CHEMICAL CONTROL OF CRABGRASS, (DIGITARIA SANGUINALIS (L.) SCOP.)

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INTRODUCTION

Crabgrass, Digitaria sanguinalis, (L.) Scop. is the most troublesome annual grassy weed found in summer planted crops in Oklahoma. It is also a pest in vegetable gardening and by far the most troublesome plant in lawns. Crabgrass has three characteristics which make it rather difficult to control after it becomes established (25).[1] These characteristics are as follows: one, it grows rapidly; two, it can reestablish itself and grow if only one tiny root is left in the ground; and, third, it has the ability to root at the lower nodes, which can make a rather large plant. Crabgrass will germinate throughout the growing season which is another reason why this plant is a serious problem in cultivated crops, lawns, and other areas.

If crabgrass could be killed by the time of crop emergence, competition for the young crop seedlings would be eliminated. During dry weather it usually can be controlled by cultivation. Crabgrass becomes a problem when wet weather occurs soon after the crop is planted. These moist conditions prevent the use of machinery in the field and allow the grass to become established. In cultivated crops

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[1] Figures in parentheses refer to Literature Cited.

under these conditions, the only way to control it is by hoeing, which is rather costly.

Pre-emergence herbicides have been used successfully for weed control in several crops. Complete control of both broadleaf and grassy weeds has been obtained with some of these pre-emerge herbicides. Many of these pre-emergents are selective herbicides. The crop that is grown as well as the weeds that are to be controlled determine which one should be used. A chemical that can be used safely on one crop may be harmful to another. Recommended rates of application of these pre-emergence herbicides have not been worked out completely for all situations.

The purpose of this experiment was to evaluate 11 pre-emerge chemicals, applied at three rates, for the control of crabgrass.

REVIEW OF LITERATURE

Crabgrass will germinate throughout the growing season. Gianfagna and Pridham (16) suggest that the continued germination of crabgrass may be due to a continued renewal of the seed supply in the germination zone by erosion and abrasive action of heavy rains or cultivation equipment. This, however, does not account for the continued germination of crabgrass in lawns or other non-cultivated areas where there is very little erosion. Toole and Toole (27) in preliminary test of freshly harvested crabgrass seed have found that the seed would remain dormant for several weeks with practically no germination under conditions ordinarily favorable for germination, but when germination finally started, it progressed steadily, although slowly, until practically all (95 to 98 percent) of the viable seed had germinated, which required several months. Crabgrass is a prolific seed producer; therefore, this dormancy period and slow germination over a long period of time would mean an abundance of seed in the soil at all times.

Many selective herbicides have been placed on the market for the control of annual weeds in various crops during the past few years. Several of these herbicides have given excellent results when tested and are recommended over conventional methods for weed control. Herbicides which do very little damage to the crop and give good control of both broadleaf and grassy weeds are more desirable. Some of these herbicides, however, have given varied results at different locations under different climatic conditions.

Work done by Hurtt, Meade, and Santelmann (19) indicates alanap-3 varied in its effect upon grasses from one location to another. These workers reported that alanap-3 and CDAA were relatively ineffective in controlling crabgrass at Upper Marlboro, Maryland, in 1956. At Linkwood, Maryland, in 1956 they reported very good control of grasses with two and four pounds of alanap-3 per acre. McRae, Hamilton, and Arle (22) reported that applications of three and six pounds of alanap-3 per acre before grass seedlings emerged gave excellent control of annual grasses for six to eight weeks. In their study, alanap-3 was more successful in the control of annual grasses than broadleaved weeds. Slife, Williams, and Gantz (23) reported pre-emergence applications of six pounds of alanap-3 per acre gave 95 percent control of both broadleaf and grassy weeds. They received 100 percent control with nine and ten pound rates of alanap-3.

A pre-emergent study by Bartley (2) shows that one pound of simazin per acre gave 99 percent control of broadleaved weeds and 86 percent control of grassy weeds for ten weeks. In the same study two pounds of simazin yielded 100 and 96 percent control, respectively, of broadleaf and grassy weeds. Complete control of annual grasses was obtained by

Chilcote, Furtick, and Fore (8) using three and six pounds of simazin per acre. One replication of six pounds of simazin per acre, without cultivation, remained weed free all season. Fletchall (14) has shown that two pounds of simazin per acre applied as a pre-emergent without cultivation gave virtually 100 percent weed control in corn. Campbell and Quinlan (7) found two and four pounds of simazin per acre killed all vegetation in plots to which it was applied in a study on crabgrass control in bluegrass. Campbell (6) found three weeks after pre-emergent spray applications that one and two pounds of simazin, four pounds of neburon, and one and one-half gallons of 3Y9 per acre gave 100 percent, 100 percent, 98 percent, and 94 percent reductions in crabgrass yields, respectively.

