FIELD STUDIES ON THE SELECTIVE CHEMICAL CONTROL OF TWO BENTGRASS SPECIES IN BLUEGRASS AND IN RED FESCUE TURF

by

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ABSTRACT

FIELD STUDIES ON THE SELECTIVE CHEMICAL CONTROL OF TWO BENTGRASS SPECIES IN BLUEGRASS AND IN RED FESCUE TURF

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Field studies were conducted over a two-year period in an attempt to discover a chemical which would be effective as a selective herbicide for bentgrass which has become established in bluegrass or red fescue turf.

Turf research plots of three common lawn grass species, Kentucky bluegrass (*Poa pratensis*), Merion bluegrass (a selection from *P. pratensis*), and Creeping red fescue (*Festuca rubra*), were seeded. The area was divided into two equal parts then one half was cross-seeded with Colonial bentgrass (*Agrostis tenuis*) and the other half cross-seeded with Creeping bentgrass (*Agrostis palustris*). Since all seeding was done at one time, the various grass species had attained comparable growth and development when the herbicidal treatments were applied. One granular and seven liquid formulations of chemicals were applied at various rates. Plots were rated on the basis of comparative phytotoxicity of the herbicides to all grass species present. Special emphasis was placed on the recording of discoloration and survival of both the desirable grass species and the bentgrass species.

Bentgrasses and red fescue were about equally susceptible to injury by the chemicals except when 2, 4, 5-TP was applied at 2 lbs. per acre. Another treatment, a mixture of dalapon and silvex caused extreme top burning of all grasses, but all species except red fescue, later recovered and restored the stand. Both bentgrass species almost completely replaced the red fescue the following season.

The bentgrasses exhibited varying degrees of susceptibility to injury by the chemicals, but in no instance was either of the bentgrass species completely eliminated.

2, 4, 5-TP gave the most effective control of bentgrass without injury to bluegrass.

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INTRODUCTION

The presence of bentgrass in lawns composed of bluegrass, fescue, or mixtures of bluegrass and fescue is a serious weed problem. (See Plate 1.) Eighty percent of all grass seed mixtures on the market today have a small percentage of bentgrass seed in them. One viable bentgrass seed per pound of grass seed mixture is sufficient to infest a lawn.

Bentgrass can be used to produce a beautiful, fine textured, and attractively colored turf which is satisfactory for lawn purposes. Such turf, however, requires an intensive care and management schedule and is highly susceptible to the growth of fungi which cause the turf diseases known as brownpatch, dollar spot, melting-out and snow mold. Bentgrass turf also requires frequent mowing at a short height as well as periodic mechanical perforation of the dense mat which interferes with proper aeration and with penetration of water into the sod. Because of these requirements, as well as the marked textural differences between bentgrass and other commonly used turf grasses, it is not a suitable component of a turf grass mixture (2).

In recent years herbicides have been used extensively for the selective control of weeds in turf. Technological progress in finding selective herbicides to control bentgrass has been slow. Comparatively little research has been done and few data have been published with respect to controlling bentgrass in other turf grasses. Therefore, a study of certain chemical formulations that might selectively eliminate bentgrass in bluegrass or red fescue turf seemed timely.

There is no selective chemical generally used for bentgrass control. Therefore, when a bluegrass lawn becomes 50% or more infested with bentgrass there are three courses of action:

1. Switch to bentgrass culture.
2. Chemically eliminate all grass and re-seed.
3. Small isolated patches of bentgrass may be physically removed and the area reseeded or resodded.

This research presented here was undertaken to determine the influence of a few specific chemical formulations, separately and in combination, and at various rates of application per acre, on the grass species involved.

Plate 1. Patches of bentgrass in lawn turf. Note color, texture, and density of the bentgrass.

