rapid but incomplete (Figure 6).

Incorporation of soil into thatch had no effect on percent germination of perennial ryegrass as a result of glyphosate treatment (Figure 3). In contrast, paraquat residual activity as measured by percent germination of perennial ryegrass was significantly improved with addition of soil to thatch (Figure 8).

In summary, the residual activity of paraquat in thatch and surface clipping debris has been demonstrated to adversely affect the development of turf on these sites. The toxic residues may be inactivated as a result of soil incorporation following core cultivation or topdressing of the treated sites. Environmental factors may also affect the magnitude of paraquat injury. Although paraquat adsorption in thatch is rapid, the weak tenacity with which it is adsorbed appears to explain its residual activity in thatch.

Table 1. Effect of establishment method and herbicide treatment on development of 'Pennfine' perennial ryegrass fifteen weeks after seeding in thatchy and thatch-free Kentucky bluegrass turf.[1]

		Thatch			Thatch-free		
Herbicide Treatment	Rate	DS	VM	CC	DS	VM	CC
	kg/ha			estimated % cover			
Glyphosate	2.2	91.6	91.0	95.6	87.6	81.6	85.3
	4.5	95.6	92.3	97.0	83.3	76.6	79.3
	9.0	90.0	94.0	97.6	85.0	81.6	86.6
Paraquat	1.1	94.0	91.6	97.3	94.0	93.3	94.0
	2.2	53.3	85.6	94.0	88.3	86.6	93.6
Source of Variation	df			F-Values[2]			
Establishment Method (E)	2		2.84			0.72	
Herbicide Treatment (H)	4		49.76**			4.25**	
(E) X (H)	8		25.63**			0.21	

[1] Herbicides applied April 29 and replanted May 3, 1976. DS:disc seeded; VM:vertically mowed + broadcast seeded; CC:core cultivated + vertically mowed + broadcast seeded.

[2] **F-values significant at 1% level.

Table 2. Effect of establishment method and herbicide treatment on developmemt of 'Pennfine' perennial ryegrass thirty weeks after seeding in thatchy Kentucky bluegrass turf.[1]

Herbicide Treatment	Rate	Establishment Method		
		DS	VM	CC
	kg/ha	estimated % cover		
Glyphosate	2.2	91.6	100.0	96.6
	4.5	91.6	95.0	96.6
	9.0	91.6	100.0	100.0
Paraquat	1.1	13.3	91.6	98.3
	2.2	5.0	81.6	86.6

Source of Variation	df	F-Values[2]
Establishment Method (E)	2	107.40**
Herbicide Treatment (H)	4	783.87**
(E) X (H)	8	57.56**

[1] Herbicides applied August 3 and replanted August 9, 1976. DS:disc seeded; VM:vertically mowed + broadcast seeded; CC:core cultivated + vertically mowed + broadcast seeded.

[2] **F-values significant at 1% level.

Table 3. Effect of herbicide residues in grass clippings harvested from the field three days after herbicide treatment on percent germination of two turfgrass species in the greenhouse.

Herbicide Treatment	Rate kg/ha	<u>Poa</u> <u>pratensis</u>	<u>Lolium</u> <u>perenne</u>
		%	%
Glyphosate	2.2	32.0	51.5
	4.5	64.5	63.5
	9.0	50.5	59.8
Paraquat	1.1	0	10.0
	2.2	0.5	1.0
Untreated	-	48.8	63.5
LSD			
	0.05	4.5	11.6
	0.01	6.0	15.5

Figure 1. Effect of herbicide treatment and establishment method on percent cover of 'Pennfine' perennial ryegrass 6 weeks after seeding in thatch-free Kentucky bluegrass turf.

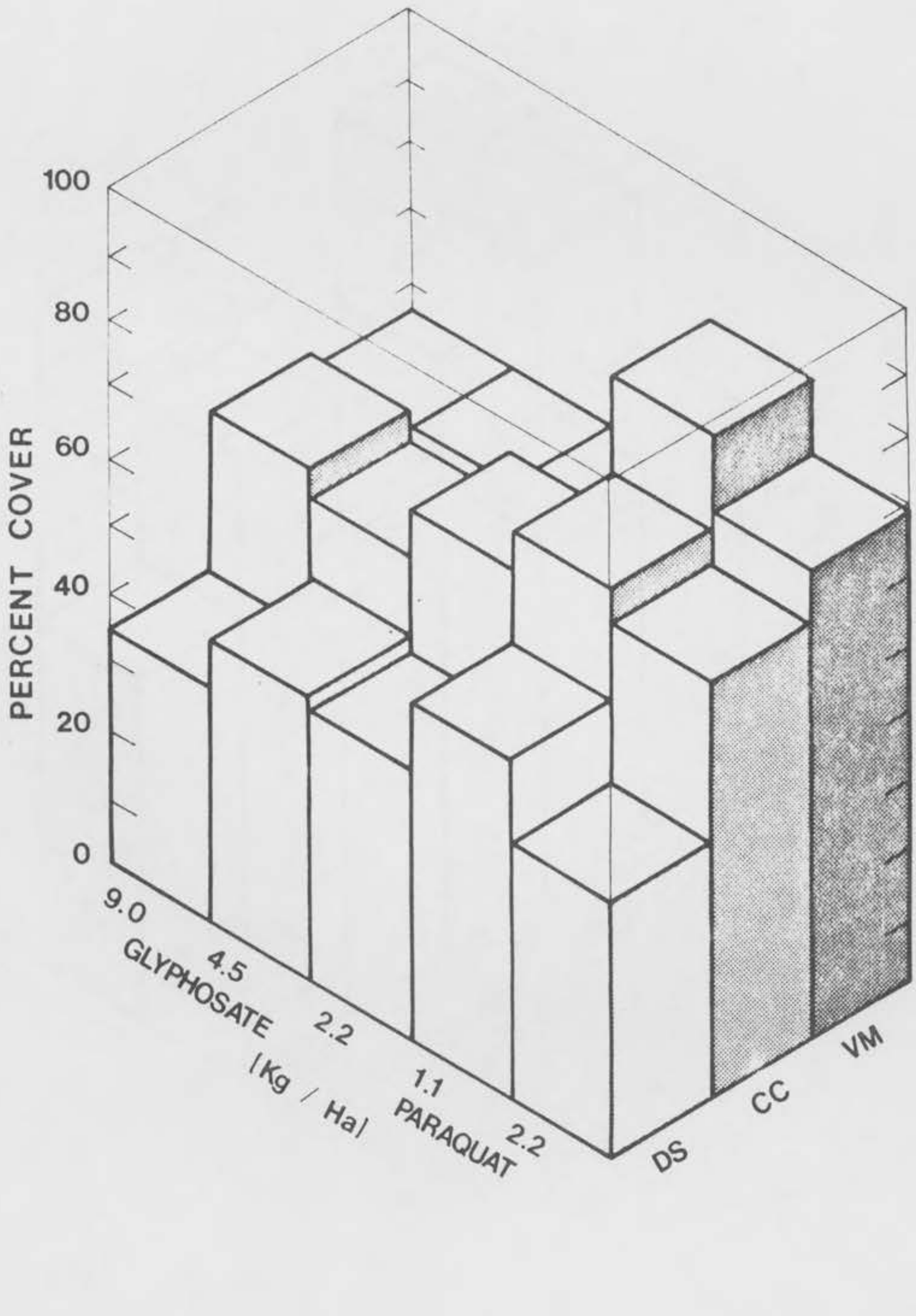

Figure 2. Effect of herbicide treatment and establishment method on percent cover of 'Pennfine' perennial ryegrass 6 weeks after seeding in thatchy Kentucky bluegrass turf.

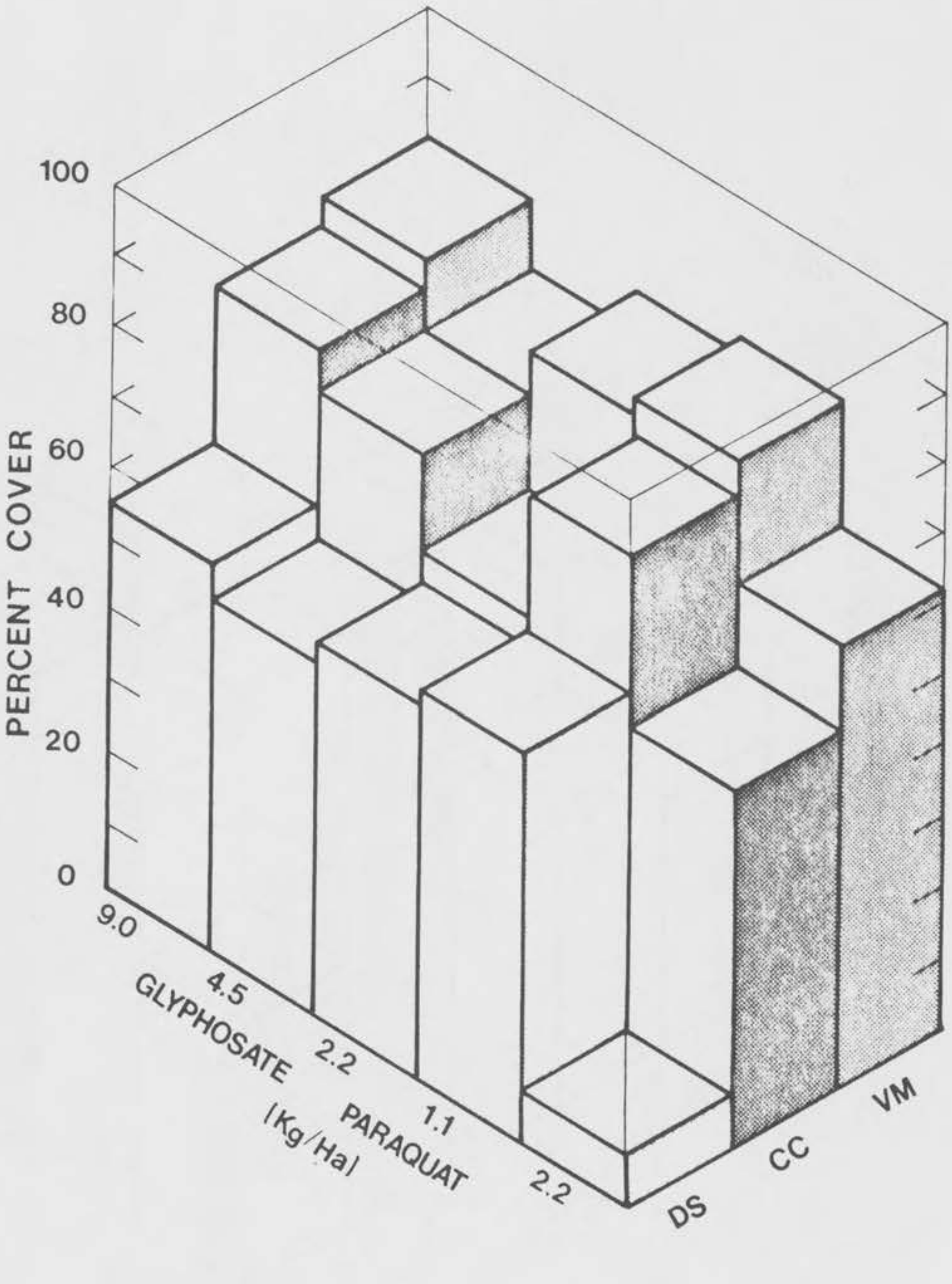

Figure 3. Effect of establishment method and herbicide treatment on stand density of 'Pennfine' perennial ryegrass eleven days after seeding in thatchy Kentucky bluegrass turf.

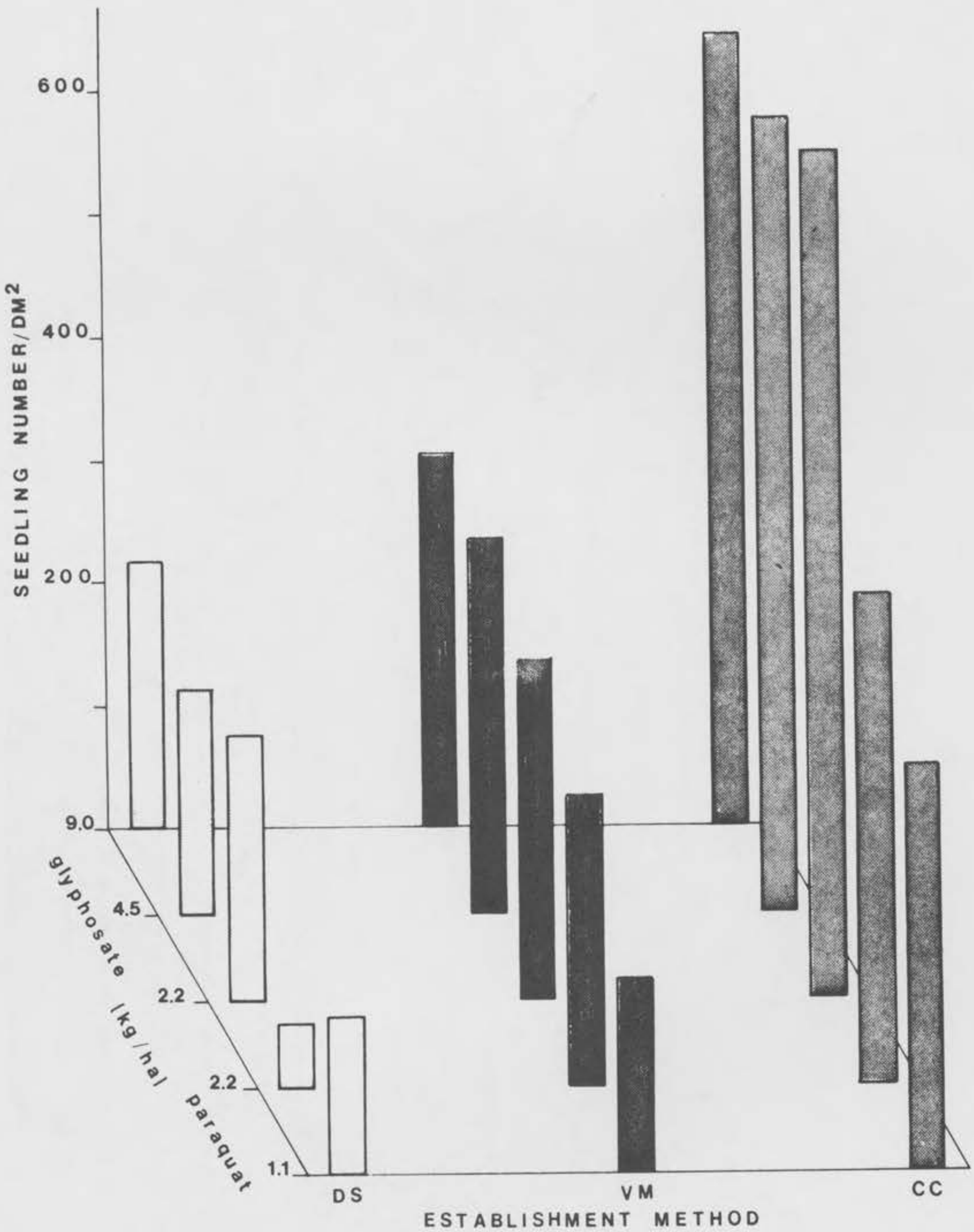

Figure 4. Effect of herbicide treatment and establishment method on percent cover of 'Pennfine' perennial ryegrass 6 weeks after seeding in thatchy Kentucky bluegrass turf.

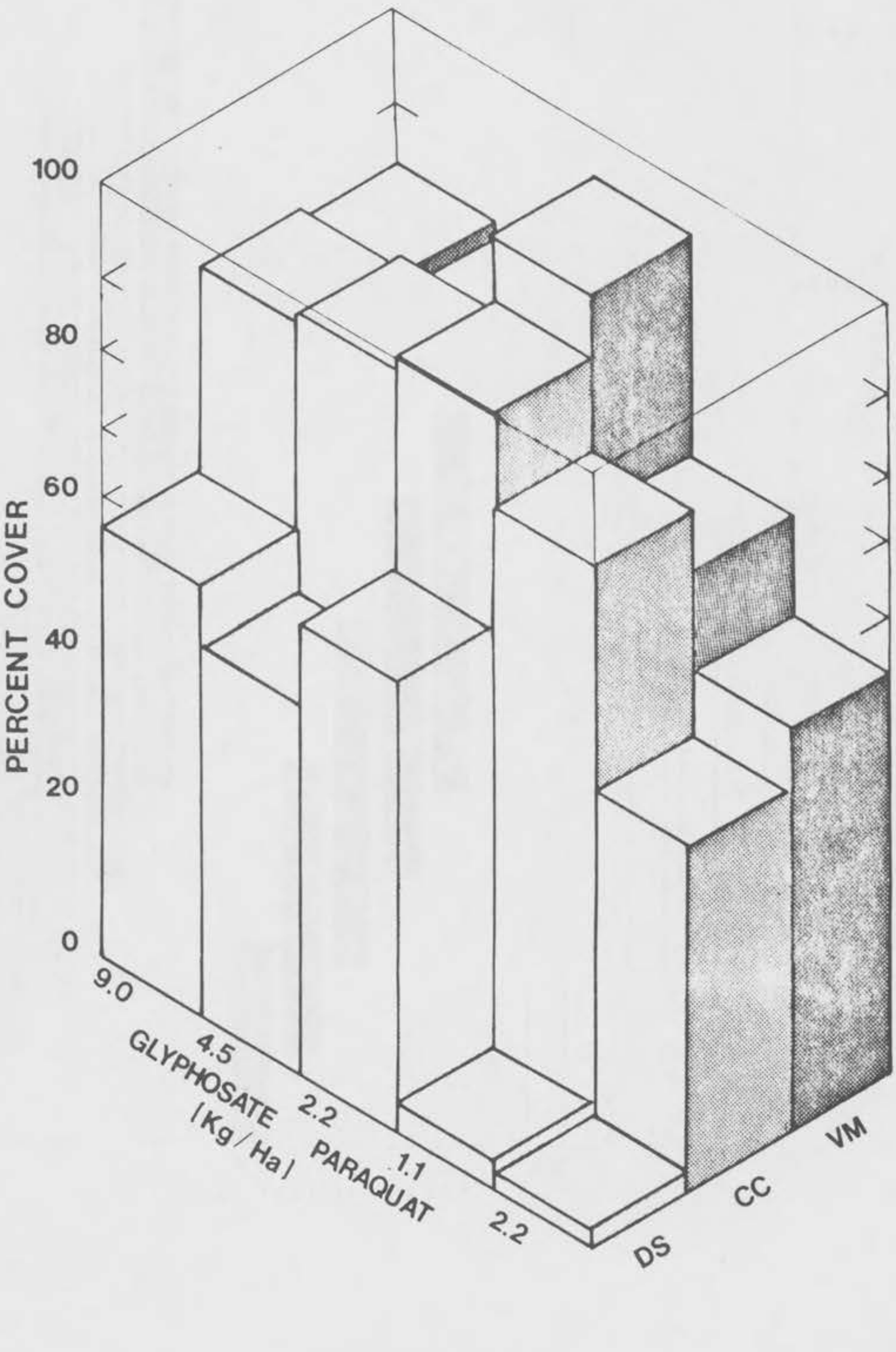

Figure 5. Effect of herbicide treatment and establishment method on percent cover of 'Pennfine' perennial ryegrass 6 weeks after seeding in thatchy Kentucky bluegrass turf.