Talbert and Fletchall (26) reported that two and four pounds of neburon per acre were very effective in early weed control. Four pounds of neburon per acre was necessary to give satisfactory control all season without cultivation. One pound of neburon per acre reduced weed yields about 40 percent; two pounds, 70 percent; and four pounds, 88 percent, as compared with the uncultivated check plot. In these studies, they found four pounds of neburon per acre to be about equal to three cultivations. Neburon was found to be slightly more effective on broadleaf weeds than on grasses. Wolf and co-workers (30) have found weed control efficiency with neburon is correlated with soil type. These workers reported that, when adequate moisture was present, two pounds of neburon per acre gave good control of annual weeds on sandy loam soils. Four pounds of neburon per acre was required for six to eight weeks control on clay loams.

Davis (9) reported six pounds of "pre-emerge" (dinitro-o-secondary butylphenol) per acre gave moderate to satisfactory control of broadleaf weeds and annual grasses in rice. The four pound rate of "pre-emerge" gave poor weed control in this study. Burt (5) has shown in a pre-emergence weed control study on peanuts that six and nine pounds of DNBP per acre gave very good to excellent control of weeds with apparently no damage to peanuts. Hurtt, Meade, and Santlemann (19) reported DNBP to be rather erratic; however, rates of six or seven pounds per acre gave fair results. Witherspoon and Rodgers (29) have found pre-emergence treatments of six, seven and one-half, and nine pounds of "pre-emerge," DNBP, per acre provided satisfactory control for three to five weeks. After this period of time, severe infestations of annual weeds occurred rapidly. This was particularly true of Florida pursley (Richardis scabra) and crabgrass (Digitaria sanguinalis). At the end of eight weeks, little difference could be observed between the check and the treated plots.

Eight pounds of CDAA per acre gave 60 percent control of broadleaf weeds and 100 percent control of weedy grasses in a pre-emergence herbicide screening test by Marshal, Bayer, and Robinson (20). Burt (5) reported four, eight, and 12 pounds of CDAA, and one-half and one pound of "karmex" dw per acre, when used as pre-emergence herbicides, gave excellent weed control with little or no injury to peanuts. Pre-emergence applications of both four and eight pounds of CDAA per acre gave good weed control with no significant effect on the yield of corn in an experiment by Bayer and Buchholtz (3). In a study by Hurtt, Meade, and Santlemann (19) at Upper Marlboro, Maryland, in 1955, three and six pounds of CDAA per acre completely killed the weeds without harming soybeans. The next year, at the same location, CDAA at three weeks caused moderate to severe injury to grasses, but little or no injury was recorded at nine weeks. Four and six pounds of CDAA per acre, applied as a pre-emergent spray, on a sandy soil failed to control crabgrass, _Digitaria sanguinalis_, in a study by Warren (28). Maxwell (21) reported rates of three to six pounds of CDAA per acre to be effective in weed control and remain herbicidally active for four to six weeks depending upon soil and seasonal conditions.

In a study by Hamilton (17), pre-emerge applications of diruon gave the most satisfactory control of crabgrass. Control for the entire season was obtained with applications of one and one-fourth to two and one-half pounds of diuron applied in March. Monuron and neburon applied in March controlled crabgrass only until June. Two and four pounds of monuron and diuron per acre destroyed all annual grasses and increased yields of smooth bromegrass in an experiment by Elder (11).

Atrazine was the most effective treatment used by Friesen (15) in a pre-emergence study on corn. No weeds survived the lowest treatment, which was one pound of atrazine per acre. Simazin also gave good control of all weeds with the exception of wild oats, which were controlled at rates above two pounds per acre. EPTC gave excellent control of wild oats but only fair control of other weeds.

Elder (12) reported four and eight pounds of EPTC per acre, applied immediately after planting, eliminated crab-grass and fall panicum for the entire season with only a slight reduction in the stand of alfalfa from the higher rate. In another study (13), he found eight pounds of EPTC per acre gave poor control of crabgrass, prairie cupgrass, and *Eragrostis* spp. Pre-emergence applications of eight and 12 pounds of EPTC per acre gave fair to excellent control of crabgrass, barnyard grass, fall panicum, and stinkgrass in a study by Hollingsworth (18).

Applications of four, six, and 12 pounds of endothol per acre gave fair weed control (50 percent reduction in stand) when incorporated in the soil without any effect on sugar beets. In this study Branden, Switzer, and Jones (4) reported both EPTC and endothol appear to be more effective herbicides when incorporated with the soil than when used as a standard pre-emergence application.

MATERIALS AND METHODS

A pre-emergent herbicide study for the control of crabgrass, *Digitaria sanguinalis*, was conducted on the Oklahoma Agronomy Research Station at Stillwater. This experiment was carried out on a Port loamy soil, located in the bottom, west of the Agronomy farm office. A seed bed was prepared on June 15 by disking and harrowing, and crabgrass seed was broadcast with a Gandy spreader. Then rows one foot apart were marked off, and crabgrass seed was planted in the rows with a one row planter. The purpose of both broadcasting and planting in the row was to obtain a more even distribution of crabgrass and an added assurance of getting a stand.

Applications of the chemicals were made the following day after the crabgrass was planted. All herbicides were applied with a two and one-half gallon knapsack sprayer equipped with a one foot boom, with an 80015E Teejet nozzle at each end. The nozzle at each end of the boom was held directly above a row during application. The spray pattern of each nozzle covered the row directly below it and six inches on either side. This made a total of two feet covered in one swath by the sprayer. All chemicals were applied in water at the equivalent rate of 40 gallons per acre with an air pressure of 30 pounds per square inch.