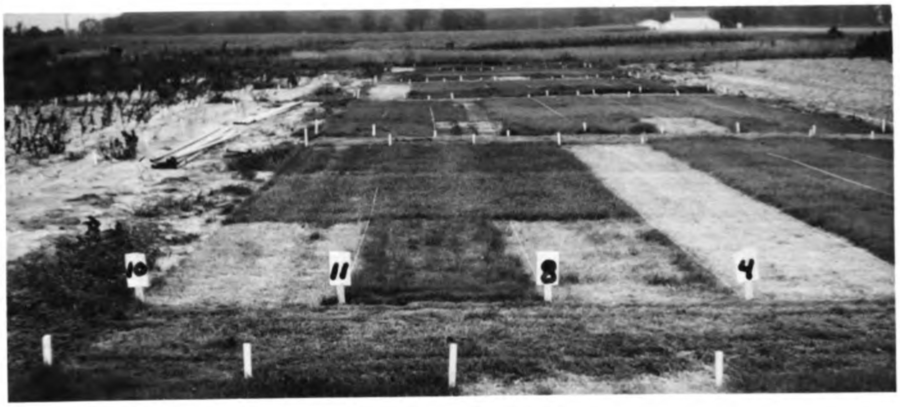

Plate 2. A general view of a section of the experimental plots. The numbered plots were treated as follows:

Plot 10 - 2, 4, 5 TP at 2 lbs./A

Plot 11 - 2, 4-D at 2 lbs./A

Plot 8 - 2, 4-D at 2.7 lbs./A

Plot 4 - dalapon + silvex at 9.5 + 2.5 lbs./A

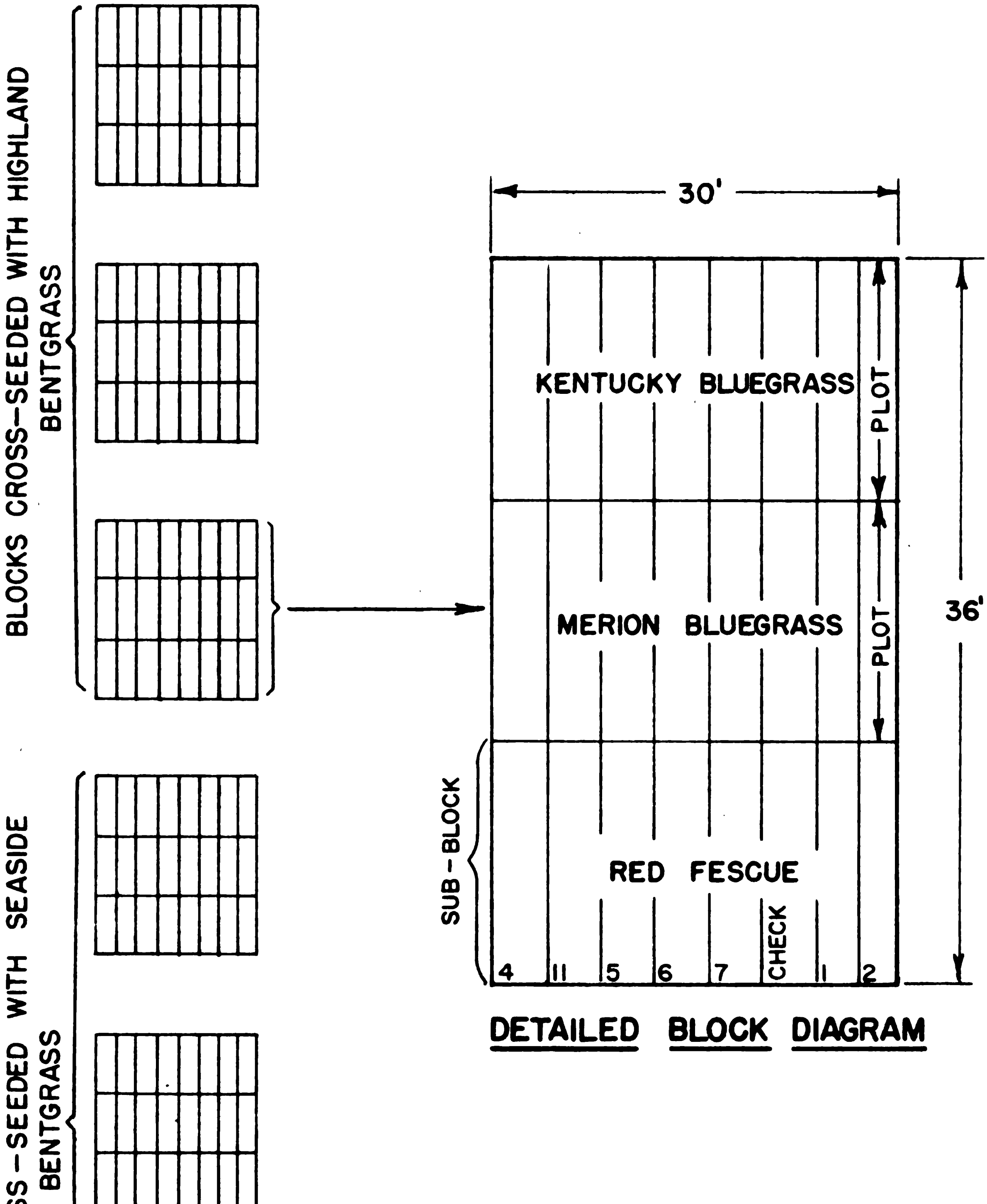

FIGURE I EXPERIMENTAL TURF PLOT LAYOUT

LITERATURE REVIEW

Creeping and colonial bentgrasses produce a shorter, thicker, and finer textured turf than bluegrass or red fescue (2). Creeping bentgrass sends out profuse, creeping stems that produce new plants at every node which results in the formation of a dense sod. Colonial bentgrass is a tufted-type grass with few creeping stems or stolons. It forms a dense turf when heavily seeded and closely mowed (3).

The speed with which bentgrasses invade bluegrass and red fescue lawns has been clearly shown by Davis (1) at the Ohio Agricultural Experiment Station, where bentgrass completely dominated all mixtures in which bentgrass seed was present. Merion bluegrass and red fescues were more resistant to invasion than common Kentucky bluegrass. Invasion occurred less rapidly at mowing heights of 2 inches than at 3/4 inch. The dense sod formed by Merion bluegrass made it more resistant to bentgrass invasion than is the sod of common Kentucky bluegrass.

Kreitlow and Juska (5) reported in 1960 that when a bluegrass lawn, infested with bentgrass, is mowed 1½ - 2 inches in height, dry or dead spots result from accumulation of bentgrass runners because water cannot permeate the mat and continue into the soil. This condition, known as thatch, is sometimes mistaken for a disease.

Shaw, et al. (7) reported in 1960 that among the factors known to influence foliar distribution, retention, and uptake of herbicides by grass plants are leaf form and shape, orientation, density, surface, and margins. The erect growth habit of bluegrass and red fescue contrasts markedly with the spreading or prostrate habit of most bentgrass species. Colonial bentgrass is slender and somewhat erect in growth habit and has very narrow leaves. The slender culms of Creeping bentgrass originate from a decumbent base. The leaves are short, flat, firm, and taper-pointed.

Plants with upright and those with horizontal leaf orientation form foliage canopies of various densities and differ markedly in their retention and absorption of herbicides.

Daniel (8) 1961, reported the use of UF-85 (26 percent urea and 59 percent formaldehyde) at 2 gallons per 1000 square feet in an attempt to control bentgrass in bluegrass turf. The turf was mowed short, sprayed with the herbicide to completely wet the foliage and then covered with a plastic sheet. He reported complete control of bentgrass in six different tests, but in every test only a few bluegrass rhizomes survived.

MATERIALS AND EXPERIMENTAL METHODS

A. Establishment of experimental turf plots:

As a prerequisite to proceeding with this problem, experimental turf plots of a specific composition were prepared. These plots were established on a fairly well-drained, level, sandy loam soil on the experimental farm of Michigan State University, East Lansing, Michigan, in September 1959. The usual soil fitting procedures of disking, dragging with a springtooth harrow and finishing with a spiketooth harrow just prior to seeding, were followed. The plot area had been plowed early in the summer and periodically tilled until the time of final fitting.

The area was hand raked with a garden rake to remove humps and fill depressions. Stones, clumps of sod, and other debris were removed prior to fertilizing and seeding. A 12-6-6 analysis commercial fertilizer was applied uniformly at a rate of 20 lbs. per 1000 sq. ft. Fertilizer application was followed by a light raking.