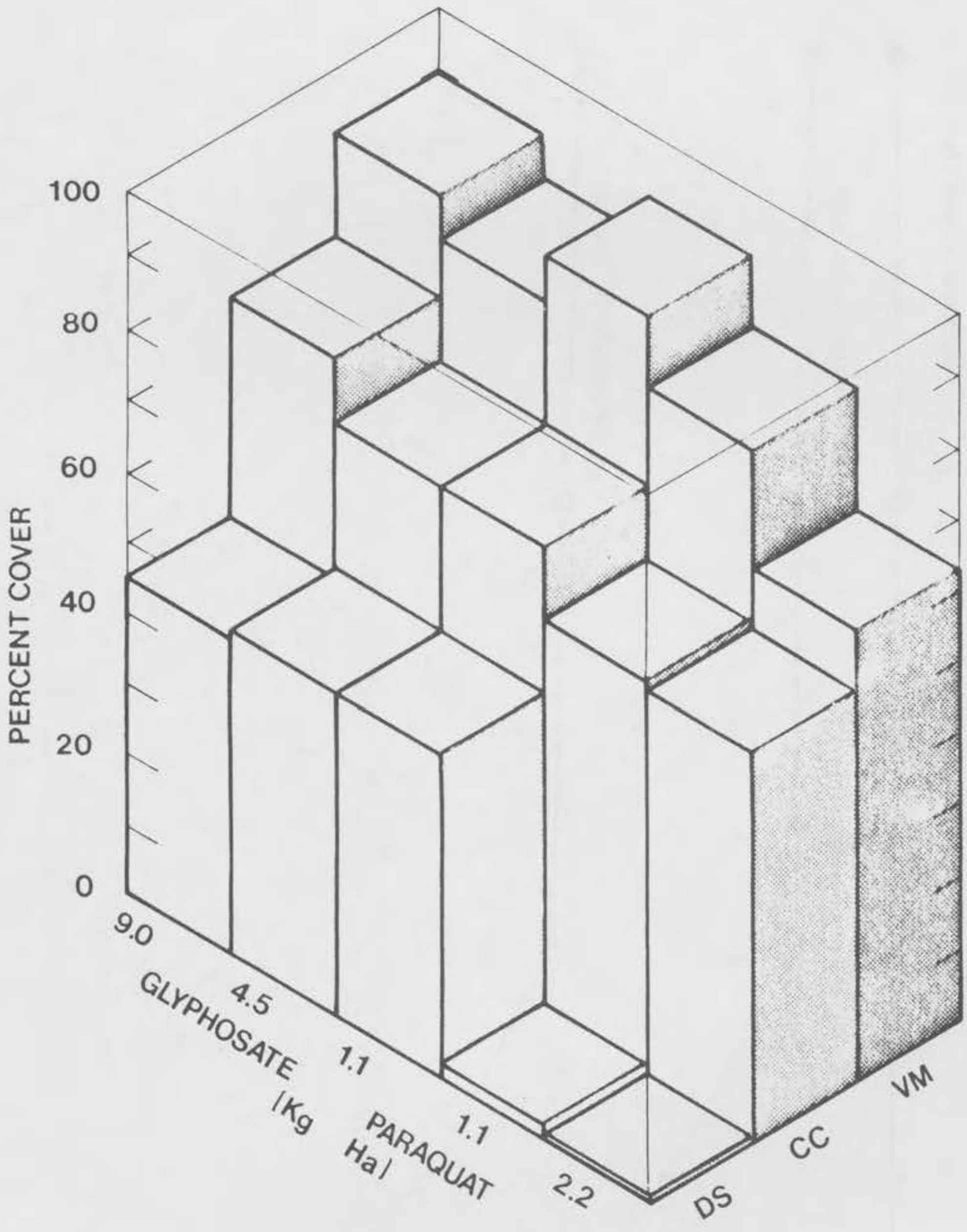

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Figure 6. Adsorption of glyphosate and paraquat from solution by Kentucky bluegrass thatch and silt loam soil.

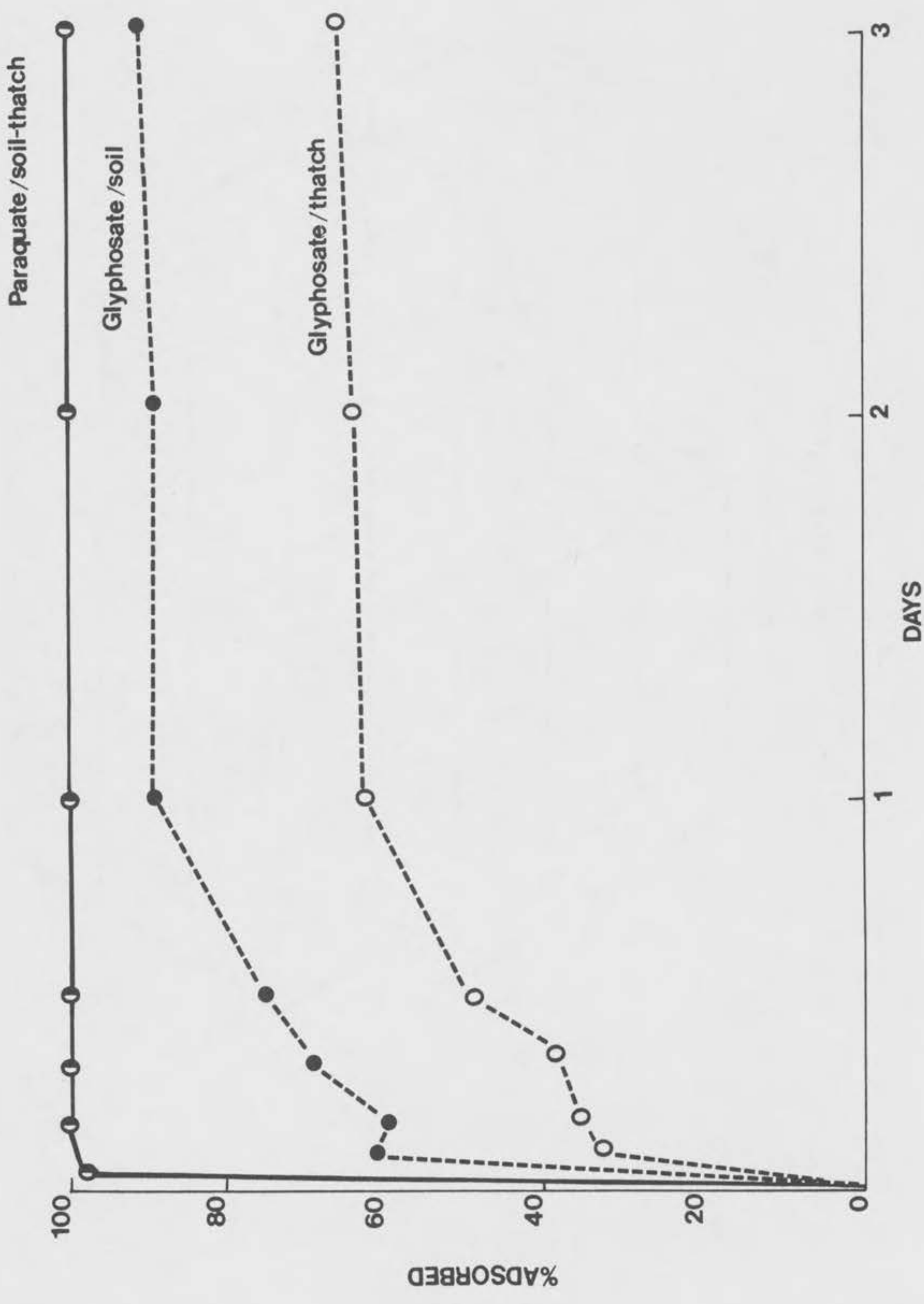


Figure 7. Effect of inclusion of soil in a disturbed thatch layer on residual activity of glyphosate as it affects the germination of 'Pennfine' perennial ryegrass.

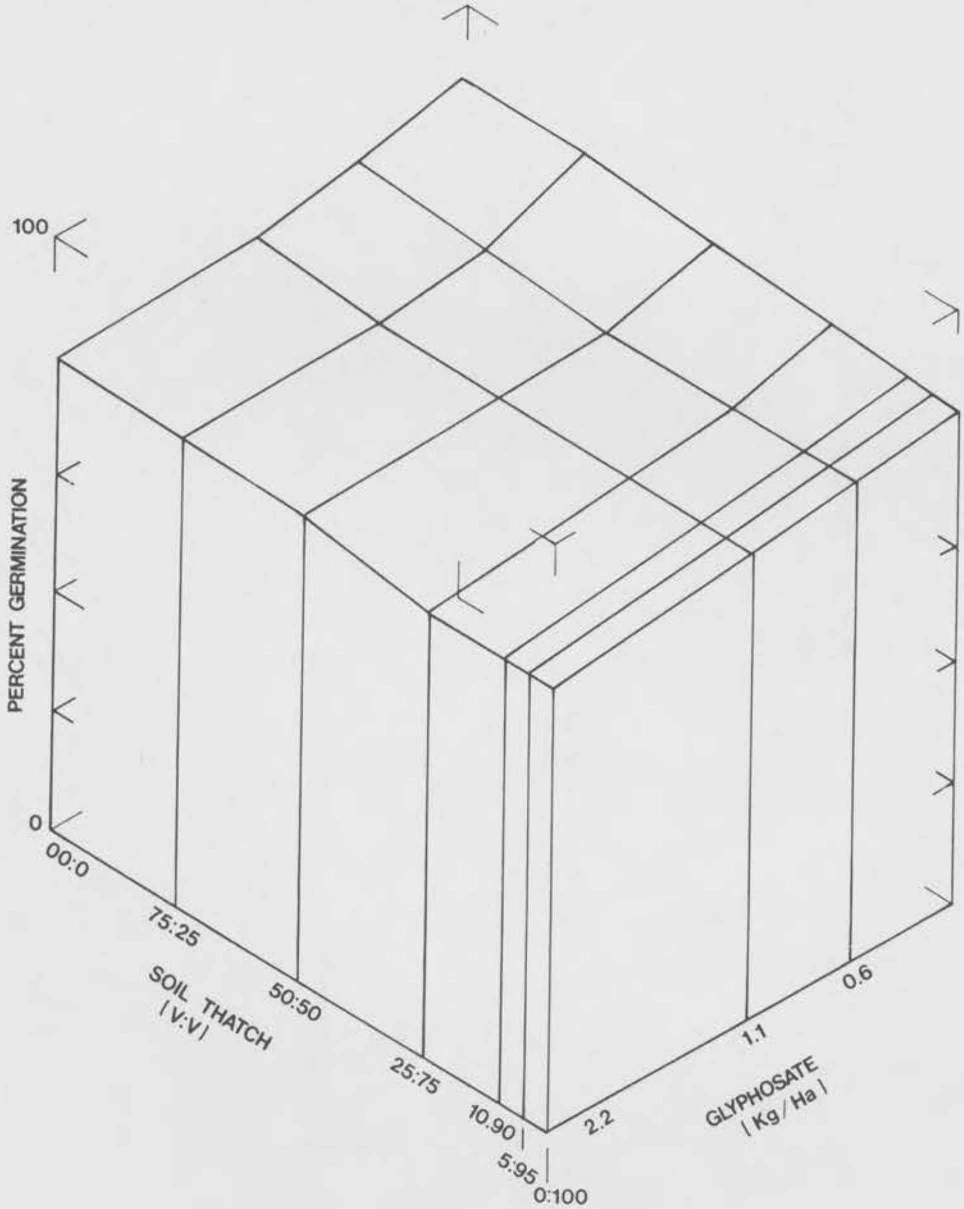
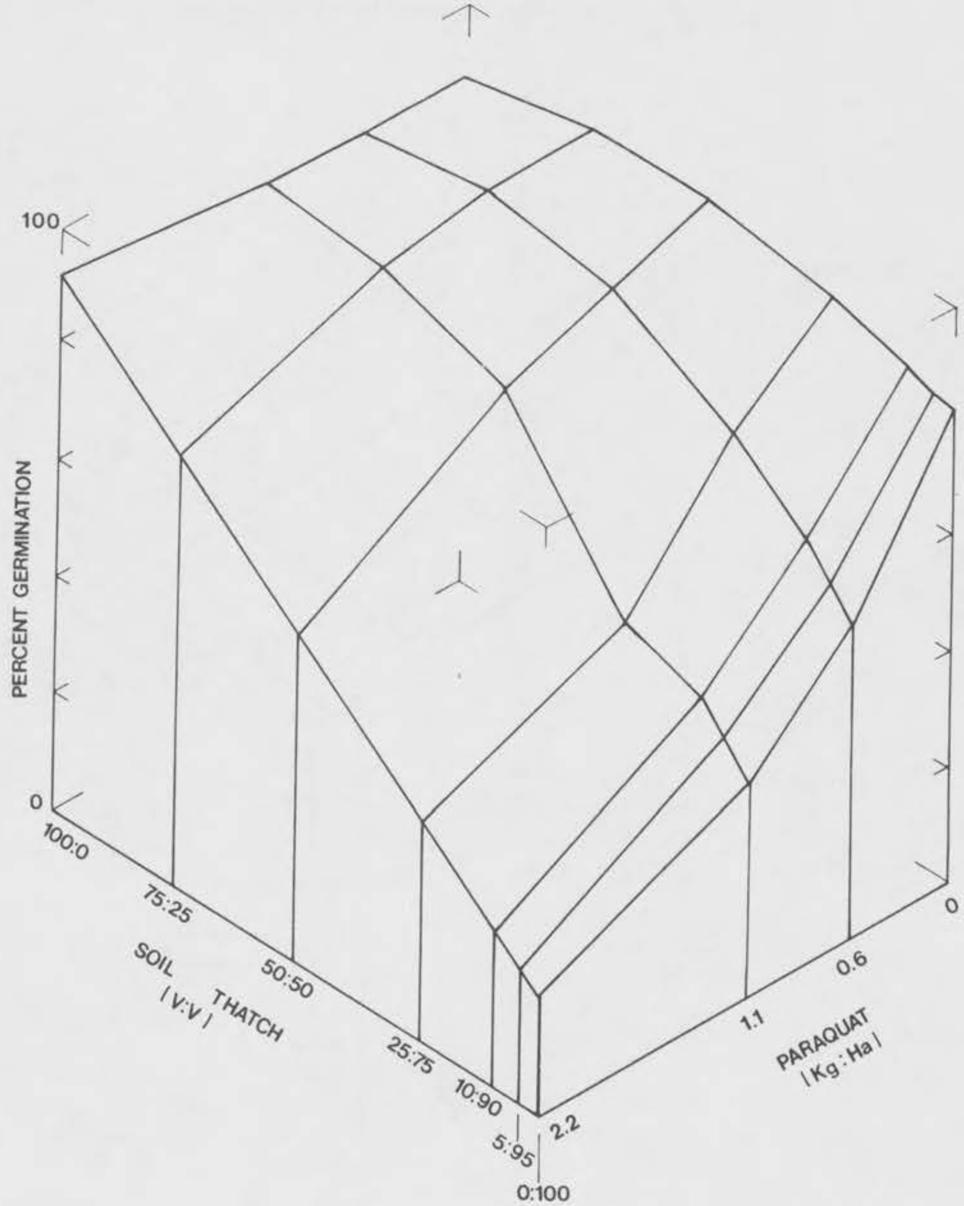


Figure 8. Effect of inclusion of soil in a disturbed thatch layer on residual activity of paraquat as it affects the germination of 'Pennfine' perennial ryegrass.



B. 3. Impact of thatch on preemergence herbicide activity in Kentucky bluegrass turf. K. A. Hurto and A. J. Turgeon.

The use of preemergence herbicides for selective control of crabgrass and other annual grasses has become an important component of turfgrass cultural programs. Extensive research has been conducted to determine the efficacy, mobility, and persistence of these chemicals in the environment. Recent research has shown several preemergence herbicides to have various effects on the turfgrass ecosystem. Repeated applications have reduced turfgrass quality due to increased susceptibility to environmental stresses and diseases. Certain herbicides have also been reported to induce thatch, a tightly intermingled layer of living and dead stems, roots, and leaves of grass that develops at the soil surface, due to their inhibitory effects on the activity of soil organisms. The occurrence of a thatch layer at the soil surface is common on many turf sites. Since very little is known about the significance of this layer on preemergence herbicide activity, the purpose of this study was to determine the impact of thatch on the efficacy; adsorption; mobility; and metabolism of preemergence herbicides in Kentucky bluegrass turf.

Preemergence herbicides were applied April 24, 1976, and again April 21, 1977, to an established Kentucky bluegrass turf at two sites: one with a thatch 2-3 cm thick and one with no thatch. Treatments were made as indicated in Table 1. Treatment plots were 3.2 m^2 and were replicated three times. Sites were overseeded with crabgrass each year. Herbicide treatments were monitored for turfgrass injury and crabgrass germination with data taken several times during the summer. Results presented in Table 1 reflect the average percent crabgrass cover and turfgrass injury of 1976 and 1977 studies.

Laboratory studies were conducted to determine the adsorption of benefin, bensulide, and DCPA in thatch and soil. Ground thatch or soil (0.5 cc) were equilibrated overtime with 100 ml of 1 μM herbicide solutions to determine the extent of herbicide adsorption from solution. The mobility of benefin, bensulide, and DCPA in thatch and soil was assessed in unsaturated flow studies in the laboratory. Undisturbed cores measuring 7-cm in diameter and 4-cm deep of Kentucky bluegrass thatch and soil from a thatch-free Kentucky bluegrass turf were placed in brass cylinders. Triplicate samples were saturated with de-ionized water and allowed to drain prior to spotting 100 μl of herbicide solution containing 0.5 μCi of 14C-labeled herbicide and unlabeled technical herbicide to produce a final concentration of 1.15, 5.76, and 5.76 mg/cylinder of benefin, bensulide, and DCPA, respectively. This is equivalent to field applications of 4.5, 22.4, and 22.4 kg/ha of benefin, bensulide, and DCPA, respectively. Two liters of de-ionized water were leached through each column, after which the cores were removed, cut into 1-cm sections and overdried at 95 C for 24 hours. Herbicides were then eluted from each section to determine percent distribution in the profile. In another study, metabolism of benefin and DCPA was determined using 14C-labeled herbicides incubated in the dark at 28 C under aerobic conditions in soil and thatch.

Preemergence crabgrass control with herbicides on thatch-free sites was good to excellent with 4.5 kg/ha benefin, and all rates of bensulide G formulations, DCPA, and higher rates of oxadiazon (Table 4). Applications of prosulfalin resulted in good weed control, but caused moderate injury to Kentucky bluegrass turf. Characteristic of prosulfalin-injured plots, was an immediate reduction in foliar growth rate and darkening in leaf color; however, no thinning was observed. Kentucky bluegrass had fully recovered by mid-August.

Application of preemergence herbicides to thatchy turf sites resulted in excellent weed control, although little weed pressure was observed (Table 4). However, turfgrass injury was moderate to severe from benefin, oxadiazon, and prosulfalin. Injury symptoms differed with herbicide and, with the exception of prosulfalin, did not appear immediately. Rather, these symptoms were associated with mid-summer stress. Prosulfalin-treated plots deteriorated rapidly due to severe thinning of the turf. By spring 1977, Kentucky bluegrass had not fully recovered in plots treated at the 3.4 kg/ha rate. Oxadiazon injury appeared initially as bleaching of leaf tips, and subsequent death of plant crowns. Benefin injury was significantly less than observed in prosulfalin- or oxadiaxon-treated plots. By September, benefin-treated plots had fully recuperated.

The results of equilibration of herbicide solutions with thatch and soil is illustrated in Table 5. Adsorption of herbicides by both media was rapid; however, more herbicide was adsorbed by thatch than soil. DCPA was adsorbed the most by thatch, while benefin and bensulide adsorption were not significantly different. In soil, bensulide was adsorbed the most; DCPA was to a lesser extent; and benefin was adsorbed the least. In these studies, it would appear that the adsorption capacity of thatch is high. However, these results may reflect the effects of grinding operations performed to facillitate this study.

Results of preemergence herbicide mobility in unsaturated water flow studies through soil and thatch are presented in Figure 9. Herbicides were more mobile in thatch than in soil, particularly in the upper profiles of the media. With increasing depth, differences in herbicide concentration between soil and thatch were less. Herbicide distribution in the profile differed between herbicides; bensulide was more mobile in both media than was DCPA or benefin (Figure 10).

Persistence of DCPA in soil and thatch is illustrated in Figure 11. Significantly more DCPA was degraded in thatch than was measured for soil. Thin-layer chromatographic analysis of thatch extracts revealed higher concentration of mono-methyl tetrachloroterephthalate than tetrachloroterephthalic acid (Figure 12). In soil, only mono-methyl tetrachloroterephthalate was detected. Results of degradation studies of benefin in thatch and soil is illustrated in Figure 13. Breakdown of benefin in soil was minimal, while in thatch, significantly more herbicide was degraded. Formation of non-extractable polar products was rapid initially in thatch, but slowed down with time (Figure 14).