Chemicals used in this study and rates of application are listed in Table I.

The soil was moist at the time of planting, and conditions were excellent for the growth of crabgrass during the study. On June 16, 17, and 18, one-third of an inch of water was applied by sprinkler irrigation to prevent the soil from drying on top, which would keep the crabgrass seed from germinating. Rainfall, on two dates, totaling approximately two inches fell after planting and before the first count was made. Between June 30 and July 13, the dates of the first and second counts, respectively, rainfall on two dates totaling approximately one inch occurred.

A randomized block design was used in this study with four replications for all treatments. Plots consisted of four rows, ten feet long and one foot apart, with a two foot alley between replications. Random counts of crabgrass and broadleaf weeds were made from four square feet of each of the inside rows of each plot. Due to the possibility of herbicide drift during application, only the two inside rows of each plot were used for making counts. These counts were made using a one foot by four foot quadrat, on June 30 and July 13, and observation notes were taken at the same time.

Analysis of variance and multiple range tests, described by Snedecor (24) and Duncan (10), were made on both grass counts and the differences between the two counts.

TABLE I

Chemicals Used and Rates of Applications

Designation	Chemical Name	Rates of Applications*		
		Low	Medium	High
CDAA	2-chloro-N, N-diallylacetamide	2	4	6
Diuron	3-(3,4-dichlorophenyl)-1,1-dimethylurea	1/2	1	2
Monuron	3-(p-chlorophenyl)-1,1-dimethylurea	1/2	1	2
NPA	N-1-naphthylpthalamic acid	2	4	6
Falone	tris(2,4-dichlorophenoxyethyl) phosphite	2	4	6
EPTC	ethyl N, N-di-*n*-propylthiolcarbamate	1	2	4
Simazin	2-chloro-4,6-bis(ethylamino)-*s*-triazine	1/2	1	2
DNBP	4,6-dinitro *o* secondary butylphenol	3	6	9
Atrazine	2-chloro-4-ethylamino-6-isopropyl-amino-s-triazine	1/2	1	2
Neburon	1-*n*-butyl-3-(3,4-dichlorophenyl)-1-methylurea	2	4	6
Endothol	3,6-endoxohexahydrophthallic acid	1	2	4

*All rates of application are expressed in pounds of active material per acre.

RESULTS AND DISCUSSION

In this experiment, data were transformed to a logarithmic scale for statistical analysis because it is felt that high counts have a high variation, and logarithms tend to equalize these variances. Bartlett (1) states that the conditions required for assessing accuracy in the ordinary unweighted analysis of variance include the important one of constant residual or error variance, and if the variance tends to change with the mean level of measurements, the variance will only be stabilized by a suitable change in scale. The transformation Y = log (x + 1), where x is the grass count, appeared to be the most logical.

The chemicals had different effects on the grass counts. The analysis of variance, Appendix Tables I, II, and III, on count 1, count 2, and the differences in the counts showed these effects to be significant at the one percent level.

In general, as the rates of application increased, the crabgrass count decreased (Tables II and III). Four pounds of NPA and four pounds of CDAA per acre were the only treatments on July 13 that had a higher grass count than the two pound rate of each of these chemicals, but the differences were not significant. The mean of the untreated check plot ranked last in the June 30 grass count and next to last in the July 13 count.

TABLE II

Multiple Range Test of June 30 Crabgrass Count

Treatments lbs. Active Material per Acre	Mean log (count + 1)	Multiple Range [X]
6# Neburon	.0000	
1# Simazin	.1193	
2# Simazin	.1748	
2# Diuron	.1748	
1# Diuron	.4005	
2# Atrazine	.4005	
4# Neburon	.5440	
2# Monuron	.6831	
1# Monuron	.8354	
4# EPTC	.8451	
6# Falone	.8779	
1# Atrazine	.9408	
4# Falone	1.0199	
6# NPA	1.2353	
½# Simazin	1.3477	
2# EPTC	1.3846	
2# Falone	1.4250	
2# Neburon	1.5099	
9# DNBP	1.6146	
6# DNBP	1.6944	
½# Monuron	1.7376	
4# NPA	1.7450	
1# EPTC	1.7872	
2# NPA	1.8505	
½# Atrazine	1.8844	
6# CDAA	1.9805	
½# Diuron	1.9912	
4# Endothol	2.0180	
2# Endothol	2.2546	
4# CDAA	2.2577	
2# CDAA	2.2694	
1# Endothol	2.4529	
3# DNBP	2.4863	
Check	2.5121	

[X] Any two means connected by the same line are not significantly different at the five percent level.