The plot layout, Figure 1, consisted of six rectangular blocks 30 x 36 feet with a six-foot aisle separating the blocks. Each of the blocks was divided into three 12 x 30 feet rectangular sub-blocks.

Creeping Red Fescue, Merion Bluegrass, and Kentucky Bluegrass were sown at the rate of 1 lb. per 1000 sq. ft. in strips 12 feet wide across each of the blocks. One half of the area, was cross-seeded with Highland bentgrass and the other half seeded with Seaside bentgrass, both at the rate of 0.8 ounce per 1000 square feet. This quantity represents 5% of the amount of the selected turf grass seed used.

All seeding was done on September 17, 1959. The sub-blocks were lightly raked on the short axis immediately following seeding. The aisles were neither seeded nor chemically treated. All plots were thoroughly sprinkled after seeding. Six days following seeding heavy rainfall caused portions of three blocks to be under flood water for up to three days. Some minor erosion occurred across the short axis of all blocks. No seedlings had emerged at the time of flooding, but apparently a high percentage had germinated and become anchored as there was no evidence of species having been carried across sub-block borders. By the end of the 1959 growing season the turf appeared normal except for a few sparse areas where flooding had been greatest.

The spring of 1960 was cool and wet, therefore conditions were ideal for the growth of fall seeded turf. The sparse areas filled in rapidly, and by April satisfactory lawn turf had developed in each block.

The usual turf cultural practices used in maintaining a bluegrass or red fescue lawn were followed. No additional fertilizer was applied during the experiment. All blocks were kept mowed at 1½ - 2 inches height throughout the experiment. Grass clippings were removed from the turf at the first mowing. A rotary type

power mower was used exclusively. The plots were irrigated when necessary. Broad-leaved weeds did not become established in any of the plots during the course of the experiment.

Some of the chemicals were selected for the experiment on the basis of research results reported in technical bulletins and proceedings of turfgrass and weed control conferences. Others were chosen because of the warning on the containers that the particular herbicide might damage bentgrass. Some were included upon the suggestion of field representatives of certain chemical companies.

A total of eleven chemical treatments was applied, with two replications, in each of the two bentgrass sections. Plots for liquid treatments were 4 feet wide, whereas the plots for dry formulations were 3 feet wide. The dry, granular, chemical formulation was applied with an 18-inch mechanical spreader. The liquid formulations were applied with a 2 gallon pressure sprayer using water as a carrier. There were two plots on which no chemicals were applied in each bentgrass section. The chemicals, formulations, and rates used are shown in Table 1.

All chemical applications were made on July 29, 1960. The soil surface and turf were dry, the temperature was 82 degrees F., and the humidity was low.

Table 1. Herbicides, formulations and rates per acre applied for the control of Bentgrasses. (All rates are expressed in pounds per acre of active ingredient.)

	Herbicide	Chemical Analysis	Form	Pounds per Acre
1.	Zytron	0-(2-4 dichlorophenyl) o-methyl isopropyl phosphoramidothioate.	Granular	10
2.	Zytron	0-(2-4 dichlorophenyl) o-methyl isopropyl phosphoramidothioate.	Granular	15
3.	Zytron	0-(2-4 dichlorophenyl) o-methyl isopropyl phosphoramidothioate.	Granular	20
4.	Dalapon-silvex mixture	2, 2-dichloropropionic acid, sodium salt, + 2-(2,4,5-trichlorophenoxy) propionic acid, propylene glycol butyl ether esters.	Liquid	9.5-2.5
5.	TD 47	Derivative of disodium 3, 6-endoxohexahydrophthalate.	Liquid	3
6.	TD 62	Derivative of disodium 3, 6-endoxohexahydrophthalate.	Liquid	3
7.	Endothal	Disodium 3, 6-endoxohexahydrophthalate	Liquid	8
8.	2,4-D ester	2,4-dichlorophenoxyacetic acid, butoxy ethanol ester.	Liquid	2.7
9.	2,4,5-T	2,4,5-trichlorophenoxyacetic acid, propylene glycol butyl ether esters.	Liquid	2
10.	2,4,5-TP	2-(2,4,5-trichlorophenoxy) propionic acid, propylene glycol butyl ether esters.	Liquid	2
11.	2,4-D	2,4-dichlorophenoxyacetic acid, butoxy ethanol ester.	Liquid	2
12.	None	-------	------	

RESULTS

Seven days after the application of the herbicides discoloration of grass foliage was observed in all plots which had received chemical applications. The combination of dalapon and silvex caused a severe browning and apparent top-kill of all grasses. Endothal and its derivatives likewise caused a browning effect upon all species but to a lesser extent than that of the dalapon and silvex mixture.