In summary, the impact of thatch on preemergence herbicide activity has been demonstrated. Application of benefin, oxadiazon, and prosulfalin resulted in increased injury to thatchy Kentucky bluegrass turf. Laboratory investigations revealed this injury may be due to at least two factors:

(1) herbicides were more mobile in thatch than in soil; thus as more herbicide enters the turfgrass rootzone, more injury results, and (2) since no differences in mobility fo benefin and DCPA in thatch were observed, selectivity of preemergence herbicides may be due to biochemical differences as well as mobility. Previous reports have demonstrated the differences in phytotoxicity of preemergence herbicides to Kentucky bluegrass. Thus, the inherent susceptibility of Kentucky bluegrass to herbicide injury varies with herbicide.

Metabolism of herbicides in thatch was shown to be markedly increased over soil. Presumably, this reflects higher microbial activity associated with higher organic matter content of thatch. These studies suggest that persistence of preemergence herbicides on thatchy sites is less and may require higher rates or more frequent applications if season-long weed control is desired. However, further studies must be conducted to determine the persistance of preemergence herbicides in thatch under field conditions.

Table 4. Preemergence crabgrass control with herbicides on thatchy and thatch-free Kentucky bluegrass turf.

Treatment	Form[1]	Rate kg/ha	Thatch-Free Turf[2] Injury	Thatch-Free Crab[3] Cover %	Thatchy Turf[2] Injury	Thatchy Crab[3] Cover %
benefin	2.5G	2.2	1.0	5.3	3.0	1.1
		3.4	1.0	5.7	3.6	0.7
		4.5	1.0	2.0	4.6	0.1
bensulide	4E	11.2	1.0	4.7	1.1	0.1
		22.4	1.0	10.3	1.6	0.1
	3.6G	11.2	1.0	1.6	1.6	0.1
		22.4	1.3	0.3	2.1	0.4
	12.5G	11.2	1.0	2.0	1.0	0.6
		22.4	1.0	3.0	1.6	0.1
DCPA	75WP	11.8	1.0	2.6	1.0	1.1
		23.5	1.0	2.6	1.3	1.3
	5G	11.8	1.0	3.7	1.1	1.3
		23.5	1.0	3.0	1.1	1.1
oxadiazon	2G	2.2	1.0	9.0	4.6	2.3
		3.4	1.0	2.8	5.6	0
		4.5	2.0	4.3	6.3	0
prosulfalin	50WP	2.2	2.0	6.0	2.1	0.2
		3.4	3.0	5.0	6.5	0.8
untreated			1.0	29.0	1.0	11.5
		LSD_{05}	0.3	8.0	0.9	2.7

[1] Formulations include: (G) granules, (E) emulsifiable concentrates, and (WP) wettable powders.

[2] Turfgrass injury ratings are an average of observations made July 21, 1976 and July 18, 1977 using a scale of 1-9 with 1 representing no injury and 9 necrosis of turf.

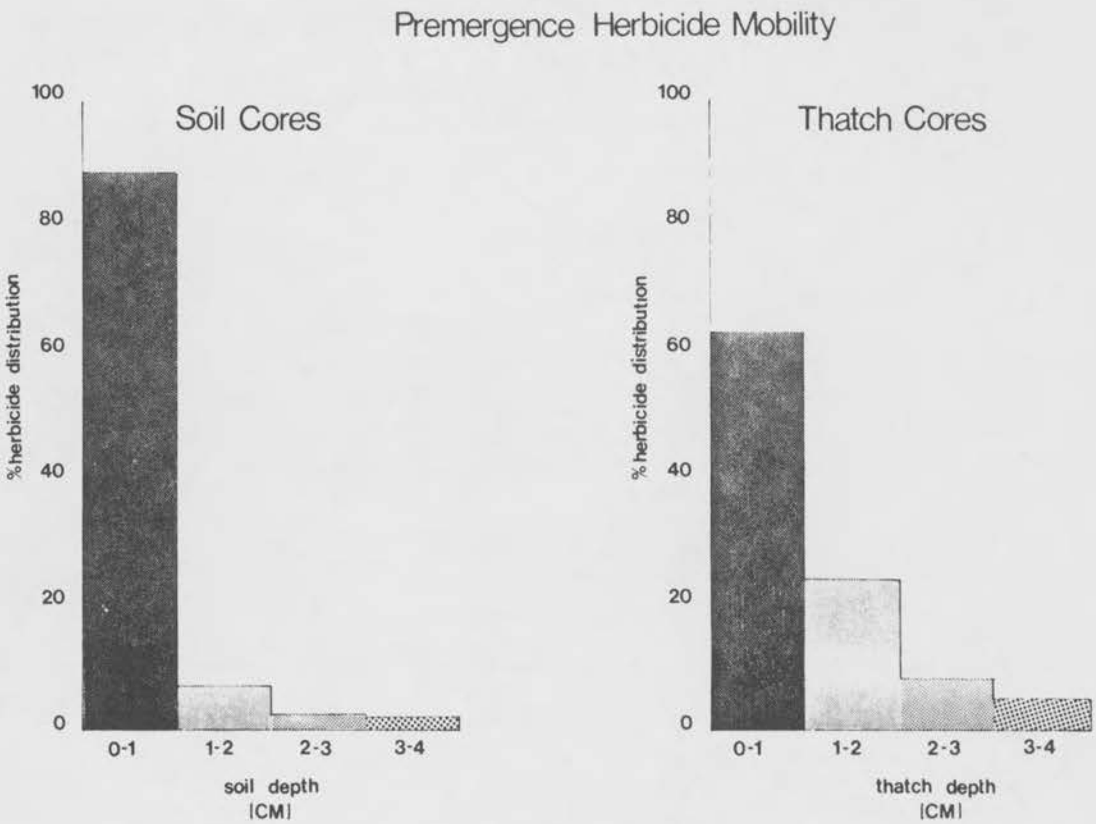
[3] Percent crabgrass cover is an average of visual observations made August 13, 1976 and September 8, 1977.

Table 5. Adsorption of three preemergence herbicides by Flanagan silt loam soil and thatch.

	Concentration in solution at equilibrium	
	Thatch	Soil
Herbicide	$\mu\underline{M}$/0.5 cc	$\mu\underline{M}$/0.5 cc
benefin	0.16 b	0.44 e
bensulide	0.15 b	0.20 c
DCPA	0.12 a	0.25 d

[1] Values followed by unlike letters are significantly different at 5% level.

Figure 9. Preemergence herbicide mobility in thatch and soil.



		F-VALUES[1]			
SOURCE	df	0-1cm	1-2cm	2-3cm	3-4cm
MEDIA (m)	1	345.59**	58.39*	24.00*	78.19*
HERBICIDE (h)	2	11.99**	4.38	14.23**	17.78**
MXH	2	5.70*	15.96*	0.81	1.33

[1] * F values significant at 5% level, ** F values significant at 1% level

Figure 10. Distribution of benefin, bensulide, and DCPA in undisturbed columns of thatch and soil.

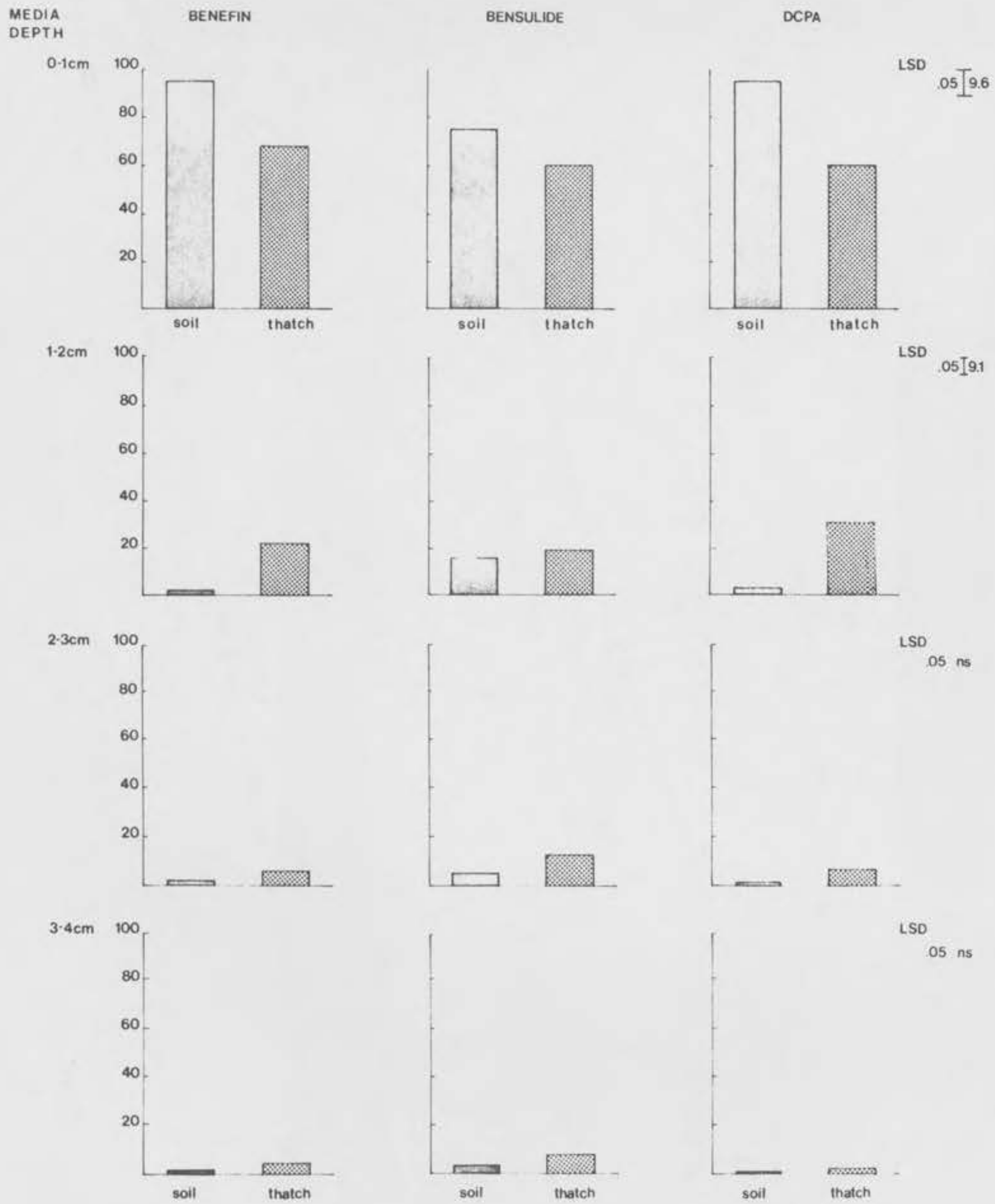


Figure 11. Aerobic metabolism of DCPA in thatch and soil.

Figure 12. Formation of metabolites of DCPA in thatch and soil: (upper) monomethyl tetrachloroterephthalate and (lower) tetrachloroterephthalic acid.

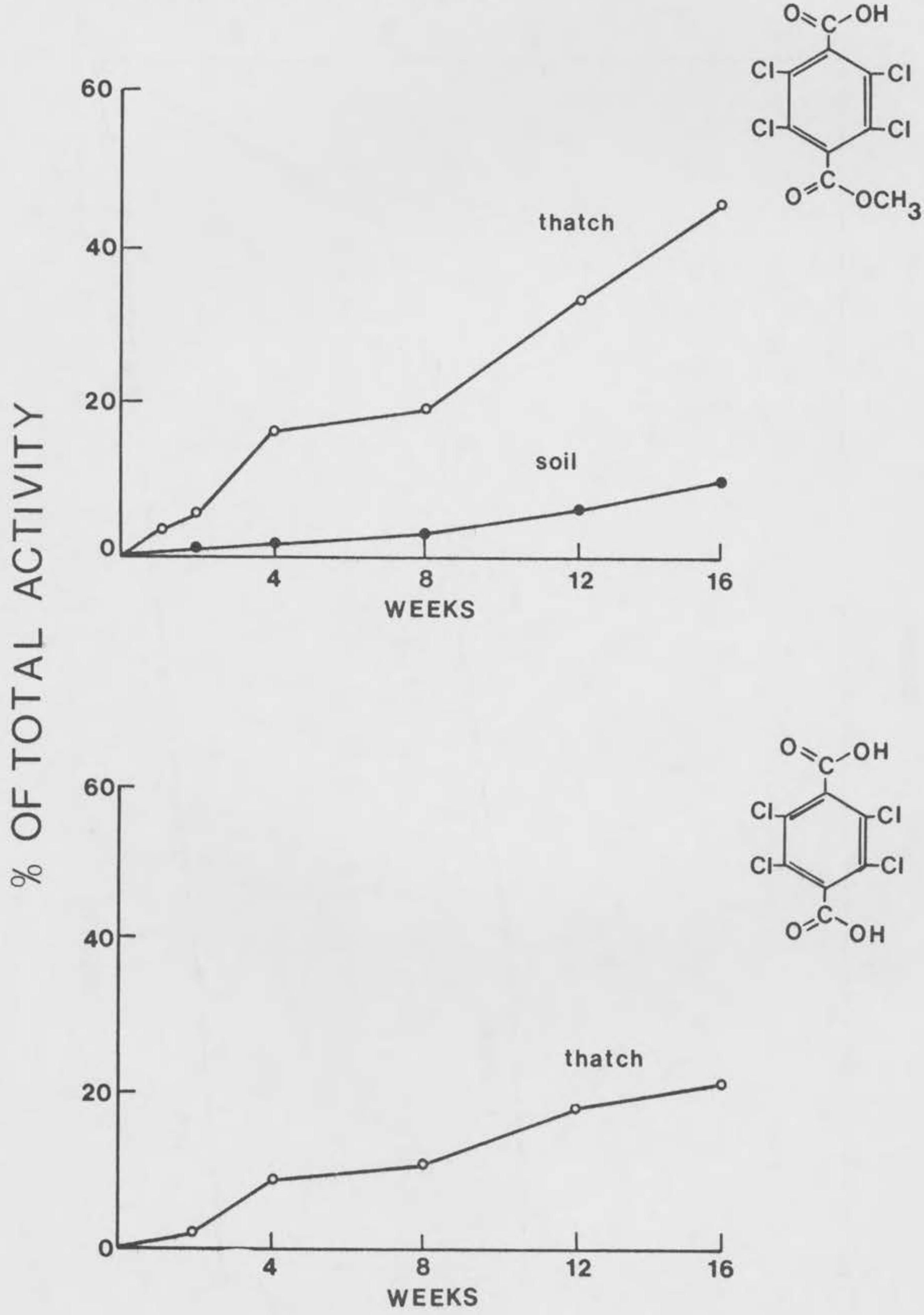


Figure 13. Aerobic metabolism of benefin in thatch and soil.

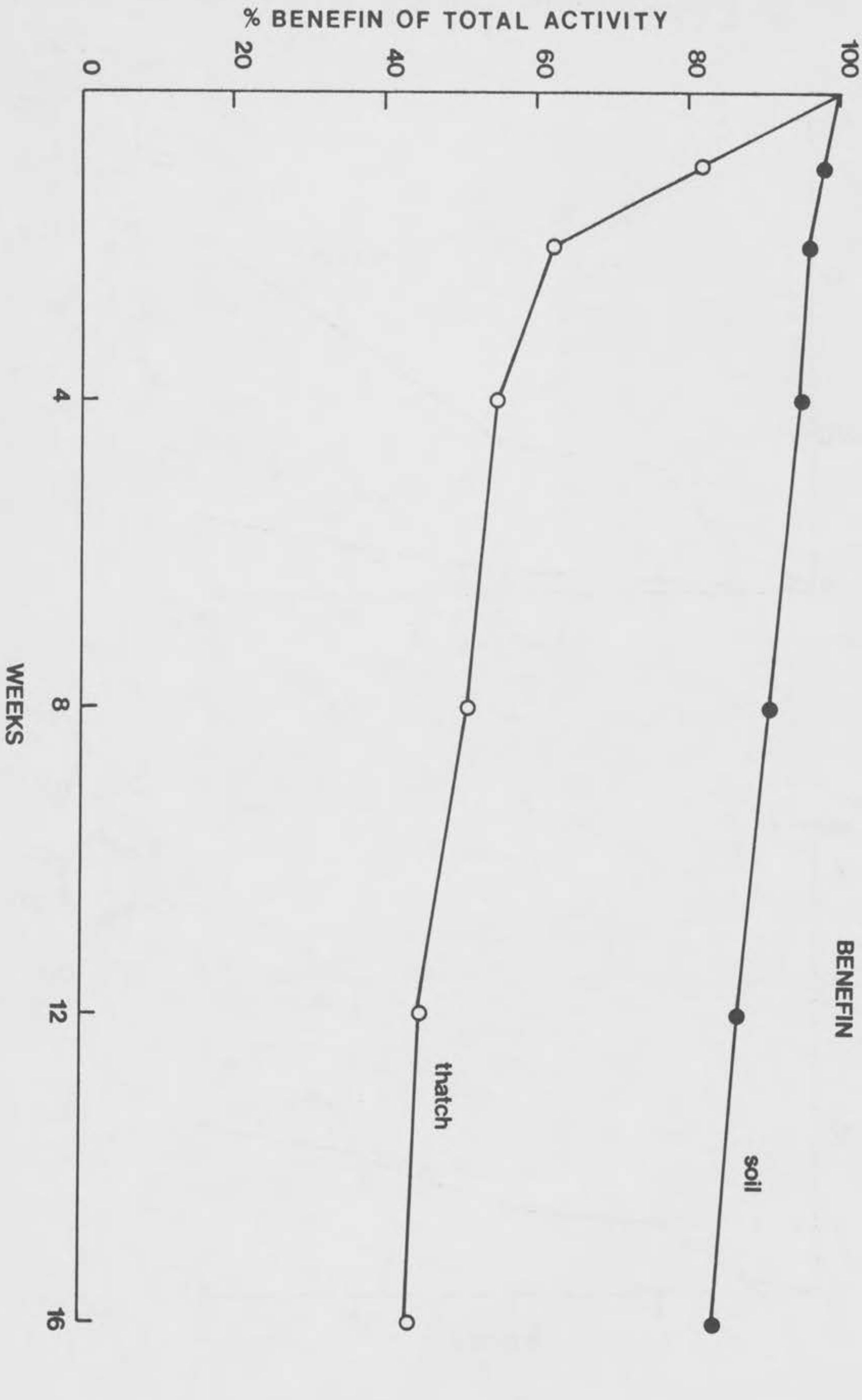
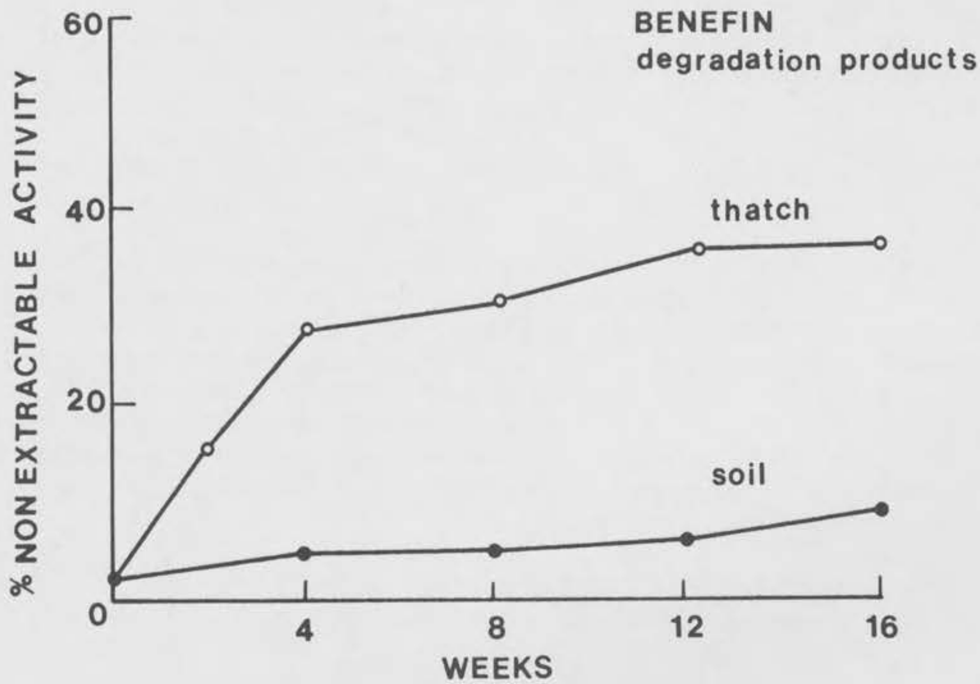


Figure 14. Formation of non-extractable polar degradation products of benefin.