TABLE III

Multiple Range Test of July 13 Crabgrass Count

Treatments lbs. Active Material per Acre	Mean log (count + 1)	Multiple Range /X
2# Simazin	.0000	
2# Atrazine	.0000	
6# Neburon	.0000	
1# Simazin	.0753	
2# Diuron	.1945	
1# Diuron	.4247	
1# Atrazine	.4956	
4# Neburon	.5123	
2# Monuron	.5268	
1# Monuron	.8904	
4# EPTC	1.1027	
½# Simazin	1.1693	
6# NPA	1.3546	
2# EPTC	1.4298	
6# Falone	1.4819	
2# Neburon	1.4996	
½# Monuron	1.5055	
9# DNBP	1.5115	
4# Falone	1.6158	
2# Falone	1.6658	
½# Atrazine	1.6875	
2# NPA	1.7216	
4# NPA	1.7819	
½# Diuron	1.7972	
1# EPTC	1.8292	
6# CDAA	1.8778	
4# Endothol	1.9434	
2# CDAA	1.9509	
4# CDAA	1.9793	
6# DNBP	2.0398	
2# Endothol	2.0457	
1# Endothol	2.1649	
Check	2.2157	
3# DNBP	2.2187	

/X Any two means connected by the same line are not significantly different at the five percent level.

TABLE IV

Multiple Range Test of July 13 Crabgrass Count
Minus June 30 Crabgrass Count

Treatments lbs. Active Material per Acre	Mean log (count + 1)	Multiple Range [X]				
		A	B	C	D	E
1# Atrazine	-.4452					x
2# Atrazine	-.4005				x	x
2# CDAA	-.3185				x	x
Check	-.2964			x	x	x
1# Endothol	-.2880			x	x	x
4# CDAA	-.2785			x	x	x
3# DNBP	-.2675			x	x	x
½# Monuron	-.2311			x	x	x
2# Endothol	-.2089		x	x	x	x
½# Atrazine	-.1969		x	x	x	x
½# Diuron	-.1941		x	x	x	x
½# Simazin	-.1785		x	x	x	x
2# Simazin	-.1748		x	x	x	x
2# Monuron	-.1563		x	x	x	x
2# NPA	-.1289		x	x	x	x
9# DNBP	-.1031		x	x	x	x
6# CDAA	-.1027		x	x	x	x
4# Endothol	-.0746		x	x	x	x
1# Simazin	-.0440		x	x	x	x
4# Neburon	-.0317		x	x	x	x
2# Neburon	-.0103		x	x	x	x
6# Neburon	.0000		x	x	x	x
2# Diuron	.0198		x	x	x	x
1# Diuron	.0242		x	x	x	x
4# NPA	.0320		x	x	x	x
1# EPTC	.0420		x	x	x	x
2# EPTC	.0452		x	x	x	x
1# Monuron	.0550	x	x	x	x	x
6# NPA	.1193	x	x	x	x	
2# Falone	.2409	x	x	x		
4# EPTC	.2576	x	x	x		
6# DNBP	.3454	x	x			
4# Falone	.5959	x				
6# Falone	.6040	x				

[X] Any two means connected by the same line are not significantly different at the five percent level.

Plots treated with two, four, and six pounds of Falone, six pounds of NPA, four pounds of EPTC, and six pounds of DNBP per acre showed an increase of more than 31 percent in number of crabgrass plants from the first to second count. This indicates that the herbicides remained in the soil for only a short period of time and when they were gone the crabgrass was able to germinate and grow.

In general, there tended to be a greater reduction in numbers of crabgrass plants in plots treated with the lighter rates as compared with the medium and high rates (Figures 1 and 2). In most cases, however, these differences were not significant. This reduction in numbers in plots treated with light application rates may be due to several factors. These plots had a large crabgrass population, and competition between plants may have eliminated some of the weaker grasses. This is indicated by a reduction in numbers of grass plants in the check plot from the first to second count. The reduction in numbers may be attributed to errors which may have been made when making the second grass count. Crabgrass plants were branched at the base at this time which made it difficult to distinguish between a branch and an entire plant in those plots with large numbers of grasses.