The growth regulating herbicides, 2, 4-D, 2, 4, 5-T and 2, 4, 5-TP caused a certain amount of discoloration of all grasses but the effects were more pronounced on some species than on others. The highest dosage level of 2, 4-D, 2.7 lbs. per acre, caused a severe injury to red fescue and to both species of bentgrass. At the 2.0 lb. level, however, all species showed only minor injury by the herbicide. The response to 2, 4, 5-T indicated that red fescue and bentgrass were less tolerant of this herbicide than was bluegrass. The greatest amount of selective action was observed in the plots treated with 2, 4, 5-TP. In these plots, fescue and bentgrasses were severely burned whereas the bluegrasses showed only mild discoloration.

The application of zytron did not cause any marked, immediate injury but appeared to have stimulated growth of all species. This effect was shown by the production of a deep green color in the foliage and a somewhat greater height of the grass leaves.

Observations One Month After Treatment

Ratings of apparent toxicity of the herbicide, based on visual observations, were made 33 days after application of the herbicides and are presented in Table 2. Injury to each grass species was given a numerical value on a scale of 0 to 10 where a value of 0 indicates no apparent injury and a value of 10 represents a complete kill of top growth.

At the time of these observations, variations in the response of all the grass species were noticeable. Generally, red fescue and both bentgrasses showed more injury than did either type of bluegrass.

Severe effects of the dalapon-silvex mixture were noted 7 days after treatment. The top growth of all species was killed in plots treated with the dalapon-silvex mixture (Plot 4 of Plate 2).

In all plots where 2, 4, 5-TP was applied (Plot 10, Plate 2) complete destruction of top growth of bentgrasses and red fescue occurred. The two types of bluegrass, however, showed very little injury.

Plots 8 and 11(Plate 2), treated with 2, 4-D at dosage levels of 2.0 and 2.7 pounds per acre, respectively, gave evidence of the narrow limit of tolerance for this herbicide by fescue and bentgrass. These grasses were injured only to a slight extent at the 2 pound level but 55 percent of the stand was destroyed at the 2.7 pound level. Bluegrass was not effected seriously at either dosage level.

Table 2, Ratings of Grass Species, Based on Visual Observations, 33 Days After Application of Herbicides.

	Cross-Seeded With Seaside bentgrass.				Cross-Seeded With Highland bentgrass			
Treat-ment	Red fescue	Merion bluegrass	Kentucky bluegrass	Seaside bentgrass	Red fescue	Merion bluegrass	Kentucky bluegrass	Highland bentgrass
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	2.5	1.0	1.5	2.0
3	1.0	1.0	1.0	1.0	2.0	2.0	3.0	2.0
4	10.0	9.5	9.5	9.5	10.0	10.0	10.0	10.0
5	6.5	5.5	6.0	6.0	6.5	5.0	5.5	6.5
6	2.5	1.0	0.0	2.5	2.0	0.0	0.0	1.0
7	1.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0
8	8.0	2.5	2.5	7.0	8.0	4.0	3.0	8.0
9	8.5	4.5	5.0	8.5	6.0	3.5	5.0	5.5
10	9.0	6.0	6.0	9.0	9.0	4.5	6.0	9.0
11	5.5	2.5	2.0	6.0	5.5	2.0	4.0	6.5
12-check	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

0 -- No effect

10 -- Complete kill

The effects produced by 2, 4, 5-T were similar in all respects to those produced by equivalent amounts of 2, 4-D.

Zytron, at the 10 pound dosage rate, had not produced any toxic effects after 33 days. Rates of 15 and 20 pounds of this compound, however, had caused some retardation of the growth of all grass species. All of the zytron plots were dark green in color and no selective tolerance between species could be observed.