B. 5. Kentucky bluegrass cultivar management study
A. J. Turgeon and J. E. Haley

Six cultivars of Kentucky bluegrass, including: Windsor, 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, all of the cultivars except Windsor were 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 1000 sq. ft., applied in one or two pounds increments in May, June, August and September. In the fall of 1973, A-20 sod was planted in an adjacent area and included in the study along with Windsor. Thus, seven cultivars were observed at eight cultural intensities through 1974, 1975, 1976 and 1977. 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 by 6 ft plots within each cultivar block.

Results showed that turfgrass quality was largely dependent upon disease incidence which, in turn, was associated with the mowing height and fertilization rate within each cultivar. Generally, close mowing and low fertility favored dollar spot incidence, especially in Nugget, while high fertility was conducive to Fusarium blight in Merion, Fylking and Pennstar. Kenblue was seriously affected by Fusarium at all cultural intensities. Previous Fusarium injury was followed by annual bluegrass invasion; thus, reduced turfgrass quality is due, in part, to the loss of annual bluegrass during the summer.

The amount of annual bluegrass cover varied among cultivars, and with cultural intensity (Table 6). Susceptibility of the cultivars to annual bluegrass invasion from greatest to least, was: Kenblue, Pennstar, Fylking, Nugget, Merion, Windsor, and A-20. Within cultivar, close mowing and high nitrogen fertilization rates favored annual bluegrass invasion. Turfgrass quality ratings reflected: (a) the condition of annual bluegrass during summer stress, (b) the incidence of disease throughout the growing season, (c) and the general response of each cultivar to the spectrum of cultural intensities imposed across the plots.

This concludes the fifth and final year of this study. The condition of the plots was such that no additional information is likely from continued observation.

Table 6. Quality of Kentucky bluegrass cultivars under different mowing and fertilization regimes.

Mowing Height in.	Fertilization LB N/1000 sq. ft/yr.	%Annual Bluegrass 7/29/77	Quality[1] 3/29/77	4/29/77	5/26/77	7/7/77	9/21/77
Windsor							
0.75	2	.7	4.0	5.3	4.3	5.0	5.0
0.75	4	7.3	3.7	6.0	5.0	5.0	5.3
0.75	6	5.7	3.3	7.0	5.3	4.7	5.3
0.75	8	11.7	3.0	7.3	6.0	5.3	6.0
1.50	2	0	5.0	5.7	4.0	4.0	4.0
1.50	4	0	3.7	6.7	5.0	4.3	4.0
1.50	6	0	3.0	7.7	5.3	4.0	4.3
1.50	8	0	3.0	8.0	5.7	4.7	5.0
A-20							
0.75	2	1.0	4.0	5.0	3.7	4.7	5.0
0.75	4	2.3	3.3	5.3	4.3	4.7	4.7
0.75	6	2.7	3.0	5.7	4.3	4.7	5.0
0.75	8	10.0	2.7	6.0	4.7	5.3	5.0
1.50	2	0	4.7	4.3	4.0	3.7	3.7
1.50	4	0	3.7	4.0	4.0	3.7	3.3
1.50	6	0	3.0	5.3	4.3	4.3	3.3
1.50	8	0	2.0	5.7	4.3	4.0	3.3
Fylking							
0.75	2	25.0	6.0	6.7	7.7	6.3	6.7
0.75	4	60.0	5.0	8.0	7.3	7.3	7.3
0.75	6	91.7	6.0	8.7	8.3	7.0	8.0
0.75	8	94.3	6.7	9.0	8.3	7.7	8.7
1.50	2	0	6.0	6.0	5.3	5.7	5.3
1.50	4	1.7	4.7	6.0	5.3	5.3	5.7
1.50	6	0	4.3	7.0	5.7	5.0	6.3
1.50	8	5.0	4.3	7.0	6.0	5.3	6.3

Table 6 (Cont'd.)

Mowing Height in.	Fertilization LB N/1000 sq. ft/yr.	%Annual Bluegrass 7/29/77	Quality[1]				
			3/29/77	4/29/77	5/26/77	7/7/77	9/21/77
Pennstar							
0.75	2	65.0	6.0	6.7	8.7	7.0	7.7
0.75	4	94.7	6.3	8.0	8.0	7.7	8.7
0.75	6	96.0	6.3	9.0	8.7	7.3	8.3
0.75	8	100.0	7.7	8.3	8.7	7.7	9.0
1.50	2	0	6.0	5.3	5.3	6.0	6.0
1.50	4	3.2	5.0	5.7	5.7	6.3	7.3
1.50	6	15.3	4.7	7.3	6.0	6.7	7.0
1.50	8	10.0	5.0	8.0	6.3	6.7	7.7
Nugget							
0.75	2	2.3	6.3	6.0	4.7	6.3	5.3
0.75	4	23.3	5.0	6.7	5.0	6.7	6.3
0.75	6	50.0	5.3	7.3	5.7	6.7	6.0
0.75	8	50.0	5.3	8.0	6.0	6.7	6.7
1.50	2	0	6.7	4.7	3.7	5.0	4.7
1.50	4	0.3	6.0	5.0	4.3	5.0	5.0
1.50	6	0	5.3	4.7	5.3	5.0	5.0
1.50	8	0	5.0	4.3	5.7	5.3	5.0
Merion							
0.75	2	10.0	4.7	5.7	6.3	6.3	5.3
0.75	4	38.3	4.7	6.0	6.7	6.7	6.0
0.75	6	43.3	4.0	7.0	7.0	6.3	6.7
0.75	8	55.0	4.3	7.7	6.7	7.3	6.7
1.50	2	0	5.7	5.0	4.3	4.7	4.3
1.50	4	0	5.0	5.3	4.3	4.7	5.0
1.50	6	0	4.0	6.3	5.0	5.0	5.0
1.50	8	0	4.0	7.0	5.3	5.7	4.7

Table 6 (Cont'd.)

Mowing Height in.	Fertilization LB N/1000 sq. ft/yr.	%Annual Bluegrass 7/29/77	Quality[1]				
			3/29/77	4/29/77	5/26/77	7/7/77	9/21/77
Kenblue							
0.75	2	91.7	6.0	8.7	8.7	7.7	8.7
0.75	4	99.3	7.0	9.0	9.0	8.0	9.0
0.75	6	100.0	7.7	9.0	9.0	8.7	9.0
0.75	8	100.0	8.0	9.0	9.0	8.7	9.0
1.50	2	0	5.3	6.7	6.0	6.3	7.3
1.50	4	6.7	5.0	7.3	6.3	7.0	7.7
1.50	6	6.7	5.0	8.0	6.7	7.0	8.0
1.50	8	10.0	5.3	8.0	6.7	8.0	8.0

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

B. 5. Expanded Kentucky bluegrass cultivar management study.
A. J. Turgeon, J. E. Haley, and J. R. Street.

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. Plots measured 5 by 6 ft and cultivars within cultural level were arranged in a randomized complete block design.

The most impressive differences among the cultivars were observed under close mowing (0.75-in) and high fertilization (8 lb N); several of the cultivars were virtually overrun by annual bluegrass while others remained nearly weed-free (Table 7). Those cultivars which are apparently best adapted to this cultural intensity include: A-34, Brunswick, and Touchdown. At a moderate intensity of culture (1.5-in mowing, 4 lb N), many of the cultivars performed quite well while, under high mowing (3 in) and minimal fertilization (1 lb N), Vantage and Code 95 were above average.

These results indicate that the selection of Kentucky bluegrass cultivars for planting should be based upon not only the geographic adaptation of the grass, but its adaptation to the specific cultural intensity employed on the site.

Table 7. Expanded Kentucky bluegrass cultivar management study.

Cultivar	Cultural Intensity	% Annual Bluegrass 5-10-77	Quality					
			3/17/77	4/21/77	5/26/77	7/8/77	8/4/77	10/11/77
A-20	M .75, F4	20.0	6.3	7.0	5.0	4.7	6.3	5.0
	M .75, F8	67.6	7.7	8.3	5.7	7.0	8.0	7.0
	M 1.5, F4	1.6	5.7	5.7	4.0	3.3	3.3	3.3
	M 1.5, F8	6.6	5.3	5.3	4.7	4.3	5.0	4.3
	M 3.0, F1	0	8.0	6.0	5.6	5.3	6.0	5.0
A-34	M .75, F4	1.3	5.3	4.3	4.3	3.3	2.3	4.3
	M .75, F8	18.3	5.7	4.7	4.7	4.7	6.7	5.0
	M 1.5, F4	0	5.7	5.0	3.3	3.0	2.7	2.7
	M 1.5, F8	0	5.0	5.0	4.7	3.0	4.0	3.0
	M 3.0, F1	0	8.0	6.0	6.3	6.0	7.0	4.0
Adelphi	M .75, F4	21.6	5.3	6.3	4.7	4.7	5.0	5.0
	M .75, F8	45.0	6.7	7.7	5.7	7.0	7.7	7.0
	M 1.5, F4	3.3	4.7	6.7	4.7	4.3	4.3	4.3
	M 1.5, F8	0	4.7	5.3	4.0	5.0	5.0	4.3
	M 3.0, F1	0	7.0	5.7	7.3	6.3	6.0	4.0
Aquilla	M .75, F4	8.3	4.7	5.7	4.3	5.0	4.7	5.3
	M .75, F8	63.3	8.0	8.0	6.3	7.0	8.0	7.3
	M 1.5, F4	0	4.7	5.0	3.7	4.0	4.7	5.0
	M 1.5, F8	5.0	6.0	5.3	4.3	5.3	6.0	5.0
	M 3.0, F1	0	8.0	6.0	6.3	5.3	6.7	4.0
Baron	M .75, F4	11.6	5.0	6.7	4.7	4.7	5.3	5.7
	M .75, F8	75.0	7.0	8.3	6.3	7.3	8.7	7.3
	M 1.5, F4	1.3	4.7	6.0	3.7	4.0	3.3	4.7
	M 1.5, F8	0	5.7	6.0	4.0	5.7	6.3	4.0
	M 3.0, F1	0	8.0	6.0	6.6	5.7	6.0	4.0

Table 7 (cont'd.)

Cultivar	Cultural Intensity	% Annual Bluegrass 5-10-77	Quality 3/17/77	4/21/77	5/26/77	7/8/77	8/4/77	10/11/77
Birka	M .75, F4	5.0	5.3	5.3	4.0	4.7	5.7	6.7
	M .75, F8	76.0	8.0	8.3	6.7	7.7	9.0	7.7
	M 1.5, F4	1.6	5.3	5.3	4.0	3.7	4.3	6.3
	M 1.5, F8	7.3	6.0	5.7	4.3	5.3	5.7	4.0
	M 3.0, F1	0	8.0	6.3	6.7	5.3	6.0	3.7
Bonnieblue	M .75, F4	8.3	5.7	6.0	4.0	4.7	4.0	4.7
	M .75, F8	53.3	6.3	6.7	5.3	7.0	8.0	6.7
	M 1.5, F4	1.6	5.7	5.7	4.3	4.0	4.0	4.3
	M 1.5, F8	7.3	5.3	5.7	4.0	5.0	6.0	4.3
	M 3.0, F1	0	7.0	5.0	7.3	6.3	6.7	3.7
Brunswick	M .75, F4	0	5.0	4.7	3.0	3.7	2.0	4.3
	M .75, F8	15.0	4.7	4.7	4.3	4.7	6.0	4.3
	M 1.5, F4	0	5.0	5.7	3.7	2.3	2.3	3.0
	M 1.5, F8	3.3	5.0	4.3	3.7	3.0	4.0	3.0
	M 3.0, F1	0	7.0	5.0	6.7	6.0	6.0	4.7
Cheri	M .75, F4	10.0	6.0	6.3	4.7	4.3	6.3	5.7
	M .75, F8	33.3	6.0	5.7	5.3	7.0	8.0	7.3
	M 1.5, F4	0	5.0	6.0	4.3	3.3	4.0	4.7
	M 1.5, F8	6	5.0	5.7	3.7	4.7	4.3	4.0
	M 3.0, F1	0	8.0	6.0	7.3	6.0	6.0	4.3
Code 95	M .75, F4	23.3	5.3	6.3	5.3	5.0	7.0	7.0
	M .75, F8	79.3	7.7	5.7	6.3	7.0	8.7	8.0
	M 1.5, F4	2.3	4.7	6.3	5.3	4.0	4.7	4.7
	M 1.5, F8	0	5.3	6.3	4.7	5.7	6.7	5.0
	M 3.0, F1	0	8.0	4.0	6.0	5.0	5.7	5.0

Table 7 (cont'd.)

Cultivar	Cultural Intensity	% Annual Bluegrass 5-10-77	Quality					
			3/17/77	4/21/77	5/26/77	7/8/77	8/4/77	10/11/77
Glade	M .75, F4	8.0	5.7	5.3	3.3	4.7	5.3	6.0
	M .75, F8	38.3	6.7	7.3	5.7	7.0	8.0	7.0
	M 1.5, F4	0	4.3	5.3	4.0	3.7	3.0	5.0
	M 1.5, F8	0	5.3	5.3	4.0	4.0	3.3	4.7
	M 3.0, F1	0	7.7	6.0	6.7	5.3	5.7	4.0
Majestic	M .75, F4	50.6	7.0	7.7	6.0	5.3	6.3	6.3
	M .75, F8	76.6	8.0	8.7	7.0	7.7	8.7	8.0
	M 1.5, F4	7.3	6.3	6.7	5.7	5.0	6.0	5.7
	M 1.5, F8	7.3	5.7	6.0	4.7	6.0	6.7	5.0
	M 3.0, F1	0	7.0	5.3	7.7	7.0	7.0	5.0
Merion	M .75, F4	12.3	6.0	6.0	5.0	4.0	5.0	5.3
	M .75, F8	30.0	4.7	4.7	5.0	5.7	7.0	5.7
	M 1.5, F4	1.6	5.3	5.3	4.3	4.3	4.7	5.7
	M 1.5, F8	0	5.0	4.7	3.7	4.0	5.3	4.7
	M 3.0, F1	0	7.7	6.0	7.0	6.3	6.7	6.0
Nugget	M .75, F4	26.6	6.3	6.7	5.3	5.0	6.3	7.0
	M .75, F8	78.3	7.3	8.3	6.3	7.3	8.7	7.7
	M 1.5, F4	16.6	7.0	7.3	5.0	4.0	5.7	5.7
	M 1.5, F8	15.0	6.7	6.7	4.0	4.7	6.3	5.3
	M 3.0, F1	0	8.0	7.0	7.7	7.7	7.7	6.0
Parade	M .75, F4	5.6	5.3	6.0	4.7	4.7	4.7	4.7
	M .75, F8	30.0	5.3	5.7	5.0	5.7	7.0	6.3
	M 1.5, F4	0	5.0	6.0	4.3	4.7	3.3	4.3
	M 1.5, F8	0	5.0	5.0	4.0	5.3	4.3	4.3
	M 3.0, F1	0	7.3	5.7	5.7	6.3	6.7	4.0

Table 7 (cont'd.)

Cultivar	Cultural Intensity	% Annual Bluegrass 5-10-77	Quality					
			3/17/77	4/21/77	5/26/77	7/8/77	8/4/77	10/11/77
Pennstar	M .75, F4	23.3	6.0	6.3	5.0	4.7	6.7	6.7
	M .75, F8	73.3	8.3	8.7	6.3	7.0	9.0	8.0
	M 1.5, F4	11.6	5.7	6.3	4.0	4.3	5.7	5.7
	M 1.5, F8	16.6	6.0	6.7	5.3	7.3	7.3	5.0
	M 3.0, F1	0	8.0	6.0	6.7	6.0	6.7	4.3
Rugby	M .75, F4	23.3	5.0	5.7	4.7	5.0	5.3	5.0
	M .75, F8	53.3	6.3	7.0	5.7	7.0	7.7	7.0
	M 1.5, F4	0.6	5.0	4.7	5.0	4.3	2.7	3.3
	M 1.5, F8	0	4.3	4.3	3.0	4.7	3.3	3.7
	M 3.0, F1	0	7.0	5.3	6.7	6.7	6.3	5.0
Sydsport	M .75, F4	8.3	5.3	5.7	4.0	4.3	6.0	6.0
	M .75, F8	31.6	6.7	5.7	4.3	6.3	7.7	6.7
	M 1.5, F4	0	5.3	5.0	3.7	2.7	4.3	4.3
	M 1.5, F8	0	5.0	4.7	4.0	4.0	5.0	4.3
	M 3.0, F1	0	8.0	6.0	6.3	6.3	6.7	5.0
Touchdown	M .75, F4	0	5.3	5.0	3.3	4.0	5.7	5.7
	M .75, F8	10.0	5.3	5.0	4.0	5.0	7.0	5.7
	M 1.5, F4	0	5.3	5.7	3.7	4.0	4.7	5.3
	M 1.5, F8	0	5.0	4.0	3.7	3.0	3.7	2.7
	M 3.0, F1	0	7.7	6.0	6.7	6.3	6.0	4.0
Vantage	M .75, F4	28.3	6.0	6.7	5.3	5.0	7.0	6.7
	M .75, F8	53.3	7.3	8.3	6.3	7.3	9.0	8.0
	M 1.5, F4	1.6	4.7	6.0	4.3	4.7	3.3	4.3
	M 1.5, F8	.6	6.0	5.3	4.7	7.0	6.7	5.3
	M 3.0, F1	0	7.3	4.0	6.0	5.6	5.7	4.3
Victa	M .75, F4	18.3	5.3	7.0	4.0	5.0	5.7	6.7
	M .75, F8	43.3	6.7	7.7	5.3	6.7	8.3	8.0
	M 1.5, F4	4.0	5.3	6.3	4.3	4.3	4.7	4.3
	M 1.5, F8	3.3	5.7	5.7	4.0	5.7	6.0	5.3
	M 3.0, F1	0	8.0	6.0	6.3	5.3	5.7	4.3

C. 1. a. Broadleaf weed control in seedling turf.
Tim Schneider and A. J. Turgeon

Control of purslane and other broadleaf species in seedling stands of Kentucky bluegrass is difficult because of the intolerance of young turfgrasses to many postemergence herbicides. Bromoxynil is recommended for this use because of its relative safety to seedling grasses, compared to phenoxy herbicides, but its efficacy is frequently insufficient for controlling purslane. Thus, new herbicides are sought for this unique role in turfgrass establishment.

A field study was initiated to evaluate bentazon, in comparison to bromoxynil and phenoxy herbicides, for controlling purslane in a seedling stand of 'Baron' Kentucky bluegrass planted September 1, 1977. Plots measured 5 by 6 ft and each chemical treatment was made to three replications on September 23, 1977. The chemicals were applied in a spray volume of 28 gal/acre using a CO_2-propelled, small-plot sprayer. Data were collected on October 10, prior to the first killing frost, for percent cover of purslane, and purslane shoot number/ft^2.

Results showed that bentazon at the lowest application rate of 0.5 lb/acre was superior in controlling purslane than treatments with 2,4-D and silvex or bromoxynil (Table 8). Decline of the purslane was first evident in the bentazon-treated plots about one week following treatment. After two weeks, essentially all of the purslane had disappeared. This was in contrast to the phenoxy (2,4-D + silvex)-treated and bromoxynil-treated plots in which purslane shoots were evident throughout the experimental period. No turfgrass injury was evident from any of the treatments. Further experiments will be needed to adequately evaluate the use of bentazon for broadleaf weed control in seedling turf. The potential for phytotoxicity to seedling Kentucky bluegrass from bentazon has not been conclusively determined, and the efficacy of this herbicide for controlling other broadleaf species must be examined as well. However, bentazon does appear to offer some important advantages over other herbicides for controlling broadleaf weeds in new turfgrass plantings.