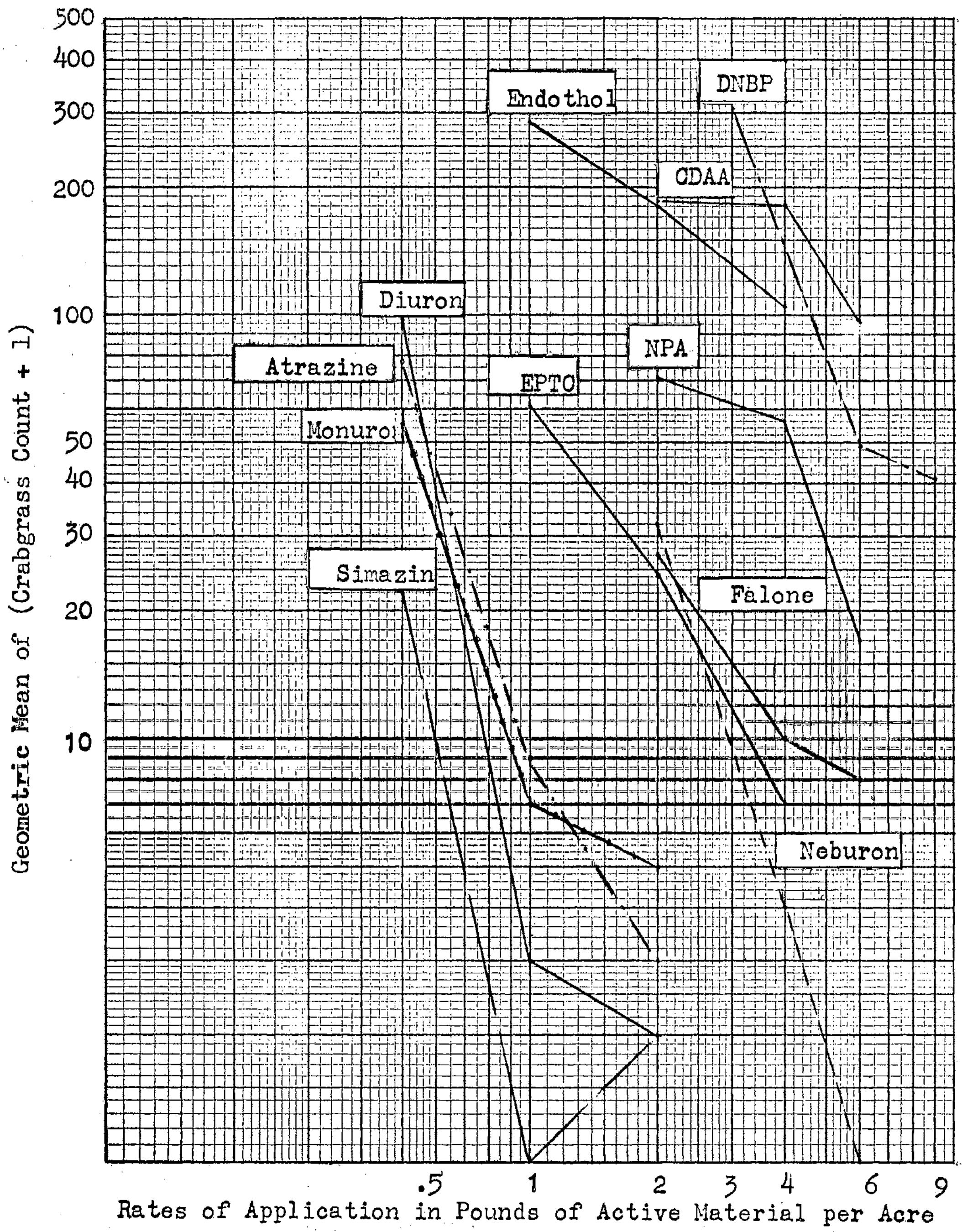

Figure 1. Relationship of rate of application of herbicides and the geometric mean (number of plants in plots + 1) on June 30.