All grasses treated with endothal and the derivative TD 62 had recovered after 33 days, from the injury observed 7 days after treatment. However, the endothal derivative TD 47 appeared to have a more persistent toxicity and caused some stunting of the turf grasses.

All plots were examined and rated again on October 1, 1960, seventy days after the initial herbicidal applications. The ratings, in Table 3, are not essentially different from those made 33 days after treatment. They did indicate, however, that Seaside bentgrass has less ability to recover from the herbicide used in these trials than does Highland bentgrass.

Plots treated with zytron, endothal, and the two endothal derivatives appeared to have made complete recovery and no reduction in stand of any grass species was observed.

Red fescue was almost completely destroyed in plots treated with 2, 4-D; 2, 4, 5-T and 2, 4, 5-TP. Some bentgrass was present in all these plots and the amount of Highland bentgrass was greater than that of Seaside bentgrass. Both types of bluegrass appeared to have made complete recovery from any injury.

Table 3. Ratings of Grass Species, Based on Visual Observations, 70 Days After Application of Herbicides.

	Seaside bentgrass.				Highland bentgrass.			
Treatment	Red fescue	Merion bluegrass	Kentucky bluegrass	Seaside bentgrass	Red fescue	Merion bluegrass	Kentucky bluegrass	Highland bentgrass
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	10.0	7.0	5.5	9.0	9.0	6.0	6.0	6.5
5	0	0	0	2.5	0	0	0	3.5
6	0	0	0	2.0	0	0	0	0
7	0	0	0	2.0	0	0	0	0
8	7.5	1.0	1.0	4.5	4.0	2.0	2.0	5.0
9	7.0	0	0	6.5	5.0	0	0	5.5
10	9.0	0	0	8.5	7.0	0	0	8.5
11	4.5	1.0	1.0	4.5	6.5	1.5	2.5	5.5
12-check	0	0	0	0	0	0	0	0

0 -- No effect

10 -- Complete kill

Observations Nine Months After Treatment

Examination of the plots in June 1961 led to the conclusion that the grass species were approaching stabilization and that reasonable estimates of the ultimate effects of the herbicial applications could be made. Quantitative data were obtained by random selection of three areas each one square foot in extent, and estimating the relative portions of these areas occupied by bentgrass. The extent of bare soil was estimated in the same manner. These data, for all treatments, are presented in Table 4.

The data show that none of the herbicides killed all the bentgrasses and that all except 2, 4, 5-TP, have seriously affected the ability of red fescue to retard the rate of invasion by bentgrasses. The data also indicate that Seaside bentgrass spreads at a more rapid rate than does Highland bentgrass. There are no important differences between the rate of invasion in Merion and Kentucky bluegrasses.

Endothal, 2, 4-D and 2, 4, 5-TP caused significant reduction in the growth of Seaside bentgrass but had lesser effects upon Highland bentgrass.

The relatively small amounts of bare soil found was considered as an indication that, except in the red fescue plots, the herbicides had not reduced the stand of turf grass to any considerably extent.

Observations Fifteen Months After Treatment

In November 1961, fifteen months after the herbicides were applied, final evaluation of the effects of herbicidal treatments