Table 8. Comparisons of herbicides for controlling purslane in Baron Kentucky bluegrass 22 days after seeding.

Herbicide	Rate, lb/acre	Purslane control	
		No. shoots/ft^2	% cover
Bentazon	0.5	0	0
	0.75	0	0
	1.5	0	0
2,4-D + silvex	1.0 + 0.5	63.5	10.7
	0.5 + 0.25	106.7	30.0
Bromoxynil	1.0	47.7	8.3
	0.5	135.2	50.0
Untreated	--	126.0	56.7

C. 1. b. Slow-release preemergence herbicide formulations.
Gary Clayton and A. J. Turgeon

Preemergence herbicides are usually applied at sufficiently high rates to provide season-long weed control. Limited research with multiple applications at relatively low rates of preemergence herbicides indicates that greater safety and better weed control are obtainable by this approach to herbicide usage. An alternative approach for achieving the same results would be to formulate preemergence herbicides with slow-release carriers. Several formulation methods for providing a gradual release of herbicides following application have been developed by USDA scientists in Peoria, Illinois. A cooperative research program was initiated in spring, 1977, to evaluate two slow-release formulations of several herbicides; they include: starch xanthate and activated sludge polymer. Starch xanthate results from encapsulation of herbicides within a corn starch granule; the herbicide becomes available by diffusion through small pores in the granules. Activated sludge polymer results from embedding of herbicides in an organic matrix which is sprayed onto the turf.

Six commercially available preemergence herbicides in commercial formulations (CF), starch xanthate (SX), and activated sludge polymer (SP) were applied to both 'Washington' creeping bentgrass and 'Kenblue'-type Kentucky bluegrass turfs as shown in Tables 1 and 2. Plots measured 5 by 6 ft, and each treatment was replicated three times in a randomized complete block design. Creeping bentgrass was maintained as a putting green (mowing @ 0.25 in) while Kentucky bluegrass was maintained as a lawn turf (mowing @ 1.5 in). Fertilization on both sites was at the rate of 4 lb N/1000 sq ft/yr. Irrigation was performed as needed to prevent wilting. The herbicides were applied on May 12, 1977, and again on August 29, 1977. Plots were monitored for injury (phytotoxicity) and crabgrass control.

Results showed little or no injury to Kentucky bluegrass from any of the Tupersan, Dacthal, Balan, or Betasan formulations; however, substantial injury resulted from Ronstar and Sward (Table 9). In the Ronstar-treated plots, both "slow-release" formulations appeared to be about as injurious as the commercial formulation following May applications, but no injury occurred from the starch xanthate formulation after August applications. The basis for this differential response is not clear. With most herbicides, the starch xanthate formulations did not provide the same level of crabgrass control as the commercial or sludge polymer formulations.

Sward-treated plots were injured substantially where the commercial and sludge polymer formulations were used; however, the starch xanthate formulation of Sward caused little injury, but provided good weed control.

In creeping bentgrass, results were comparable except that the starch xanthate formulation of Ronstar was even more injurious than either the commercial or sludge polymer formulations (Table 10). The variable response from Ronstar-sludge-polymer from May and August applications may have been due to differences in the degree of encapsulation when the formulations were made; this will be investigated further in 1978. Sward formulations caused almost no phytotoxicity; this was in sharp contrast to results from applications to Kentucky bluegrass.

With a few exceptions, the sludge polymers yielded results comparable to the commercial formulations, while the starch xanthates provided substantially slower herbicide release with consequent loss in efficacy. In future research, different types of sludge polymer and starch xanthate will be synthesized in order to approach an ideal formulation offering superior efficacy and optimum safety to the turfgrasses.

Table 9. Phytotoxicity and crabgrass control in 'Kenblue'-type Kentucky bluegrass from slow-release preemergence herbicide formulations applied May 12 and August 29, 1977.

Herbicide	Rate (Lb/A)	Formulation[2]	Phytotoxicity[1] May 18	May 23	Jun 6	Jun 24	Jul 28	Sep 7	Sep 26	Oct 22	Crabgrass Control, % Sep 7	Oct 22
Tupersan	12	CF	1.0	1.0	1.3	1.0	1.0	1.0	1.0	1.0	93	89
"	6	CF	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	83	93
"	12	SP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	81	93
"	6	SP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	78	82
"	6:6	CF:SP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	78	89
"	12	SX	1.0	1.3	1.7	1.7	1.0	1.0	1.0	1.0	59	75
"	6	SX	1.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0	29	20
"	6:6	CF:SX	1.3	1.7	1.0	1.0	1.0	1.0	1.0	1.0	85	93
Dacthal	12	CF	1.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0	85	93
"	6	CF	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	78	86
"	12	SP	1.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0	96	93
"	6	SP	1.0	1.7	1.0	1.0	1.0	1.0	1.0	1.0	81	82
"	6:6	CF:SP	1.0	1.3	1.3	1.0	1.0	1.0	1.0	1.0	93	100
"	12	SX	1.0	1.3	1.0	1.3	1.3	1.0	1.0	1.0	75	93
"	6	SX	1.0	1.3	1.0	1.0	1.3	1.0	1.0	1.0	38	35
"	6:6	CF:SX	1.0	1.3	1.3	1.0	1.0	1.0	1.0	1.0	88	100
Ronstar	3	CF	1.0	5.3	4.7	4.7	2.7	4.7	4.0	2.0	100	100
"	1.5	CF	1.0	5.0	3.7	3.3	1.0	2.3	1.0	1.3	100	100
"	3	SP	2.3	3.3	2.3	4.7	1.0	5.0	4.0	2.0	93	93
"	1.5	SP	2.0	3.7	2.0	1.0	1.0	4.3	2.0	2.0	100	100
"	1.5:1.5	CF:SP	2.0	5.3	4.3	4.3	2.7	5.7	4.0	3.0	100	100

Table 9. (Continued)

"	3	SX	4.0	4.3	4.3	3.7	2.0	1.0	1.0	1.0	41	45
"	1.5	SX	3.0	3.7	2.0	2.3	1.0	1.0	1.0	1.0	26	9
"	1.5:1.5	CF:SX	4.3	4.0	2.7	2.7	1.3	4.0	1.7	1.0	100	100
Balan	3	CF	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.0	81	89
"	1.5	CF	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	63	75
"	3	SP	1.0	1.3	1.0	1.0	1.3	1.0	1.3	1.0	60	75
"	1.5	SP	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	48	71
"	1.5:1.5	CF:SP	1.3	1.0	1.0	1.3	1.0	1.0	1.0	1.0	63	56
"	3	SX	1.0	1.0	1.3	1.7	1.0	1.0	1.0	1.3	85	100
"	1.5	SX	1.0	1.0	1.0	1.0	1.3	1.0	1.0	1.0	78	93
"	1.5:1.5	CF:SX	1.0	1.0	1.3	1.3	1.0	1.0	1.0	1.0	88	93
Betasan	10	CF	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.0	100	100
"	5	CF	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	88	82
"	10	SP	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.0	93	93
"	5	SP	1.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0	85	89
"	5:5	CF:SP	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.0	100	100
"	10	SX	1.0	1.3	1.7	1.3	1.0	1.0	1.0	1.0	93	89
"	5	SX	1.0	1.3	1.0	1.3	1.0	1.0	1.0	1.0	63	64
"	5:5	CF:SX	1.0	1.0	1.0	1.7	2.0	1.0	1.0	1.0	93	100
Sward	3	CF	1.0	1.0	2.3	5.3	3.0	1.0	5.0	6.0	53	56
"	1.5	CF	1.0	1.7	1.7	2.7	1.3	1.0	3.7	4.0	83	89
"	3	SP	1.0	1.7	2.0	5.7	3.0	1.0	5.0	6.0	60	64
"	1.5	SP	1.0	1.0	1.0	3.0	1.0	1.0	3.7	4.0	73	75
"	1.5:1.5	CF:SP	1.0	1.0	2.0	3.3	3.3	1.0	6.0	7.0	85	82
"	3	SX	1.3	1.3	1.7	1.7	3.0	1.0	2.7	2.3	88	82
"	1.5	SX	1.0	1.0	1.0	1.0	1.3	1.0	1.0	1.0	67	75
"	1.5:1.5	CF:SX	1.0	1.0	1.3	2.7	2.0	1.0	5.3	4.0	83	82

Table 9. (Continued)

Untreated	---	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0	0
"	---	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0	0
LSD.05		0.4	0.7	0.7	0.8	.8	.2	.4	.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.

[2] Formulations include: commercial formulation (CF), starch xanthate encaps (SX), and sludge polymer entrapment (SP), with all treatments originating from wettable powders (WP), liquid concentrate (LC) and emulsifiable concentrate (EC).

Table 10. Phytotoxicity to 'Washington' creeping bentgrass from slow-release preemergence herbicide formulations applied May 12 and August 29, 1977.

Herbicide	Rate (lb/A)	Formulation[2]	Phytotoxicity[1] May 18	May 23	Jun 6	Jun 24	Jul 29	Sep 7	Sep 26	Oct 22
Dacthal	12	CF (75 WP)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"	24	CF "	1.0	1.0	1.0	1.7	1.3	1.0	1.0	1.0
"	24	SX "	1.0	1.0	1.3	1.0	1.0	1.0	1.0	1.0
"	24	SP "	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.0
Balan	3	CF (1.5 LC)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"	6	CF "	1.0	1.0	1.3	1.3	1.0	1.7	2.0	3.3
"	6	SX "	1.0	1.7	1.0	1.3	1.3	1.0	1.0	2.0
"	6	SP "	1.0	1.0	1.0	1.3	1.0	1.0	1.0	2.7
Tupersan	12	CF (50 WP)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"	24	CF "	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"	24	SX "	1.0	1.7	1.7	1.3	1.0	1.0	1.0	2.0
"	24	SP "	1.0	1.0	1.3	1.3	1.0	1.0	1.0	1.3
Ronstar	3	CF (75 WP)	1.0	3.0	2.0	1.3	1.0	4.0	6.0	5.0
"	6	CF "	1.0	3.7	4.3	5.0	6.0	4.0	8.0	7.7
"	6	SX "	7.0	8.0	9.0	8.3	8.3	1.0	4.0	4.0
"	6	SP "	1.0	4.0	3.7	3.0	4.7	6.0	8.0	8.0
Betasan	10	CF (4.5 EC)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"	20	CF "	1.0	1.0	1.0	1.7	1.0	1.0	1.0	1.0
"	20	SX "	1.0	1.0	1.3	1.3	1.0	1.0	1.0	1.0
"	20	SP "	1.0	1.0	1.3	1.0	1.0	1.0	1.0	1.7

Table 10. (Continued)

Sward	3	CF (50 WP)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"	6	CF "	1.0	1.0	1.0	1.0	1.3	1.0	1.0	2.0
"	6	SX "	1.0	1.3	1.3	1.0	1.7	1.0	1.0	3.7
"	6	SP "	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.3
Untreated	---		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LSD.05			0	0.5	0.6	0.6	.6	.3	.3	.5

[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] Formulations include: commercial formulation (CF), starch xanthate encapsulation (SX), and sludge polymer entrapment (SP) with all treatments originating from wettable powders (WP), liquid concentrates (LC), and emulsifiable concentrates (EC).

C. 1. b. Topdressing and core cultivation effects on phytotoxicity from preemergence herbicides. Gary Clayton and A. J. Turgeon

Previous studies at the University of Illinois have indicated that turfgrass injury from preemergence herbicides can be associated with the presence of thatch since thatchy plots showed more injury than thatch-free turf. A conclusion from this work was that by either removing the thatch layer or incorporating soil into the thatch, injury from subsequently applied preemergence herbicides could be reduced. An experiment was initiated in May, 1977, in which 'Penncross' creeping bentgrass and 'Pennstar-Fylking-Prato' Kentucky bluegrass plots were core cultivated several times followed by vertical mowing to disperse the soil cores. On adjacent creeping bentgrass plots, topdressing was performed. One day later, preemergence herbicides were applied to the pretreated as well as untreated plots as shown in Tables 16 and 17. Plots measured 5 by 6 ft, and each treatment combination was replicated three times in a randomized complete block design.

Results showed that a topdressing pretreatment reduces the injury from subsequently applied Ronstar, the only herbicide causing substantial injury to creeping bentgrass. In contrast, core cultivation resulted in more injury from one or more herbicides in both creeping bentgrass and Kentucky bluegrass (Tables 11 and 12). A tentative conclusion from this work is that topdressing, applied either directly or through reincorporation of soil cores following core cultivation, is effective in reducing injury from subsequently applied herbicides. However, sufficient time should be allowed between core cultivation and herbicide application for recovery of the turf; otherwise, the open "aerifier" holes may allow the herbicide to contact exposed plant tissues that are easily injured by the herbicides. Additional studies are in progress to further test these hypotheses.

Table 11. Effects of topdressing and core cultivation on phytotoxicity from preemergence herbicides applied to 'Penncross' creeping bentgrass.[1]

Herbicide	Rate (lb/A)	Formulation[2]	Time after treatment, days							
			10	15	21	29	40	47	66	81
Dacthal	12	75 WP TD	1.0	1.0	1.0	1.3	1.0	1.3	1.3	1.0
"	12	" CC	1.0	1.3	1.0	1.3	1.0	1.3	1.3	1.0
"	12	" U	1.7	1.3	1.0	1.7	1.0	1.3	1.0	1.0
"	24	" TP	1.0	1.3	1.3	1.3	1.0	1.0	1.3	1.0
"	24	" CC	1.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0
"	24	" U	1.7	1.3	1.3	1.3	1.0	1.0	1.0	1.0
Ronstar	3	" TD	1.7	1.3	1.0	1.0	1.0	1.0	2.0	1.7
"	3	" CC	6.3	8.0	9.0	7.3	8.0	4.7	4.7	4.3
"	3	" U	2.3	3.7	7.0	3.3	1.7	3.7	2.0	3.3
Balan	3	1.5 LC TD	1.0	1.0	1.0	1.7	1.0	1.3	1.0	1.0
"	3	" CC	1.0	1.0	1.0	1.7	1.0	1.0	1.0	1.0
"	3	U	1.3	1.0	1.7	1.3	1.0	1.0	1.0	1.0
"	6	1.5 LC TD	1.3	1.3	1.3	1.3	1.3	1.3	1.0	1.0
"	6	" CC	1.0	1.0	1.3	1.0	1.0	1.0	1.0	1.0
"	6	" U	1.3	1.3	2.0	1.7	1.3	1.7	1.3	1.0
Betasan	10	4.5 EC TD	1.0	1.3	1.3	1.0	1.0	1.0	1.0	1.0
"	10	" CC	1.3	1.0	1.0	1.3	1.0	1.3	1.0	1.0
"	10	" U	2.0	1.7	1.7	1.7	1.3	1.0	1.0	1.3
"	20	" TD	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"	20	" CC	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.0
"	20	" U	1.7	1.3	1.7	2.3	1.3	1.3	1.0	1.0

Table 11. (Continued)

Sward	3	50 WP	TD	1.0	1.0	1.0	1.7	1.0	1.0	1.0	1.0
"	3		CC	1.3	1.0	1.3	1.3	1.0	1.0	1.0	1.0
"	3	"	U	1.7	1.7	1.7	1.7	1.0	1.3	1.0	1.0
"	6	"	TD	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"	6	"	CC	1.0	1.0	1.3	1.0	1.3	1.0	1.0	1.0
"	6	"	U	1.3	1.3	2.0	2.3	1.7	2.0	1.0	1.0
Tupersan	12	"	TD	1.0	1.0	1.0	1.7	1.3	1.0	1.0	1.0
"	12	"	CC	1.0	1.0	1.3	1.7	1.0	1.0	1.0	1.0
"	12	"	U	1.3	1.3	1.7	1.7	1.0	1.3	1.0	1.0
"	24	"	TD	1.0	1.0	1.7	1.3	1.0	1.0	1.0	1.0
"	24	50 WP	CC	1.0	1.0	1.0	1.7	1.3	1.3	1.3	1.0
"	24	"	U	1.3	1.7	1.7	2.3	1.0	1.3	1.0	1.0
Untreated	--	--	TD	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"	--	--	CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"	--	--	U	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LSD.05				0.6	0.7	0.5	0.9	0.9	1.0	0.7	0.6

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 Pretreatments included topdressing (TD), core cultivation (CC), and no pretreatment (U).

Table 12. Effects of core cultivation on phytotoxicity from preemergence herbicides applied to 'Pennstar - Fylking - Prato' Kentucky bluegrass.[1]

Herbicide	Rate (lb/A)	Pretreatment[2]	Time after treatment, days							
			10	15	21	29	40	47	66	81
Dacthal	12	U	1.0	1.3	1.0	2.0	2.3	2.3	1.7	1.7
"	12	CC	1.0	1.3	4.0	2.0	1.7	1.3	1.0	1.0
Ronstar	3	U	3.3	3.3	3.7	2.7	4.3	3.7	3.3	2.3
"	3	CC	3.7	3.3	5.7	3.7	2.7	2.0	3.0	2.0
Balan	3	U	1.3	2.3	3.0	2.7	1.3	1.0	1.0	1.0
"	3	CC	1.3	1.0	4.3	1.7	1.3	1.0	1.0	1.0
Betasan	10	U	1.0	2.0	1.3	2.7	1.0	1.0	1.0	1.0
"	10	CC	1.0	1.0	3.7	1.0	1.7	1.0	1.0	1.0
Sward	3	U	1.0	1.0	2.3	2.7	1.3	1.0	1.0	1.0
"	3	CC	1.0	1.0	3.3	1.0	2.0	2.3	1.0	1.0
Tupersan	12	U	1.0	1.0	1.3	1.7	1.0	1.0	1.0	1.0
"	12	CC	1.0	1.0	3.0	1.7	1.3	1.0	1.0	1.0
Untreated	--	U	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
"		CC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LSD.05			0.6	0.9	1.7	1.0	1.2	1.3	1.0	0.8

[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] Pretreatments include core cultivation (CC) and no pretreatment (U).

C. 2. b. Fungicide evaluation for control of Sclerotinia dollar spot and Rhizoctonia brown patch on creeping bentgrass.
Thomas M. Sjulin, Malcolm C. Shurtleff and Thomas G. Wiliczko

A continuing part of the turfgrass research program at the University of Illinois is fungicide evaluation for disease control. Commercial and experimental fungicides are annually screened for their effectiveness in controlling natural occurrences of Sclerotinia dollar spot and Rhizoctonia brown patch diseases on bentgrass. This year proved to be an excellent season for evaluation of both of these diseases.

Fungicides were tested on Seaside and Washington creeping bentgrass at the Ornamental Horticulture Research Center in Urbana. A total of 26 chemical treatments plus two unsprayed treatments were included in a completely randomized design. Each treatment was replicated five times, using 3 ft. x 6 ft. plots. Fungicides were applied in 5 gallons of water per 1000 sq. ft. at 25 psi using a Hudson Matador power sprayer and a Mallinckrodt Spray Hawk boom.

Fungicide applications began on May 16, 1977 and continued at weekly intervals through June 13, 1977. Prior to the first application, the average incidence of Sclerotinia dollar spot in the test area was 24.3%. All chemical treatments showed good to excellent control of dollar spot when evaluated on June 14, 1977, after five applications (Table 13). Fungicide applications ceased at that time, and the treatments were evaluated for their ability to provide residual control of dollar spot. Acti-dione TGF + $FeSO_4$, Thiram 4F and mancozeb 80W lost their effectiveness to control dollar spot within 15 days after the last application. Acti-dione Thiram with or without $FeSO_4$, and Acti-dione TGF at the 2.0 oz. rate, had lost most of their effectiveness within 23 days after the last application. All other treatments continued to show good to excellent control of dollar spot 23 days after the last application.

Fungicide applications resumed on July 6, 1977 to determine if the good to excellent control of most treatments could be maintained on a biweekly application schedule. Acti-dione Thiram with or without $FeSO_4$, Acti-dione TGF with or without $FeSO_4$, Thiram 4F, and mancozeb 80W were unable to effectively control dollar spot when applied on this schedule (Table 14). All other treatments, however, continued to show good to excellent control of dollar spot throughout this period.