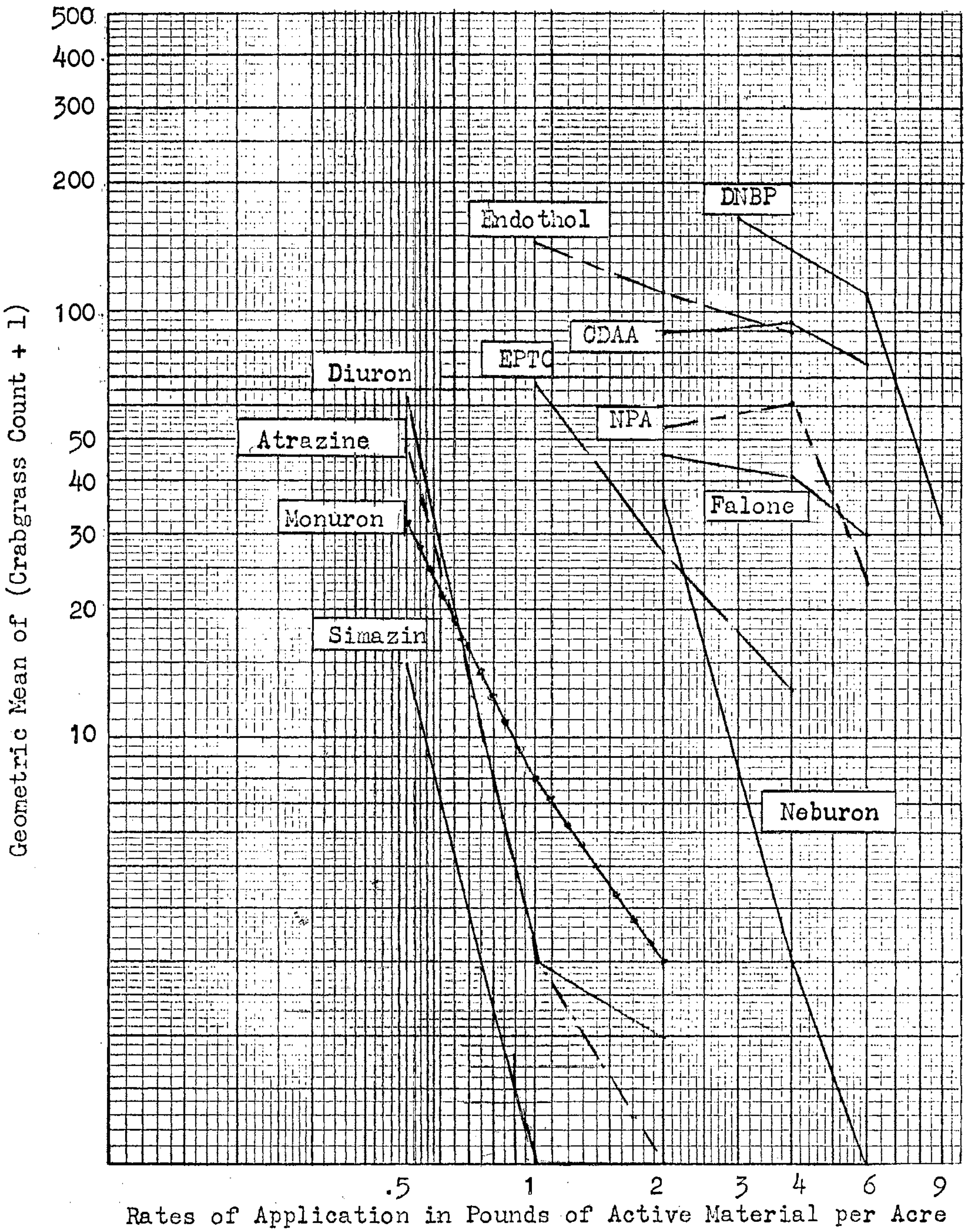

Figure 2. Relationship of rate of application of herbicides and the geometric mean (number of plants in plots + 1) on July 13.

Table II shows that the treatments giving the best control of crabgrass on June 30 were six pounds of neburon, one and two pounds of simazin, one and two pounds of diuron, two pounds of atrazine, four pounds of neburon, and two pounds of monuron per acre. One and two pounds of simazin, one and two pounds of diuron, two pounds of atrazine, and six pounds of neburon gave the best results in the second count (Table III). When the second count was made on July 13, plots treated with six pounds of neburon, two pounds of simazin, and two pounds of atrazine per acre were entirely free of both crabgrass and broadleaf weeds. One pound of simazin and two pounds of diuron per acre gave complete control of broadleaf weeds but allowed a few crabgrass plants to grow. In this experiment, one pound of atrazine, four pounds of neburon, one pound of monuron, four pounds of EPTC, and one-half pound of simazin per acre also gave satisfactory control. One-half pound of simazin per acre gave better results than the low rate of any other herbicide in this study (Figures 1 and 2). There were no significant differences between the untreated check plot and three and six pounds of DNBP, one, two, and four pounds of endothol, two, four, and six pounds of CDAA, one pound of EPTC, one-half pound of diuron, and two and four pounds of NPA per acre (Table III).

Tables II and III and Figures 1 and 2 indicate the control given by most of the herbicides. There were two herbicides, NPA and endothol, which did not kill the crabgrass but inhibited its growth. The grass plants in plots treated with all three rates of NPA had leaves curled at the edges. They were also small and had a bluish color. The effect of this chemical seemed to be more severe at the six pound rate. Plants in plots treated with NPA were much smaller than the check but had begun to grow about the time the second count was made. Plots treated with NPA had very few crabgrass plants in the middles between rows. This seems to indicate this chemical killed nearly all plants except those planted in rows. Crabgrass seeds germinating on the surface of the ground may have come in contact with the herbicide and were killed, while those planted in rows were below the surface and did not come in contact with the herbicide until later. Four pounds of endothol also inhibited the growth of crabgrass. On July 13, grass plants in plots having this treatment looked normal but were only about half as large as plants in the check plot.

SUMMARY

A pre-emergence herbicide study was conducted on a Port loamy soil at the Agronomy Research Station at Stillwater, Oklahoma. The purpose of the study was to evaluate 11 pre-emerge herbicides, applied at three rates, for the control of crabgrass.

Conditions were excellent for growth of crabgrass during the study. The soil was moist when the crabgrass seed was planted, but supplemental irrigation was used to prevent the soil from drying out on the surface.

A randomized block design was used with four replications for all treatments. Plots consisted of four rows, ten feet long and one foot apart. Random counts of crabgrass seedlings and broadleaf weeds were made from four square feet of each of the inside rows of each plot on June 30 and July 13.

Data were transformed to a logarithmic scale for statistical analysis. The transformation $Y = \log (x + 1)$, where x is the grass count, was used. Analysis of variance tables show significant difference in treatments at the one percent level on the first and second grass counts and the difference between the two counts.

There were no significant differences among the untreated check plot and three and six pounds of DNBP, one,

two, and four pounds of endothol, two, four, and six pounds of CDAA, one pound of EPTC, one-half pound of diuron, and two and four pounds of NPA per acre (Table III).

NPA at all three rates of application and four pounds of endothol per acre inhibited the growth of crabgrass. The leaves of crabgrass plants in plots treated with NPA were bluish in color and were curled at the edges. This effect seemed to be more severe at the six pound rate. NPA also seems to have killed almost all of the grass plants growing in the middles.