Table 4. Percent of Bentgrasses and of Bare Soil in Turf Treated with Herbicides

15 Months After Treatment.

			Red Fescue		Merion Bluegrass		Kentucky Bluegrass		Red Fescue		Merion Bluegrass		Kentucky Bluegrass	
Plot	Herbicide	lbs./A	Seaside bentgrass	bare soil	Seaside bentgrass	bare soil	Seaside bentgrass	bare soil	Highland bentgrass	bare soil	Highland bentgrass	bare soil	Highland bentgrass	bare soil
1	Zytron	10	79.4	12.5	50.0	5.0	50.0	3.0	38.0	0.0	10.0	0.0	9.0	0.0
2	Zytron	15	82.6	20.0	50.0	3.0	50.0	3.0	18.5	3.0	9.0	2.0	9.0	4.0
3	Zytron	20	95.0	10.0	50.0	4.0	52.5	4.5	51.0	5.0	11.0	5.0	15.5	5.0
4	Dalapon-silvex	9.5-2.5	97.3	4.5	12.0	6.0	11.5	6.0	90.0	5.5	12.5	6.0	10.0	5.0
5	TD 47	3	57.5	0.0	50.0	0.0	50.0	0.0	51.5	0.0	5.0	0.0	6.0	0.0
6	TD 62	3	65.0	0.0	50.0	0.0	23.0	7.0	50.0	0.0	9.5	0.0	8.0	0.0
7	Endothal	8	72.0	1.5	4.0	5.0	49.5	6.5	75.0	0.0	9.5	0.0	9.0	0.0
8	2,4-D ester	2.7	68.0	13.5	1.5	1.5	10.5	5.0	62.0	0.0	12.0	0.0	10.0	0.0
9	2,4,5-T	2	60.0	27.5	10.0	1.5	23.0	3.5	71.0	0.0	5.5	0.0	8.0	0.0
10	2,4,5-TP	2	4.0	40.0	0.5	0.0	2.5	0.0	50.0	1.0	6.0	2.0	7.0	0.0
11	2,4-D ester	2	30.0	17.5	7.0	2.0	10.0	3.5	50.0	0.0	11.5	0.0	11.0	0.0
12	No treatment	---	50.0	5.0	13.0	0.0	10.0	8.0	50.0	0.0	5.0	0.0	6.0	0.0

on all grass species was made. For this purpose a line transect, 100 inches in length was made diagonally across each of the plots, and the number of inches in which each species occurred was determined. Frequency of occurrence of a species in the inch units is a measure of the distribution of the various species and variations in distribution are attributed to the effects of the various herbicidal applications upon growth of the five kinds of grasses. The relative frequencies of all species are shown in Table 5.

At the time of final evaluation, there were no plots in which bentgrass had been eliminated and no evidence of residual toxicity from herbicides could be observed. Effects of herbicides on the stand of turf grasses were visible but recovery of the bluegrasses was completed.

Differences in growth habit of the two types of bentgrass were shown by the more frequent appearance of Seaside bentgrass in all plots where this grass was seeded than that of Highland bentgrass in the portion seeded to the latter type.

Plots in which severe injury had followed application of the herbicides generally were heavily infested with bentgrass. Other grass species had made reasonable recovery and had formed satisfactory turf.

Best control of bentgrasses was obtained in the plots treated with 2, 4, 5-TP, and 2, 4, 5-T. Neither of these compounds caused permanent reduction in the stand of bluegrass but did reduce the apparent stand of red fescue in half of the plots.

Table 5. Relative Distribution of Each Grass Species 15 Months After Application of Herbicides. No. of Inches in Which Each Species Occurred.

	Seaside Bentgrass.						Highland Bentgrass.					
Treatment	Red fescue	Bentgrass	Merion Bluegrass	Bentgrass	Kentucky Bluegrass	Bentgrass	Red fescue	Bentgrass	Merion Bluegrass	Bentgrass	Kentucky Bluegrass	Bentgrass
1	5.5	100	100	97.5	100	96.0	68.5	70.5	100	63.5	100	69.0
2	12.0	100	100	95.0	100	94.0	90.5	61.0	100	50.5	100	57.5
3	15.0	99.5	100	100	100	99.0	63.0	79.5	100	51.0	100	65.5
4	6.5	100	100	79.0	100	71.0	44.5	90.5	100	54.5	100	55.5
5	45.0	100	100	92.5	100	89.0	75.0	89.0	100	62.5	100	59.5
6	61.0	98.5	100	96.5	100	95.5	76.5	90.0	100	60.0	100	53.5
7	31.5	100	100	95.5	100	86.5	79.0	100	100	57.0	100	68.5
8	47.5	95	100	22.5	100	53.0	20.0	100	100	67.0	100	69.0
9	72.5	80.5	100	61.0	100	58.5	27.5	100	100	44.0	100	60.0
10	92.0	40.0	100	21.5	100	18.0	59.5	48.0	100	23.0	100	36.0
11	72.5	81.0	100	68.0	100	63.5	45.0	100	100	64.0	100	76.5
12-check	47.5	100	100	95.0	100	91.5	78.6	83.0	100	73.0	100	64.5

Seaside bentgrass had made full recovery in plots treated with zytron, dalapon-silvex, endothal, and the derivatives of endothal. Highland bentgrass had not made complete recovery in either of the bluegrass species.