On August 19, 1977, one day after the final fungicide application for the season, a severe outbreak of Rhizoctonia brown patch was observed in the test area. The test plots were rated at this time, and the results are given in Table 15. The following treatments showed good to excellent control of Rhizoctonia brown patch: Tersan 1991 with or without either Daconil 2787 or Tersan 75; Daconil 2787 at all rates and formulations; Bromosan; Spectro; Duosan 75W at the 6.0 oz. rate; and BTS 40-542 25% EC at the 10.0 fl. oz. rate.

On August 5, 1977, during an extended period of both high temperatures and high humidity, apparent phytotoxicity was observed in all treatments containing BTS 40-542 or El-222.

Table 13. Residual control of Sclerotinia dollar spot on creeping bentgrass by fungicide treatment.

Material	Product Rate/1000 sq ft	Percent Dollar Spot, Days after Final Application[1] 1 day 6/14/77	15 days 6/28/77	23 days 7/6/77
EL-222 12.5%EC	1.5 fl oz	0.1 a[2]	0.0 a	0.0 a
EL-222 12.5%EC	3.0 fl oz	0.1 a	0.0 a	0.1 a
Tersan 1991	1.0 oz	0.0 a	0.0 a	0.6 a
Tersan 1991 + Daconil 2787 75W	1.0 oz + 3.0 oz	0.0 a	0.1 a	0.2 a
Tersan 1991 + Tersan 75 75W	1.0 oz + 5.0 oz	0.1 a	0.0 a	0.1 a
Bromosan 67W	3.0 oz	0.1 a	0.0 a	0.3 a
Spectro 50W	3.0 oz	0.0 a	0.2 a	0.3 a
Duosan 75W (MF-598)	3.0 oz	0.0 a	0.0 a	0.6 a
Duosan 75W (MF-598)	6.0 oz	0.0 a	0.1 a	0.7 a
BTS 40-542 25%EC	5.0 fl oz	0.0 a	0.1 a	0.9 a
BTS 40-542 25%EC	7.5 fl oz	0.0 a	0.1 a	0.2 a
BTS 40-542 25%EC	10.0 fl oz	0.1 a	0.0 a	0.2 a
Daconil 2787 6F	4.0 fl oz	0.1 a	0.3 a	0.9 a
Daconil 2787 6F	6.0 fl oz	0.0 a	0.1 a	0.7 a
Daconil 2787 6F	8.0 fl oz	0.0 a	0.4 a	4.1 b
Daconil 2787 75W	4.0 oz	0.0 a	-----[3]	-----
Daconil 2787 75W	6.0 oz	0.1 a	-----	-----
Daconil 2787 75W	8.0 oz	0.0 a	-----	-----
Dyrene 50W	4.0 oz	0.0 a	0.1 a	1.1 a
Acti-dione Thiram + $FeSO_4$	2.0 oz + 1.0 oz	0.6 ab	4.4 bc	12.6 c
Acti-dione Thiram	4.0 oz	0.0 a	3.6 b	13.4 c
Acti-dione TGF + $FeSO_4$	1.0 oz + 0.5 oz	1.6 bcd	18.1 d	35.0 de
Acti-dione TGF	2.0 oz	1.3 abc	8.7 c	17.1 cd
Thiram 4F	6.0 fl oz	4.7 d	27.2 d	36.3 de
Mancozeb 80W	2.25 oz	4.0 cd	26.4 d	41.0 e
Mancozeb 80W	4.5 oz	2.9 cd	27.8 d	38.4 de
Unsprayed Control #1	----	25.1 e	28.0 d	33.8 de
Unsprayed Control #2	----	23.9 e	22.8 d	35.6 de

1 Fungicides applied to 3 x 6 ft plots at 25 psi in 5 gal water per 1000 sq ft. Fungicides applied weekly, May 16 to June 13, 1977, for a total of 5 applications.

2 Dollar spot ratings based on percent of plot area showing symptoms, average of 5 replications per treatment. Data transformed by log x+1 prior to analysis. Small letters following the numbers for a given date indicate the separation of the means of the transformed data at P=0.05 by Duncan's multiple range test.

3 Due to a shortage of materials, the final application of Daconil 2787 75W at the 8.0 oz rate was made on 6/1/77, and the final applications of Daconil 2787 75W at the 4.0 & 6.0 oz rates were made on 6/7/77.

Table 14. Control of Sclerotinia dollar spot on creeping bentgrass by fungicide treatment - biweekly applications following residual control study.

Material	Product Rate/1000 sq ft	Percent Dollar Spot After Biweekly Applications[1] after 2 applications 7/18/77	after 4 applications 8/15/77
EL-222 12.5%EC	1.5 fl oz	0.1 a[2]	0.2 a
EL-222 12.5%EC	3.0 fl oz	0.1 a	0.2 a
Tersan 1991	1.0 oz	0.6 ab	0.2 a
Tersan 1991 + Daconil 2787 75W	1.0 oz + 3.0 oz	0.8 ab	0.1 a
Tersan 1991 + Tersan 75 75W	1.0 oz + 5.0 oz	0.7 ab	0.4 a
Bromosan 67W	3.0 oz	2.1 abc	0.6 a
Spectro 50W	3.0 oz	0.7 ab	0.6 a
Duosan 75W (MF-598)	3.0 oz	1.1 ab	0.3 a
Duosan 75W (MF-598)	6.0 oz	0.1 a	0.3 a
BTS 40-542 25%EC	5.0 fl oz	0.7 ab	1.0 a
BTS 40-542 25%EC	7.5 fl oz	0.6 ab	0.2 a
BTS 40-542 25%EC	10.0 fl oz	2.7 bc	0.6 a
Daconil 2787 6F	4.0 fl oz	0.8 ab	0.1 a
Daconil 2787 6F	6.0 fl oz	0.6 ab	1.1 a
Daconil 2787 6F	8.0 fl oz	2.1 abc	0.2 a
Dyrene 50W	4.0 oz	1.0 ab	1.1 a
Acti-dione Thiram + $FeSO_4$	2.0 oz + 1.0 oz	5.2 cd	19.8 bc
Acti-dione Thiram	4.0 oz	13.3 de	15.2 b
Acti-dione TGF + $FeSO_4$	1.0 oz + 0.5 oz	25.2 e	33.7 c
Acti-dione TGF	2.0 oz	11.6 de	22.9 bc
Thiram 4F	6.0 fl oz	27.5 e	14.0 b
Mancozeb 80W	2.25 oz	30.9 e	0.3 a
Mancozeb 80W	4.5 oz	33.6 e	23.9 bc
Unsprayed Control #1	----	19.6 e	12.3 b
Unsprayed Control #2	----	30.0 e	14.3 b

[1] Fungicides applied to 3 x 6 ft plots at 25 psi in 5 gal water per 1000 sq ft. Fungicides applied weekly, May 16 to June 13, 1977, for a total of 5 applications (see Table 1); treatment then resumed on July 6, 1977 at biweekly intervals.

[2] Dollar spot ratings based on percent of plot area showing symptoms, average of five replications per treatment. Data was transformed by log x+1 prior to analysis. Small letters following the numbers for a given data indicate the separation of the means of the transformed data, P=0.05, by Duncan's multiple range test.

Table 15. Control of Rhizoctonia brown patch on creeping bentgrass by fungicide treatment.

Material	Product Rate/1000 sq ft[1]	Percent Rhizoctonia Brown Patch[2]
Tersan 1991	1.0 oz	0.5 abc
Tersan 1991 + Daconil 2787 75W	1.0 oz + 3.0 oz	1.5 abcde
Tersan 1991 + Tersan 75 75W	1.0 oz + 5.0 oz	1.4 abcde
Daconil 2787 6F	4.0 fl oz	0.7 abcd
Daconil 2787 6F	6.0 fl oz	1.1 abcde
Daconil 2787 6F	8.0 fl oz	0.3 ab
Daconil 2787 75W	4.0 oz	0.0 a
Daconil 2787 75W	6.0 oz	2.0 abcde
Daconil 2787 75W	8.0 oz	0.7 abcd
Bromosan 67W	3.0 oz	1.4 abcde
Spectro 50W	3.0 oz	1.5 abcde
Duosan 75W (MF-598)	3.0 oz	6.2 cdefg
Duosan 75W (MF-598)	6.0 oz	1.4 abcde
Dyrene 50W	4.0 oz	5.1 bcdefg
Mancozeb 80W	2.25 oz	9.6 efg
Mancozeb 80W	4.5 oz	5.8 bcdefg
Acti-dione Thiram + $FeSO_4$	2.0 oz + 1.0 oz	7.2 cdefg
Acti-dione Thiram	4.0 oz	4.9 bcdefg
Acti-dione TGF + $FeSO_4$	1.0 oz + 0.5 oz	15.4 fg
Acti-dione TGF	2.0 oz	20.5 fg
BTS 40-542 25%EC	5.0 fl oz	15.5 fg
BTS 40-542 25%EC	7.5 fl oz	3.4 abcdef
BTS 40-542 25%EC	10.0 fl oz	1.8 abcde
EL-222 12.5%EC	1.5 fl oz	7.5 cdefg
EL-222 12.5%EC	3.0 fl oz	8.1 defg
Thiram 4F	6.0 fl oz	30.0 g
Unsprayed Control #1	-----	21.1 fg
Unsprayed Control #2	-----	23.7 g

[1] Fungicides applied to 3 ft x 6 ft plots at 25 p.s.i. in 5 gal water per 1000 sq ft. Fungicides applied at 7 to 14 day intervals beginning May 16, 1977, with a total of 10 applications (9 applications only of Duosan 75W, Dyrene 50W, and Daconil 2787 75W). Last fungicide application was made on August 18, 1977.

[2] Percent of plot area showing disease symptoms on August 19, 1977, average of five replications per treatment. Data was transformed by log x+1 prior to analysis. Small letters following the numbers indicate the separation of the means of the transformed data, $\underline{P}$=0.05, by Duncan's multiple range test.

C. 3. Cutworm control in creeping bentgrass. Roscoe Randell

Cutworm, particularly, the black cutworm species are often an economic pest of bentgrass areas, particularly, golf greens. This caterpillar hatches from an egg laid by a moth, probably attracted to the lush growing green grass on a green. Black cutworms generally do not overwinter in the area, but migrate into golf courses, laying eggs on the soil surface or near the soil surface, and first generation usually appears in late May and continuing generations are generally found throughout the summer, with peak activity in July and August.

At one time, chlordane was commonly applied to golf greens to control black cutworms and other cutworm species. It was effective as a soil insecticide and it was residual, giving control throughout most of the summer from one application. Later additional applications were made and still these were effective in controlling cutworm on the golf green. Today, the chlordane is not labeled for such use, and its effectiveness is questionable as in prior tests we have observed chlordane, giving fair to poor results on cutworm control.

In order to test some new insecticides, as well as those that are recommended for cutworm control on golf greens, a series of plots were laid out and treated with five insecticides, plus an untreated. There were three replicates of each treatment. Each plot was 30 square feet in size. The insecticides used in the study were Dursban, Dylox, also called Proxol, CGA-12223, Pounce, Lannate, and an untreated area. Table 16 contains the results of readings taken on July 15, approximately four weeks after application of the insecticides. The plots were observed on August 11, again four weeks after the second insecticide treatment. The insecticides were applied on a monthly basis and will continue on through August and September. Preliminary results taken in mid-July and August by observing bird feeding holes where birds have attempted to feed on the cutworm in the thatch or next to the soil surface, the insecticide giving the best results was Dursban, with Lannate also reducing the population of cutworm. Pounce, an FMC experimental insecticide being a synthetic pyrethroid, did not perform well after the first month, but showed excellent results in the August readings. CGA-12223 and Dylox did not reduce populations as much as the other materials tested. The only labeled insecticides in this study that can be used on cutworm control on golf greens are Dursban and Dylox.

Table 16. Cutworm-bird damage on bentgrass - University of Illinois turfgrass plots, 1977.

Insecticide	Feeding Holes/sq ft[1/]	
	7/15/77	8/11/77
Dursban	0.07	0.04
Dylox	1.10	0.99
CGA-12223	1.20	0.43
Pounce	0.89	0.13
Lannate	0.27	0.67
Untreated	1.21	1.28

[1] Counts are the average of three replicates. Observed four weeks after treatment.

D. 1. Kentucky bluegrass establishment with industrial sludge.
B. A. Fritz and A. J. Turgeon

The disposal of industrial wastes is a serious problem for commercial manufacturers. Suitable receptor sites for a wide assortment of waste materials are limited in the vicinity of industrial centers. Furthermore, the cost of disposal may represent a significant percentage of overall production costs. Thus, there is a growing need to identify suitable receptor sites for industrial wastes and to determine their impact at these sites. Because of their chemical and physical composition, some waste materials may actually have a beneficial effect on plant growth. The purpose of this research is to determine whether turfgrass planting sites can be used for the disposal of a waste material from a pigment manufacturing plant in Illinois. After drying and grinding, the material is a fine-textured brown powder with a density of 1 g/ml. Chemical analysis reveals that it is composed of iron oxides (ca. 40%), barium sulfate (ca. 11%) and calcium sulfate (ca. 49%).

On September 3, 1976, field plots were planted with Kentucky bluegrass after soil-incorporation of dried industrial sludge at 0, 50, 250 and 1000 lb/1000 sq ft. Seedling density and turfgrass cover were measured 100 days following planting, and sod strengths were measured in October, 1977, at the conclusion of the study.

Density and cover in the seedling turf both declined as sludge application rate increased (Table 17). However, approximately one year after planting, sod strength measurements indicated no adverse effects from the 50 or 250 lb sludge rates; only the 1000 lb rate appeared to be too high.

Thus, an industrial sludge of this type can probably be disposed of on turfgrass planting sites as long as relatively low application rates are used. There appears to be no specific advantage to using this material and, consequently, the prospect of developing a commercial material from sludge for amending turf soils appears unlikely.

Table 17. Effects of soil-incorporated industrial sludge on the establishment of Kentucky bluegrass seeded September, 1976.

Sludge rate[1]	Shoot density Dec 6	Turfgrass cover Dec 76	Sod strength Oct 77
lb/1000 ft^2	No. shoots/25 cm^2	%	lb/yd^2
0	20.2	72.5	67.6
50	18.2	72.0	76.4
250	15.0	64.2	80.0
1000	11.2	32.0	55.8

[1] Sludge surface-applied and raked into the top inch of soil; Kentucky bluegrass seeded at 2 lb/1000 ft^2.

D. 4. Vegetative establishment of Kentucky bluegrass from plugs.
A. J. Turgeon

Research at the University of Illinois has shown that vegetative establishment of weed-free A-20 Kentucky bluegrass turf can be accomplished using closely-spaced plugs of sod in conjunction with oxadiazon (Ronstar) herbicide application to a prepared soil. Studies were undertaken in May, 1975, to determine the effects of mowing height (0.75, 1.5, 3 in.; no mowing) and fertilization level (0, 0.5, 1,2 lb N/1000 sq ft/month using a 10-6-4 soluble fertilizer) on the rate of coverage by a planting of A-20 plugs subsequently treated with Ronstar 2G at 3 lb a.i./acre. Plots measured 12 by 6 ft and each treatment combination was replicated three times. Percent cover was visually estimated from May, 1975, to June, 1977. At the conclusion of the experiment, two strips of sod measuring 6 by 1.5 ft were harvested from each plot, and sod strengths (the force required to pull the sod apart) were measured.

Through 1975, mowing height significantly affected the rate at which turfgrass cover developed; however, by mid 1976, turfgrass cover was comparable among mowing plots when all fertilization treatments were averaged (Table 18). Nitrogen fertilization rates did not affect turfgrass cover until late in 1975. By mid 1976, all fertilized plots had comparable turfgrass cover; only the unfertilized plots showed a significant reduction of lateral growth from the plugs. Sod strength means were not significantly affected by mowing treatments, but were influenced by fertilization;

the lowest fertilization rate of 0.5 lbN/1000 ft^2 produced the strongest sod compared to higher rates of fertilization, or no fertilization.

Table 18. Effects of mowing and fertilization on the rate of coverage by A-20 Kentucky bluegrass from plugs in May, 1975.

Treatment		Percent cover			Sod strength, kg/m^2
		Aug 75	Oct 75	Jul 76	Jun 77
Mowing height, cm					
0.75		23.7	42.9	90.0	48.3
1.5		38.4	59.6	92.5	55.6
3.0		51.7	73.8	94.4	52.2
N		58.7	70.8	96.0	55.9
Fertilization, lbN/M/Mo					
0		39.2	53.7	84.2	79.3
0.5		41.2	62.5	96.2	91.2
1.0		46.2	63.3	96.2	53.2
2.0		45.8	67.5	96.4	41.8
Source of variation	df			"F values	
Mowing height (M)	3	7.57*	14.08**	1.53	2.68
Fertilization (F)	3	2.78	5.40**	18.26**	15.98**
M x F	9	1.40	0.79	0.21	1.15

E. 3. a. Kentucky bluegrass cultivar, blend and mixture evaluation
A. J. Turgeon and J. E. Haley

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 varieties plus 10 blends and 4 mixtures from an April, 1972 planting under test at this station. Plots measure 6 by 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 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 varieties.

The diseases of importance this year have been *Helminthosporium* melting out, as reflected in the April quality data, *Fusarium* blight, and stripe smut (Table 19). This was the first year in which the incidence of stripe smut was accurately assessed by estimating the present infected tillers in each plot. Those cultivars seriously affected by the stripe-smut-causing pathogen included: Geronimo, Merion, Park, Rugby, and Windsor.

The blends generally reflect disease and quality levels that represent compromises between the two component cultivars. Since no single cultivar is perfect, blending superior cultivars allows for incorporating the desirable features of each component while reducing the impact of a specific weakness on general turfgrass quality. However, there are some reservations concerning blending; incorporation of a disease-susceptible cultivar in a blend may result in a reduction of the field resistance of an otherwise resistant cultivar because of severe disease pressure from adjacent inoculum-producing plants. If this were not true, a disease-resistant cultivar would soon dominate a blend with a susceptible cultivar; comparison of data on disease incidence and quality for blends and their component cultivars shows that both grasses are still present five years after planting.

Table 19. Quality of Kentucky bluegrass cultivars in 1977

Cultivar	Striped Smut[1]	Fusarium Blight[2] 7/29/77	Quality[3] 3/16/77	4/28/77	5/24/77	7/14/77	8/2/77	10/11/77
A-20 (seeded)	0	2.7	4.3	2.0	3.3	2.0	4.0	2.7
A-20 (veg)	0	1.0	4.0	3.0	2.3	2.0	2.0	2.7
A-34	0	1.7	4.7	3.0	3.7	3.0	3.0	3.0
A-20-6	0	1.0	4.3	2.3	2.0	2.0	2.0	1.7
Adelphi	0	1.0	4.0	4.0	2.3	2.3	4.0	3.0
Ba 61-91	0	3.0	4.0	3.0	2.3	2.7	4.3	4.3
Ba 62-55	0	2.0	3.7	3.3	2.3	3.0	3.0	3.7
Baron	2.3	1.0	4.0	4.0	2.3	3.7	3.0	4.0
Bonnieblue	0	2.3	3.0	4.0	2.7	4.0	4.0	4.7
Brunswick	0	2.7	4.3	3.3	2.3	2.3	3.7	5.3
Campina	0	1.0	3.7	6.7	4.0	4.3	3.7	4.7
Cheri	0	2.3	5.0	3.7	3.0	2.7	3.7	3.3
Delft	0	4.3	3.7	5.0	2.7	2.7	4.7	5.3
EVB 282	0	1.0	4.0	4.7	2.3	3.0	3.0	3.7
EVB 305	0	4.3	4.0	3.3	2.3	3.0	5.7	6.0
EVB 307	10.0	2.0	4.0	4.7	2.3	3.0	4.7	5.0
EVB 391	0	2.7	4.3	4.3	3.0	2.7	3.3	4.0
Fylking	0.3	3.3	4.3	4.0	3.0	4.3	5.3	5.7
Galaxy	6.7	1.0	3.7	4.3	2.7	3.3	3.3	4.0
Geronimo	53.3	3.3	4.0	5.0	3.0	3.7	5.0	5.3
Glade	0	1.0	4.7	4.7	2.3	2.7	2.7	4.7
Kl-131	0	1.7	4.7	5.3	2.3	3.3	4.3	4.7
Kl-132	0	2.0	4.0	4.3	2.7	3.7	4.3	4.7
Kl-133	0	1.7	3.7	5.0	2.3	3.0	4.0	5.7
Kl-138	6.7	7.3	4.0	6.0	4.3	4.3	7.0	7.0
Kl-143	0	2.7	3.3	4.3	2.7	3.7	4.3	5.0
Kl-155	25.0	1.0	4.7	3.3	3.0	3.0	2.7	3.7
Kl-157	0	3.7	3.7	5.3	3.7	3.3	5.0	5.3
Kl-158	0	1.7	4.7	5.0	3.0	3.0	3.3	3.3
Kl-187	0	2.7	3.7	5.3	2.7	2.3	3.7	5.0

Table 19 (cont'd.)