In this study it appears that one pound of simazin and one pound of diuron per acre controlled crabgrass as well as the two pound rates of each of these herbicides. Treatments giving the best control of crabgrass on June 30 were six pounds of neburon, one and two pounds of simazin, one and two pounds of diuron, two pounds of atrazine, four pounds of neburon, and two pounds of monuron per acre. One and two pounds of simazin, one and two pounds of diuron, two pounds of atrazine, and six pounds of neburon gave the best results on July 13. One pound of atrazine, one pound of monuron, four pounds of EPTC, and one-half pound of simazin per acre also gave satisfactory control in this experiment.

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APPENDIX

APPENDIX TABLE I

ANALYSIS OF VARIANCE OF LOG (CRABGRASS COUNT + 1)
JUNE 30, 1959

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Total	135	93.67708021		
Replications	3	.394624		
Treatments	33	75.499115	2.2878520	12.7364**
Error	99	17.783341	.1796297	

**Indicates significance at the one percent level.

APPENDIX TABLE II

ANALYSIS OF VARIANCE OF LOG (CRABGRASS COUNT + 1)
JULY 13, 1959

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Total	135	76.88420687		
Replications	3	.25801811		
Treatments	33	69.22964939	2.0979	28.0843**
Error	99	7.39653937	.0747	

**Indicates significance at the one percent level.

APPENDIX TABLE III

ANALYSIS OF VARIANCE OF LOG (JULY 13 CRABGRASS COUNT + 1) MINUS LOG OF (JUNE 30 COUNT + 1)

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Total	135	18.06647464		
Replications	3	.06201580		
Treatments	33	7.93682591	.24051	2.365**
Error	99	10.06763293	.10169	

**Indicates significance at the one percent level.

APPENDIX TABLE IV

JUNE 30, 1959, CRABGRASS COUNT*

Treatment	Rep. I	Rep. II	Rep. III	Rep. IV	Sum
2# CDAA	217	145	202	184	748
4# CDAA	154	184	319	116	773
6# CDAA	47	79	169	127	422
½# diuron	135	232	40	70	477
1# diuron	1	19	0	0	20
2# diuron	0	4	0	0	4
½# monuron	111	134	9	58	312
1# monuron	0	60	1	17	78
2# monuron	2	4	11	2	19
2# NPA	124	35	101	54	314
4# NPA	81	65	13	125	284
6# NPA	13	10	26	20	69
2# Falone	8	14	105	34	161
4# Falone	2	5	28	22	57
6# Falone	1	6	7	28	42
1# EPTC	177	18	84	48	327
2# EPTC	163	26	12	5	206
4# EPTC	23	19	4	0	46
½# simazin	8	21	17	68	114
1# simazin	2	0	0	0	2
2# simazin	0	4	0	0	4
3# DNBP	407	299	257	278	1241
6# DNBP	167	204	173	0	544
9# DNBP	33	7	119	87	246
½# atrazine	50	84	155	50	339
1# atrazine	6	5	5	22	38
2# atrazine	0	4	1	3	8
2# neburon	36	31	24	36	127
4# neburon	0	4	2	9	15
6# neburon	0	0	0	0	0
1# endothol	302	332	270	236	1140
2# endothol	184	177	219	143	723
4# endothol	36	123	235	108	502
check	287	392	421	233	1333
Total	2,777	2,746	3,029	2,183	10,735

*Counts taken from eight square feet of each plot.

APPENDIX TABLE V

JULY 13, 1959, CRABGRASS COUNT*

Treatment	Rep. I	Rep. II	Rep. III	Rep. IV	Sum
2# CDAA	96	85	120	62	363
4# CDAA	98	100	152	53	403
6# CDAA	77	64	99	63	303
½# diuron	88	117	29	48	282
1# diuron	0	24	0	1	25
2# diuron	0	2	0	1	3
½# monuron	51	80	6	35	172
1# monuron	2	26	2	14	44
2# monuron	1	3	7	1	12
2# NPA	109	48	33	41	231
4# NPA	73	61	42	67	243
6# NPA	25	15	34	17	91
2# falone	33	42	66	46	187
4# falone	35	31	59	41	166
6# falone	18	29	32	44	123
1# EPTC	188	52	44	45	329
2# EPTC	96	17	24	11	148
4# EPTC	25	9	10	8	52
½# simazin	4	11	17	43	75
1# simazin	0	1	0	0	1
2# simazin	0	0	0	0	0
3# DNBP	187	158	164	151	660
6# DNBP	84	130	101	126	441
9# DNBP	33	7	72	55	167
½# atrazine	27	74	102	25	228
1# atrazine	0	7	1	5	13
2# atrazine	0	0	0	0	0
2# neburon	33	30	26	34	123
4# neburon	0	3	1	13	17
6# neburon	0	0	0	0	0
1# endothol	169	171	136	113	589
2# endothol	124	128	140	66	458
4# endothol	75	141	109	49	374
check	147	218	198	112	675
Total	1,898	1,884	1,826	1,390	6,998

*Counts taken from eight square feet of each plot.