The results observed in the 2, 4-D plots were variable and not consistent with the dosage applied.

DISCUSSION

The chemical treatments were applied in this experiment before the bentgrass had established definite clumps or patches. The bentgrass plants were, therefore, partially protected from sprays by the leaves of other species.

Results obtained in this experiment indicated that if a herbicide did not kill bentgrass but depressed the vigor of desirable turf grasses, then, as a result of reduced competition, bentgrass quickly occupied the area. Bluegrass appeared to possess much greater capacity to resist bentgrass invasion and greater herbicide tolerance range than did red fescue.

None of the herbicides permanently reduced the stand of the bluegrass species. Red fescue and the bentgrasses were about equally susceptible to the herbicides used, but there was a wide difference in stand restoration capacity. The bentgrasses were markedly more aggressive in restoring the stand and subsequently spreading than was fescue.

The fact was noted that the bare ground, which occurred in the red fescue plots as a result of the action of herbicides, was quickly occupied by bentgrass plants. A notable exception occurred in the 2, 4, 5-TP plots. The bare areas in these plots remained mostly devoid of any growth until the second season. Growth of scattered red fescue and bentgrass clumps tended to fill the bare spots and form a solid cover of vegetation.

2, 4, 5-TP was the most effective herbicide in controlling bentgrass. Although growth of red fescue was seriously reduced, bentgrass growth was likewise reduced, and in this instance the bentgrass did not progress toward domination as it did in all of the other treatments to which bentgrass was susceptible.

The results obtained in this study show clearly that there are wide variations in the responses of turf grass species to herbicides. The data also point to the great capacity of grasses to recover from injury to top growth as well as to the lack of systemic effects of growth regulating compounds on grasses. Red fescue, in these trials, was more susceptible to chemical injury than was any of the other grasses. Kentucky and Merion bluegrasses were not injured by most of the herbicides and also showed considerable ability to compete successfully with bentgrass.

While none of the herbicides eliminated bentgrass, some of them produced sufficient effect to suggest a possible way to bring bentgrass under control. The limited injury to bluegrass by 2, 4, 5-TP, suggests that this herbicide might be utilized in a program of repeated applications, during two growing seasons, and perhaps lead to complete destruction of bentgrass in the treated area.

The data presented in this report are not sufficient to permit one to propose a method for general use but they do indicate a need for additional research along the lines followed in this study. Combinations of herbicides, repeated applications, alternate applications of two or more herbicides, etc., appear to be types of investigations which could lead to the development of a control program for bentgrass in turf.

SUMMARY

Turf plots of Kentucky bluegrass, Merion bluegrass and red fescue were overseeded with either Seaside or Highland bentgrass in order to provide a bentgrass infestation somewhat similar to that which often develops in lawn turf.

Eight herbicides, selected for their known effects upon grasses, were applied in an attempt to control bentgrass selectively in the other turf grasses.

All grass species were injured by the herbicides, but the two bluegrass types made rapid recovery and no permanent injury was observed.

Red fescue was injured more severely than any of the other species. This effect was shown by actual killing of fescue plants and by the failure of plants which survived to form a turf in the plots.

Both types of bentgrass were severely injured by all herbicides except zytron. None of the herbicides killed all the bentgrass.

Seaside bentgrass was injured more severely, recovered more quickly, and spread more profusely in the other grasses than did Highland bentgrass. The recovery and propagation capabilities of Seaside bentgrass are due to its characteristic production of creeping stems that develop roots and stems at every node, whereas Highland bentgrass is a tufted-type grass with few creeping stems and rhizomes.

The herbicide 2, 4, 5-TP was the most effective material for the control of bentgrass and did not cause permanent damage to bluegrass.

Ester formulations of 2, 4-D and 2, 4, 5-T caused temporary suppression of bentgrass but the effects were scarcely visible at the end of the second growing season.

The possibility of developing a control program for bentgrass, based on repeated applications of 2, 4, 5-TP is suggested.

Results obtained in this study emphasize the need for additional research in this field and suggestions for certain lines of approach are made.

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