Cultivar	Striped Smut[1]	Fusarium Blight[2] 7/29/77	Quality[3] 3/16/77	4/28/77	5/24/77	7/14/77	8/2/77	10/11/77
Kenblue	0	2.0	4.7	6.0	3.0	3.3	4.0	4.3
IL-3817	7.0	3.3	4.0	4.3	3.7	4.7	5.3	4.7
Majestic	0	1.0	3.3	4.3	3.3	3.3	3.0	4.0
Merion	76.7	2.0	4.7	4.0	3.0	3.3	4.0	4.7
Monopoly	0	1.0	4.0	4.0	3.0	4.0	3.2	4.3
Nugget	0	3.7	6.3	4.3	2.0	3.7	5.3	6.0
P-59	0	1.0	3.3	3.0	3.0	3.0	3.0	2.3
P-140	0	2.7	3.0	5.0	2.3	3.3	4.3	2.7
Parade	2.0	1.7	3.3	2.0	2.7	3.0	3.7	3.3
Park	20.3	1.0	4.3	6.3	3.7	4.0	4.3	4.7
Pennstar	13.3	3.0	4.3	4.7	3.0	3.7	4.3	4.3
Plush	0	2.3	4.0	4.7	2.0	2.0	3.7	4.3
PSU-150	0	1.0	4.3	4.0	2.3	2.3	3.0	2.7
PSU-169	3.3	4.0	4.0	4.3	2.3	2.3	5.0	4.3
PSU-190	0	3.0	4.0	4.0	2.3	2.7	4.3	5.0
PSU-197	0.3	4.0	5.0	5.0	3.0	3.0	4.7	5.0
RAM #1	0	2.0	3.7	5.0	2.3	2.7	2.7	3.3
RAM #2	0	3.7	3.3	5.0	3.0	2.7	5.0	5.7
Sodco	0.3	1.0	4.3	4.3	2.3	2.3	2.7	2.3
Sydsport	0	2.3	4.3	4.0	2.7	4.0	3.7	3.3
Touchdown	0	2.3	4.7	3.3	2.0	2.7	3.0	3.0
Vantage	0	2.0	4.0	4.3	3.0	3.0	3.7	4.3
Victa	0	1.0	4.0	4.0	2.3	3.3	3.0	4.3
Windsor	90.0	1.0	4.7	4.7	2.7	2.7	3.0	3.0
. . . . Blends								
Merion + Kenblue	33.3	3.0	4.0	5.0	3.0	2.7	4.7	4.7
Merion + Pennstar	73.3	1.0	4.0	4.7	3.0	3.0	3.0	4.3
Merion + Baron	26.7	1.0	3.7	3.7	2.3	3.0	4.0	4.0

Table 19 (cont'd.)

Cultivar	Striped Smut[1]	Fusarium Blight[2] 7/29/77	Quality[3] 3/16/77	4/28/77	5/24/77	7/14/77	8/2/77	10/11/77
Nugget + Pennstar	2.0	3.0	5.0	5.0	1.7	2.7	4.3	5.2
Nugget + Park	0	3.3	5.0	5.7	3.0	2.3	3.7	6.0
Nugget + Glade	0	1.0	4.3	4.0	2.3	2.7	3.0	5.0
Nugget + Adelphi	0	2.7	4.0	4.3	2.7	2.7	4.0	4.0
Victa + Vantage	0	1.0	4.0	4.3	2.7	3.0	2.7	4.7
P-59 + Brunswick	0	4.3	3.7	4.0	2.0	2.0	5.3	4.3
Blend 38	0	1.0	5.0	3.3	2.3	2.7	2.7	3.7
. . . . . . Mixtures								
Fylking + Jamestown RF	1.7	3.3	4.3	4.0	3.3	3.3	6.0	5.3
Fylking + Pennlawn RF	0	4.3	4.3	4.7	3.0	4.3	6.0	5.7
Fylking + C-26 RF	0	4.3	4.3	4.3	2.7	4.3	6.0	5.7
Fylking + Pennfine RF	0	3.0	4.3	5.0	3.7	4.0	5.3	4.7

[1] Stripe smut was rated as the estimated percent infected tillers within two, 1-ft^2 squares per plot.

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

E. 3. a. Expanded Kentucky bluegrass selection evaluation.
A. J. Turgeon and J. E. Haley

With the introduction of many new experimental selections, a new series of Kentucky bluegrass plots were planted in September, 1974, to determine their performance in central Illinois. Plot size was 5 by 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.

The principal diseases evident in these plots were dollar spot and *Fusarium* blight (Table 20). Quality level varied with Kentucky bluegrass selection and time during the growing season. Data collected during subsequent seasons will be needed before these selections can be adequately characterized in terms of their likely performance under our conditions.

Table 20. Kentucky bluegrass experimental selection evaluation.

Selection	Dollar[1] Spot 7/10/77	Fusarium[1] Blight 8/5/77	Quality 3/17/77	4/29/77	5/26/77	7/8/77	8/4/77	10/11/77
Adiker A214	3.0	3.0	5.7	6.3	4.7	5.0	5.0	4.7
Adiker K1096	2.0	1.3	5.3	6.3	5.0	3.7	4.3	4.0
Burl D-517	3.0	1.3	5.3	5.3	4.7	4.7	5.3	5.7
Burl F1086	2.7	1.7	5.3	5.7	5.0	5.3	4.0	4.0
Burl F1145	1.7	1.0	5.3	6.0	4.3	4.0	3.0	3.0
Burl F2039	1.7	1.0	5.7	7.0	5.7	5.0	6.0	5.3
Calturf P143	1.7	1.7	5.7	5.7	4.7	4.7	4.7	4.0
Grun K860	3.7	1.0	6.0	6.7	4.7	4.7	5.3	5.3
GWSH #2	1.7	2.7	5.7	5.7	4.7	5.0	4.3	4.7
NK-P154	2.0	1.3	5.0	4.0	4.0	3.3	3.3	3.3
P-3N	2.0	1.3	5.0	5.0	4.7	3.7	4.0	4.0
P-167	3.0	1.0	5.3	6.3	6.7	5.7	4.7	5.3
Princeton 104	2.3	1.0	5.0	5.0	3.7	3.3	3.0	2.7
Princeton 164	3.0	1.0	5.3	5.7	5.0	3.7	4.3	4.3
K1-80	4.3	3.0	6.0	6.0	6.3	4.7	5.3	5.0
K1-88	3.0	1.3	5.7	6.3	5.7	4.3	6.0	5.0
K1-121	3.0	3.7	5.7	5.3	5.3	5.0	6.0	5.0
K1-122	4.7	2.0	6.3	6.0	5.0	5.7	5.0	5.0
K1-136	4.0	3.0	5.3	5.3	5.3	5.3	5.7	6.0
K1-140	5.0	1.3	5.3	4.7	4.7	5.0	5.3	5.3
K1-144	3.7	1.0	5.3	4.0	3.7	4.3	4.7	4.0
K1-152	2.3	1.0	5.0	5.3	4.3	4.7	4.7	4.3
K1-153	3.3	2.0	5.3	4.7	4.3	4.3	4.3	3.7
K1-154	3.7	2.7	5.3	5.0	4.0	4.7	4.3	3.0
K1-159	4.3	2.0	5.3	5.0	4.3	5.7	5.0	4.7
K1-165	6.3	2.3	5.7	5.3	4.7	6.0	5.0	4.7
K1-189	4.3	2.3	6.0	5.3	4.3	5.3	4.7	4.0
K2-200	3.7	1.7	6.0	5.7	5.3	5.0	5.0	4.7
K3-162	2.0	1.0	4.7	4.3	4.7	4.0	3.7	3.3
K3-164	3.7	1.3	5.3	5.0	5.0	4.7	4.7	4.3

Table 20. (Continued)

Selection	Dollar[1] Spot 7/10/77	Fusarium[1] Blight 8/5/77	Quality 3/17/77	4/29/77	5/26/77	7/8/77	8/4/77	10/11/77
K3-166	3.0	1.0	5.0	4.3	4.0	5.0	4.0	4.0
K3-168	3.0	4.0	5.0	5.3	4.7	4.3	5.0	4.3
K3-169	2.0	2.7	5.3	5.7	5.3	4.7	4.3	5.3
K3-170	3.0	3.0	5.7	5.3	4.0	5.3	4.3	5.0
K3-171	4.0	1.0	6.0	5.3	5.0	4.7	4.0	3.3
K3-172	3.0	1.7	4.7	4.7	5.3	5.3	5.0	5.0
K3-174	3.0	1.0	5.7	5.3	4.0	4.0	4.0	3.3
K3-178	2.7	1.0	5.3	5.3	5.0	4.3	4.3	4.0
K3-179	4.0	1.0	6.0	5.7	4.3	5.3	4.7	4.0
K3-180	3.0	1.0	5.3	5.3	4.0	4.0	3.7	3.3
K3-181	2.0	1.0	5.0	5.0	5.3	4.7	4.0	4.0
K3-182	4.3	1.0	4.7	5.3	5.3	4.3	4.3	4.7
K3-222	3.0	2.7	5.7	5.7	5.3	5.3	5.3	5.3
K8-176	1.7	1.3	5.0	6.3	4.7	5.0	4.7	4.7
WTN-A20-6	2.7	1.0	5.0	4.3	3.7	4.0	4.0	3.7
WTN-A29-10	4.0	1.0	5.0	4.7	3.3	4.7	3.7	2.7
WTN-H-11	4.7	1.0	5.0	4.3	3.0	5.0	3.7	3.3
WTN-I-13	5.7	1.3	5.0	5.0	4.0	5.0	3.7	2.7
WTN-N-1	5.7	1.0	5.3	4.7	4.0	5.0	3.7	3.0
WTN-N-37	6.0	1.3	5.7	6.7	4.7	5.3	5.0	4.3
WTN-0-59	4.0	1.0	5.0	5.3	4.3	5.3	4.7	4.0
WTN-0-758	1.0	1.0	4.7	5.0	4.0	3.3	3.3	3.3
Newport	2.7	1.3	5.3	4.7	5.0	5.0	5.0	5.3
Park	3.7	3.3	4.7	5.3	5.7	4.3	5.3	5.0
Aquilla	5.0	1.7	4.7	4.0	3.7	4.7	4.0	3.7

Table 20. (Continued)

Selection	Dollar[1] Spot 7/10/77	Fusarium[1] Blight 8/5/77	Quality 3/17/77	Quality 4/29/77	Quality 5/26/77	Quality 7/8/77	Quality 8/4/77	Quality 10/11/77
. . . . Combinations								
WTN #1	3.7	1.3	5.3	5.0	4.0	5.0	4.0	4.3
WTN #2	4.7	1.0	5.0	4.7	4.0	4.7	4.7	4.0
Prato-Fylking-Pennstar	5.0	3.3	5.3	5.0	3.7	5.7	5.7	5.7
Adelphi-Aquilla-Parade-Nugget	5.7	1.3	5.3	5.7	4.0	5.7	5.0	4.3
Adelphi-Aquilla-Parade	5.7	1.0	5.7	6.0	4.3	5.0	4.7	3.7
Majestic-Nugget	7.0	1.0	6.0	6.7	4.0	6.0	5.0	4.3
Adelphi-Baron-Bonnieblue	4.3	1.0	5.3	6.0	4.3	4.7	4.7	4.0
Brunswick-Parade	3.3	1.3	5.7	5.7	4.3	4.7	3.7	4.0
Baron-Nugget	5.0	1.7	6.3	6.7	4.7	5.0	5.0	5.0
Pennfine-Majestic	6.3	1.0	6.7	6.3	7.0	6.3	6.7	5.3
Sydsport-Majestic	4.0	1.3	5.3	5.0	3.7	4.7	4.0	4.0

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

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

E. 3. b. Fine fescue cultivar evaluation. A. J. Turgeon and J. E. Haley

Fine-leaf fescues (creeping red, Chewings, hard and sheep) have traditionally been used as shade grasses or for drouthy, sandy sites.

The fine-leaf fescue cultivars were planted April, 1972. Plots measured 6 by 8 ft and each was replicated three times. Fertilizer is applied twice yearly to supply a total of 2 lb N/1000 sq ft.

None of the cultivars provided high quality turf under the experimental conditions (Table 21). The one cultivar that consistently looked best during the growing season was Barfalla. In previous years, spring quality of the fine-leaf fescues was generally good; however, disease, weed invasion, and deterioration during the summer have resulted in scarred, mixed stands with generally poor quality for most cultivars.

This concludes the sixth and final year of evaluation of fine-leaf fescues. A conclusion from this study is that these fescue species are not well adapted for use as lawn grasses in sunny locations on fine-textured Illinois soils.

Table 21. Quality of fine-leaf fescue cultivars in 1977.

Cultivar	Quality Rating[1]				
	3/15/77	4/28/77	5/25/77	7/7/77	8/3/77
Barfalla	5.0	4.7	4.0	5.0	5.0
Dawson	5.7	5.3	5.3	6.3	7.3
Encota	6.3	6.0	5.3	5.7	6.3
Flavo	6.0	4.7	4.7	5.7	6.7
Highlight	7.0	7.0	6.3	6.7	8.7
Jade	8.3	4.0	3.7	5.0	7.3
Jamestown	5.0	4.3	4.3	5.3	6.7
Koket	5.3	5.0	4.3	5.3	5.7
Menuet	4.3	5.0	5.0	6.0	8.0
Oregon K	5.7	5.7	4.0	5.3	7.0
Pennlawn	5.3	5.0	4.3	5.3	6.7
Polar	5.0	5.3	5.0	5.3	6.3
Roda	6.0	6.7	6.0	7.7	7.7
Scaldis	6.7	6.0	5.7	6.7	7.3
Waldorf	6.3	5.3	5.3	7.0	8.3
C-26	5.3	3.7	4.3	5.7	7.7

Table 21. (Continued)

Cultivar	Quality Rating[1]				
	3/15/77	4/82/77	5/25/77	7/7/77	8/3/77
CEBECO S70-2	7.3	6.0	7.3	7.0	7.7
CEBECO H_2 71-4	7.0	7.0	8.0	8.3	7.3
ERG-11	7.0	7.0	7.0	7.7	8.3
Scarlet	6.0	6.7	6.0	7.3	8.3
HF-11	6.3	6.3	6.0	6.7	7.3
Durlawn	6.3	7.0	7.3	6.0	6.7
Novarubra	5.7	4.7	5.3	5.7	5.7
Barok	6.0	5.7	5.3	5.7	6.0
Ru-45C	4.7	5.3	5.0	6.0	8.0
C-26 + Jamestown	5.7	5.0	4.0	5.3	7.0

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

E. 3. c. Creeping bentgrass cultivar evaluation.
A. J. Turgeon and J. E. Haley

Creeping bentgrass cultivars were established in May, 1973, in plots measuring 6 by 8 ft with three replications of each variety. 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. Fungicides were not applied in 1976 in order to differentiate disease incidence in the cultivars.

The cultivars varied widely in their quality ratings due to differences in texture, color, density, annual bluegrass invasion and disease incidence (Table 22). The poorest cultivar was Toronto which deteriorated severely in 1974 due to red leaf spot disease and, now, annual bluegrass covers over 50 percent of the plot areas. In contrast, the Toronto plots at the two satellite stations (Scott Air Force Base, Chicago Botanic Garden) have been good quality turfs since red leaf spot disease did not occur at those locations. Good turfgrass quality has been observed with Washington, Penncross, Cohansey, Pennpar, Old Orchard, and the experimental selections: MSU-Ap-28 and MSU-Ap-38. Annual bluegrass invasion varied from 0 to 53 percent among 18 cultivars.

Table 22. Creeping bentgrass cultivar evaluation

Cultivar	Quality[1]				
	3/17/77	5/26/77	7/14/77	8/5/77	10/12/77
Arlington	5.0	5.7	5.7	6.0	4.3
Cohansey	3.3	5.3	5.3	5.0	3.7
Collins	5.3	6.3	5.0	4.7	5.0
Congressional	4.3	6.7	5.0	5.7	4.0
Emerald	3.3	5.0	5.0	5.3	4.3
Metropolitan	4.7	5.7	5.3	7.0	4.0
Morrissey	5.0	6.0	4.0	5.0	5.3
MSU-AP-18	4.3	6.7	4.0	6.3	6.3
MSU-AP-28	4.0	4.3	4.7	4.3	5.7
MSU-AP-38	4.3	5.7	4.0	4.3	5.0
Nimisilia	6.7	7.0	4.0	7.7	6.7
Old Orchard	4.3	4.7	5.0	4.0	4.0
Penncross	4.0	5.0	3.7	4.3	3.7
Pennlu	4.3	6.7	5.7	6.0	5.0
Pennpar	3.7	4.7	5.0	4.0	3.3
Seaside	4.0	5.3	5.7	5.3	3.7
Toronto	5.3	7.0	6.7	7.0	4.7
Washington	4.7	5.7	3.7	5.3	5.0

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

E. 3. d. <u>Perennial ryegrass cultivar evaluation.</u>
A. J. Turgeon and J. E. Haley

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.

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.

There was surprisingly little injury from the severe winter in any of the cultivars as indicated in the March data; however, quality declined substantially during the severe midsummer period in most cultivars (Table 23). As in previous years, Manhattan was superior in spring while Pennfine appeared best during the summer months.

Table 23. Quality of perennial ryegrass cultivars in 1977.

Cultivar	Quality[1]					
	Mar	Apr	May	Jul	Aug	Oct
Common	3.3	6.0	4.3	5.3	7.0	6.0
K8-137	2.0	4.3	3.3	5.7	6.3	4.7
K8-142	3.0	4.3	3.7	5.7	5.3	4.0
Manhattan	2.7	3.3	3.3	5.0	5.3	4.3
NK-100	3.3	4.7	4.0	5.0	6.3	5.3
NK-101	3.0	5.0	3.7	4.7	6.7	5.3
NK-200	3.0	4.0	4.0	4.7	7.0	5.7
Pelo	3.0	4.7	4.0	5.0	6.7	5.7
Pennfine	3.0	4.3	3.0	4.7	5.0	4.7

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

E. 3. e. Coarse fescue cultivar evaluation.
A. J. Turgeon and J. E. Haley

Coarse fescues include tall fescue (Festuca arundinacea) and meadow fescue (Festuca 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 State University 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 September with a 10-6-4 water-soluble fertilizer. Irrigation is conducted as needed to prevent wilting.

In early spring of 1975 and 1976, turfgrass quality varied widely among the selections due to their differential winter hardiness; Maris Kasbah, Maris Jebal and KO-103 were moderately-to-severely injured while the other selections exhibited good cold hardiness. Quality of the MSU meadow fescue deteriorated substantially during late summer due, presumably, to its poor heat tolerance. A non-replicated plot of Kentucky-31 tall fescue, which is widely used in southern Illinois, appeared as good as any of the experimental selections. In 1977, the experimental selections - KO-111 and K4-204 were superior to the others in persistence and general quality (Table 24). Apparently, tolerance of the selections to the climatic extremes (heat and cold stresses) encountered in central Illinois is the principal determinant of their quality as turfs.

Table 24. Performance of coarse fescue cultivars in 1977.

Cultivar	Quality[1]					
	3/17/77	4/29/77	5/26/77	7/8/77	8/3/77	10/11/77
MSU-MF	6.3	5.7	5.3	6.0	7.7	7.0
Maris-Kasbah	6.0	6.0	6.7	6.3	7.0	6.0
Maris-Jebal	6.7	7.3	7.0	6.7	7.7	6.7
KO-103	6.0	6.3	6.7	6.3	7.3	6.7
KO-111	5.3	4.7	4.0	3.0	5.3	4.0
K4-204	5.0	4.3	4.0	3.0	5.3	3.3
K8-108	5.7	6.0	5.0	4.3	6.0	5.7

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

G. 2. Soil physical amendment for golf greens and other drained soils. L. Art Spomer and James Kramer

A perched water table forms at the drainage level following the irrigation and drainage of a drained soil such as a golf green. Since these soils are typically relatively shallow (25-35 cm), most natural soils remain saturated in these sites and the growth of turfgrass plants in them is adversely affected by the prevalent poor soil aeration conditions which result. This problem is solved in practice by developing special media consisting of sufficient very coarse-textured media to provide adequate large or aeration pores (which empty of water despite the water table) mixed with sufficient fine-textured media to provide adequate small, water retention pores (which remain saturated following drainage). Unfortunately, most of these media have been developed through "trial-and-error studies" rather than systematic physical examinations of how aeration and water retention are affected by different proportions of components.

This project has developed a simple physical model which can be used to predict the total, aeration, and water retention porosity of any mixture of very coarse-textured and fine-textured components. This model has been thoroughly tested in the lab and was found to be an accurate predictor of mixture physical properties for a wide range of amendments. Studies are currently underway to investigate the change in mixture physical properties with time. A new class of soil amendment, hydrophyllic gels (superslurper and Viterra II) designed to retain water are also under examination for possible use in golf course green soils.

This information is not completely useful unless we also know plant requirements for water and aeration. Studies are currently under way using root metabolic rates to determine plant aeration requirements and evapotranspiration rates and water stress tolerance to determine plant water requirements. In other words, we need to define plant requirements before we can design optimal soil mixes.

G. 5. a. Effect of thatch on the mobility and metabolism of nitrogen form soluble and slow-release carriers. Kim Falkenstrom, A. J. Turgeon, and J. R. Street

Fertilizers applied to turf may contact a thatch layer, rather than the soil, and may be influenced more by thatch than by soil in releasing plant-available nitrogen. Laboratory studies were initiated to determine what influences thatch has on the downward mobility of soluble nitrogen from urea and IBDU fertilizers. Cores of thatch measuring 5 cm deep and 5 cm in diameter were extracted from a Kentucky bluegrass turf in Chicago, Illinois, and compared to soil cores from a thatch-free Kentucky bluegrass turf. These were enclosed within brass cylinders fixed to air-tight plastic bases with a pore for suction drainage. Water was pulled from the cores by an electric pump and collected in Erlenmeyer flasks. Water was added daily to maintain the cores in a moist condition. Vegetation was killed in one-half of the thatch and soil cores by applying glyphosate at the rate of 2 lb/acre one week prior to initiating fertilizer treatments. Urea and IBDU granules were applied to the surfaces of each core at the rate of 5 lb N/1000 ft^2. Leachates from each core were collected for analysis and, at the conclusion of the experiment, the cores were dried, ground, and digested prior to analyzing for nitrogen.

At this stage of the research, results are not conclusive because of some difficulties in experimental procedure. However, several observations can be reported. Where urea was the nitrogen source, as much as 90 percent of the nitrogen measured in leachates one day after application was still urea which had not been converted to inorganic nitrogen. In contrast, only about 10 percent of the leachate nitrogen from IBDU-treated cores was urea. Considerable more nitrogen was leached from urea-treated cores than from cores receiving IBDU. This was especially true in cores where live grass was still present. Specific questions of the leachability of nitrogen from thatch and soil, and relative loss of nitrogen from volatilization from thatch and soil, are currently under study. Information to date suggests that a slowly soluble nitrogen carrier, such as IBDU, may be a more efficient nitrogen source than soluble carriers because of physical stability within the medium (thatch, soil) supporting turfgrass growth. This contradicts previous reports from ureaformaldehyde fertilizer research using turfgrass shoot growth response as an index of nitrogen efficiency. Hopefully, this issue will be resolved by information from our research in 1978 and subsequent years.

G. 5. a. Evaluation of UF and IBDU fertilizers. J. R. Street and A. J. Turgeon

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. Some products contain a high percentage of soluble nitrogen, others consist primarily of slowly-soluble components, whereas certain products are formulated to consist of soluble and slowly-soluble components in specific proportions. The nitrogen release pattern and, consequently, turfgrass response depend upon the fertilizer material chosen and the particular fertilization program instituted.

Several UF (methylene urea) and IBDU (isobutylidene diurea) type fertilizers are presently under evaluation on a mature 'Pennstar-Fylking-Prato' Kentucky bluegrass turf. 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 in May, 1976. The entire area received 1 lb N/1000 sq ft using a 10-6-4 analysis fertilizer, in April, 1976. Treatments consist of 9 nitrogen carriers applied at various rates and dates under either a spring or fall initiation program (Table 25). Each treatment was replicated three times with 6 by 10 ft plots. Mowing was performed 2 or 3 times weekly at 0.75 in. Irrigation was performed as needed to prevent wilting.

Fertilizer materials were evaluated on the basis of turfgrass color and visual density ratings at various times following treatment.

Observations during 1976 revealed no major differences among fertilizer treatments. Unfertilized, check plots consistently showed poorer quality throughout the growing season than fertilized plots.

In 1977, IBDU (31-0-0) showed superior early spring green-up from the previous year's application compared to the other nitrogen sources (Table 26). IBDU is not dependent on microbial activity for nitrogen release and both color and density results indicated that nitrogen release during cool periods exceeded that released from the microbially decomposed material (Hercules UF). UF performance improved as temperatures increased during the late April-early May period. Differences among sources became less apparent during the summer months. IBDU, ProTurf Super, and UF applications at 2 lbs N/1000 sq ft in April provided acceptable quality through mid-August. Fertilizer applications made in April and June under the fall initiation program resulted in improved summer quality over treatments dependent on residual nitrogen from the previous year's application (Table 27).

Turfgrass quality from fall (1977) applications revealed responses similar to those observed in 1976. Turfgrass quality on fall initiation plots not receiving April-June applications was comparable to plots receiving nitrogen fertilization when evaluated in November.

Thatch depth and soil-thatch pH values were not noticeably different among the nitrogen sources and check (Table 28). The soil type underlying this study is a Flanagan silt loam. The buffering of this soil obviously eliminated any acidifying effects from the nitrogen sources during the initial stages of this study.

Table 25. Evaluation of UF fertilizers and IBDU fertilizers.

Fertilizer	Analysis	% WIN	Lb N/M	Application Dates	
				Spring Initiation	Fall Initiation
1. Proturf Super Fairway	34-3-7	5.2	1.0	May, June, Sept.	Sept., April[1/], June [1/]
2. ProTurf Fairway	30-3-10	8.8	1.0	" " "	" " "
3. Proturf N-0-K	28-0-14	9.4	1.0	" " "	" " "
4. ProTurf Super Fert.	31-5-3	15-6	2.0	May, September	September, April[1/]
5. Par Ex IBDU Coarse	31-0-0	27.9	2.0	" " "	" "
6. Par Ex	24-4-12	10.8	1.0	May, June, Sept.	Sept., April[1/], June[1/]
7. Par Ex	20-0-16	14.8	1.0	" " "	" " "
8. Par Ex	27-3-9	18.0	1.0	" " "	" " "
9. Hercules U/F	38-0-0	28.0	2.0	May, September	September, April[1/]
10. Check					

[1/] Only 1/2 of plot scheduled for retreatment at times indicated.

Table 26. Color and density ratings for UF and IBDU fertilizers under the spring initiation program.[1]

Fertilizers	Color and Density Rating[2]																			
	4/1/77		5/1/77		6/3/77		6/14/77		6/20/77		7/8/77		7/15/77		7/22/77		8/6/77		11/1/77	
Proturf Super Fairway	4.0	3.7	3.0	2.0	2.3	1.7	3.3	2.7	3.0	2.7	3.3	2.7	2.7	2.0	2.7	2.0	2.0	2.0	3.0	3.0
Proturf Fairway	4.0	3.7	2.7	2.0	2.3	1.3	3.0	3.0	2.7	3.0	3.5	3.0	2.7	2.0	2.3	2.7	2.0	2.0	3.0	2.7
Proturf N-0-K	4.3	4.0	3.0	2.0	2.3	1.7	2.7	2.7	2.7	2.7	2.0	2.7	3.0	2.0	2.7	2.0	2.0	2.0	3.3	2.7
Proturf Super Fert.	4.0	3.7	2.7	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.7	3.0	3.0	2.0	2.3	2.0	2.0	2.0	2.7	2.7
Par Ex IBDU Coarse	3.0	2.3	2.0	2.0	2.3	1.3	2.0	2.2	2.0	2.2	3.0	2.7	3.0	2.0	2.7	2.0	2.0	2.0	3.0	2.7
Par Ex 24-4-12	4.3	4.0	2.7	2.0	2.7	2.0	3.0	3.0	3.3	3.0	3.7	3.0	3.0	2.0	2.7	2.3	2.0	2.0	3.0	3.0
Par Ex 20-0-16	4.0	3.7	3.0	2.0	2.3	2.0	2.3	2.7	3.0	2.7	3.7	2.7	2.7	2.0	3.0	2.0	2.0	2.0	3.0	3.0
Par Ex 27-3-9	4.0	3.7	3.0	2.3	2.7	1.7	2.7	2.7	2.7	2.7	3.0	2.7	2.7	2.0	2.7	2.0	2.0	2.0	3.3	3.0
Hercules U/F	5.0	4.3	3.0	2.7	3.0	2.0	3.0	3.0	3.0	3.0	2.7	3.0	2.7	2.3	2.0	2.0	2.3	2.0	3.7	3.3
Check	6.0	5.3	4.3	3.0	5.0	3.0	5.0	4.2	5.0	4.2	4.3	4.2	4.7	4.0	4.3	3.3	4.0	3.3	5.0	4.3

[1] See Table 1 for treatment schedules; color and visual density rating were made on a scale of 1 through 9 with 1 representing best and 9 representing poorest.

[2] Numerical values under each date refer to the color (left) and density (right), respectively.

Table 27. Color and density ratings for UF and IBDU fertilizers under the fall initiation program[1]

Fertilizers	Color and Density Rating[2]																				
	4/1/77		*1	5/1/77		6/3/77		6/14/77		6/20/77		7/8/77		7/15/77		7/22/77		8/6/77		11/1/77	
Protruf Super Fairway	4.7	4.0	U	2.0	2.3	2.7	2.0	3.0	2.7	2.3	2.7	3.7	2.7	3.0	2.0	2.3	2.0	2.0	2.0	3.0	3.0
			L	2.7	2.3	3.0	2.3	3.3	3.0	2.7	3.0	4.3	3.0	3.3	2.3	2.7	2.0	2.7	2.7	3.0	3.0
Proturf Fairway	4.7	4.0	U	2.3	2.3	3.0	2.7	3.0	3.7	2.7	3.7	2.7	3.7	2.7	2.3	3.0	2.0	2.0	2.3	3.0	3.0
			L	3.0	2.3	3.3	2.7	3.3	4.0	3.0	4.0	3.3	4.0	3.0	2.7	3.0	2.0	2.7	2.7	3.0	3.3
Proturf N-0-K	5.0	4.0	U	3.0	2.0	2.3	1.7	3.0	2.7	3.0	2.7	2.7	2.7	3.0	2.0	2.3	2.0	2.0	2.0	3.0	3.3
			L	3.0	2.0	3.0	2.7	3.7	3.3	3.3	3.3	4.0	3.3	3.3	2.3	2.7	2.3	3.0	3.0	3.0	3.3
Proturf Super Fert	4.3	3.7	U	2.0	2.3	2.7	2.0	2.3	3.0	2.0	3.0	3.0	3.0	3.0	2.0	2.3	2.0	2.0	2.0	3.0	3.0
			L	3.0	2.3	3.3	2.3	3.3	3.7	3.3	3.7	3.7	3.7	3.7	2.0	3.0	2.0	2.7	2.7	3.0	3.0
Par Ex IBDU Coarse	3.0	2.7	U	2.3	2.0	2.3	1.7	2.7	3.3	2.0	3.3	3.7	3.3	3.0	2.0	2.7	2.0	2.0	2.0	3.0	3.0
			L	2.7	2.0	3.0	2.0	3.3	4.0	3.0	4.0	4.3	4.0	3.3	2.0	3.0	2.0	2.3	2.0	3.0	3.0
Par Ex 24-4-12	5.0	4.3	U	2.3	2.3	3.0	2.3	3.0	3.3	3.0	3.3	3.3	3.3	2.7	2.0	2.3	2.0	2.0	2.3	3.0	3.0
			L	3.0	2.3	3.0	3.0	3.0	4.0	3.0	4.0	4.0	4.0	3.3	2.7	2.7	2.3	3.0	2.7	3.0	3.0
Par Ex 20-0-16	4.7	4.0	U	2.3	2.3	2.3	1.7	2.7	2.7	2.3	2.7	3.3	2.7	3.0	2.0	3.0	2.0	2.3	2.3	3.0	3.0
			L	3.0	2.3	2.7	2.0	3.0	3.7	3.0	3.7	4.0	3.7	3.3	2.3	3.3	2.3	3.3	2.7	3.0	3.0
Par Ex 27-3-9	4.7	4.0	U	2.0	2.0	2.3	1.3	2.0	2.7	2.3	2.7	3.3	3.7	3.0	2.0	3.0	2.0	2.0	2.0	3.0	3.0
			L	3.0	2.0	3.0	2.3	2.7	3.7	3.0	3.7	4.0	3.7	3.0	2.0	3.0	2.3	2.3	2.3	3.0	3.0
Hercules U/F	5.3	4.0	U	2.0	3.0	2.0	2.0	2.3	3.0	2.3	3.0	3.0	3.0	3.0	2.3	2.3	2.0	2.0	2.0	3.3	3.3
			L	3.0	3.0	3.0	2.3	3.0	3.3	3.0	3.3	4.0	3.3	3.7	2.3	3.0	2.0	2.3	2.3	3.7	3.3
Check	6.3	4.7	U	3.3	3.3	3.3	3.0	3.7	4.3	4.0	4.3	4.7	4.3	4.7	4.0	4.4	3.3	3.7	3.7	4.7	4.3
			L	3.3	3.3	3.3	3.3	4.0	4.7	4.0	4.7	4.7	4.7	4.7	4.0	4.3	3.3	3.7	3.7	4.7	4.3

[1] See Table 1 for treatment schedules; color and visual density ratings were made on a scale of 1 through 9 with 1 representing best and 9 representing poorest.

[2] Numerical values under each date refer to the color (left) and density (right), respectively.

[3] Only the upper half (U) of plot received nitrogen application in April and June - See Table 1.

Table 28. Thatch accumulation and pH values among fertilizer treatments for the spring initiation program.[1]

Fertilizer	Soil pH	Thatch pH	Thatch depth (cm)
Proturf Super Fairway	5.37	6.27	1.30
Proturf Fairway	5.43	6.30	1.36
Proturf N-0-K	5.43	6.27	1.25
Proturf Super Fert.	5.37	6.23	1.32
Par Ex IBDU Coarse	5.57	6.37	1.15
Par Ex 24-4-12	5.47	6.43	1.18
Par Ex 20-0-16	5.43	6.33	1.41
Par Ex 27-3-9	5.60	6.53	1.11
Hercules U/F	5.47	6.50	1.30
Check	5.53	6.33	1.11

[1] Thatch accumulation and pH values were determined during May, 1977.

H. 3. Kentucky bluegrass-perennial ryegrass mixtures. A. J. Turgeon and Gwen Stahnke

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 maintenance were as in A. After two years, two 5 by 5-cm plugs were extracted from all replications of plots planted with 10, 20, and 50 percent 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 15). 'A-34' Kentucky bluegrass was more competitive than 'Fylking', while 'Pennfine' perennial ryegrass was more competitive than 'Citation'. The 20-percent level of perennial ryegrass in the stand two years after planting was exceeding by both perennial ryegrasses at 10 percent of the seed mixture with 'Fylking', and by 'Pennfine' at 20 percent of the seed mixture with 'A-34'; however, less than 20 percent perennial ryegrass occurred in stands resulting from 50:50 mixtures of 'A-34' and 'Citation' by seed weight. 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.

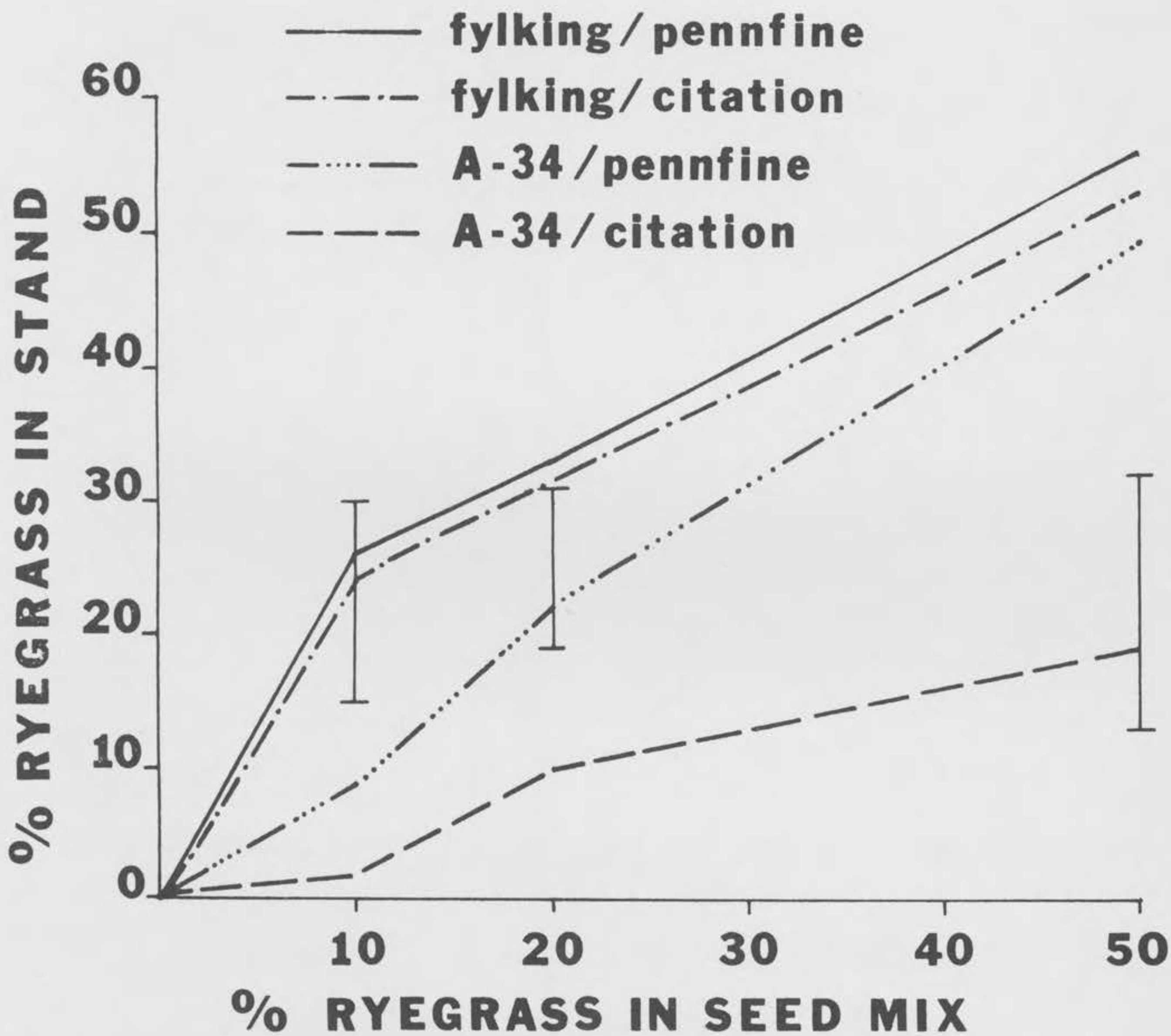


Figure 15. Relationship between the percent perennial ryegrass in a seed mixture and its percent in a stand two years after planting.