APPENDIX TABLE VI

LOG OF (JUNE 30 CRABGRASS COUNT + 1)*

Treatment	Rep. I	Rep. II	Rep. III	Rep. IV	Sum
2# CDAA	2.3385	2.1643	2.3075	2.2672	9.0775
4# CDAA	2.1903	2.2672	2.5052	2.0682	9.0309
6# CDAA	1.6812	1.9031	2.2304	2.1072	7.9219
½# diuron	2.1335	2.3673	1.6128	1.8513	7.9649
1# diuron	0.3010	1.3010	0.0000	0.0000	1.6020
2# diuron	0.0000	0.6990	0.0000	0.0000	0.6990
½# monuron	2.0492	2.1303	1.0000	1.7708	6.9503
1# monuron	0.0000	1.7854	0.3010	1.2553	3.3417
2# monuron	0.4771	0.6990	1.0792	0.4771	2.7324
2# NPA	2.0969	1.5563	2.0086	1.7403	7.4021
4# NPA	1.9138	1.8195	1.1462	2.1003	6.9798
6# NPA	1.1462	1.0414	1.4314	1.3222	4.9412
2# falone	0.9543	1.1761	2.0253	1.5441	5.6998
4# falone	0.4771	0.7782	1.4624	1.3617	4.0794
6# falone	0.3010	0.8451	0.9031	1.4624	3.5116
1# EPTC	2.2504	1.2787	1.9294	1.6902	7.1487
2# EPTC	2.2149	1.4314	1.1140	0.7782	5.5385
4# EPTC	1.3802	1.3010	0.6990	0.0000	3.3802
½# simazin	0.9543	1.3424	1.2553	1.8389	5.3909
1# simazin	0.4771	0.0000	0.0000	0.0000	0.4771
2# simazin	0.0000	0.6990	0.0000	0.0000	0.6990
3# DNBP	2.6107	2.4771	2.4116	2.4456	9.9450
6# DNBP	2.2253	2.3117	2.2405	0.0000	6.7775
9# DNBP	1.5315	0.9031	2.0792	1.9445	6.4583
½# atrazine	1.7075	1.9294	2.1931	1.7075	7.5375
1# atrazine	0.8451	0.7782	0.7782	1.3617	3.7632
2# atrazine	0.0000	0.6990	0.3010	0.6021	1.6021
2# neburon	1.5682	1.5052	1.3979	1.5682	6.0395
4# neburon	0.0000	0.6990	0.4771	1.0000	2.1761
6# neburon	0.0000	0.0000	0.0000	0.0000	0.0000
1# endothol	2.4814	2.5224	2.4330	2.3747	9.8115
2# endothol	2.2672	2.2504	2.3424	2.1584	9.0184
4# endothol	1.5682	2.0934	2.3729	2.0374	8.0719
check	2.4594	2.5944	2.6253	2.3692	10.0483
Total	44.6015	49.3490	46.6630	45.2047	185.8182

*Counts taken from eight square feet of each plot.

APPENDIX TABLE VII

LOG OF (JULY 13 CRABGRASS COUNT + 1)*

Treatment	Rep. I	Rep. II	Rep. III	Rep. IV	Sum
2# CDAA	1.9868	1.9345	2.0828	1.7993	7.8034
4# CDAA	1.9956	2.0043	2.1847	1.7324	7.9170
6# CDAA	1.8921	1.8129	2.0000	1.8062	7.5112
½# diuron	1.9494	2.0719	1.4771	1.6902	7.1886
1# diuron	0.0000	1.3979	0.0000	0.3010	1.6989
2# diuron	0.0000	0.4771	0.0000	0.3010	0.7781
½# monuron	1.7160	1.9085	0.8451	1.5563	6.0259
1# monuron	0.4771	1.4314	0.4771	1.1761	3.5617
2# monuron	0.3010	0.6021	0.9031	0.3010	2.1072
2# NPA	2.0414	1.6902	1.5315	1.6233	6.8864
4# NPA	1.8692	1.7924	1.6335	1.8325	7.1276
6# NPA	1.4150	1.2041	1.5441	1.2553	5.4185
2# falone	1.5315	1.6335	1.8261	1.6721	6.6632
4# falone	1.5563	1.5052	1.7782	1.6233	6.4630
6# falone	1.2788	1.4771	1.5185	1.6532	5.9276
1# EPTC	2.2765	1.7243	1.6532	1.6628	7.3168
2# EPTC	1.9868	1.2553	1.3979	1.0792	5.7192
4# EPTC	1.4150	1.0000	1.0414	0.9542	4.4106
½# simazin	0.6990	1.0792	1.2553	1.6435	4.6770
1# simazin	0.0000	0.3010	0.0000	0.0000	0.3010
2# simazin	0.0000	0.0000	0.0000	0.0000	0.0000
3# DNBP	2.2742	2.2014	2.2175	2.1818	8.8749
6# DNBP	1.9294	2.1173	2.0086	2.1038	8.1591
9# DNBP	1.5315	0.9031	1.8633	1.7482	6.0461
½# atrazine	1.4472	1.8751	2.0128	1.4150	6.7501
1# atrazine	0.0000	0.9031	0.3010	0.7782	1.9823
2# atrazine	0.0000	0.0000	0.0000	0.0000	0.0000
2# neburon	1.5315	1.4914	1.4314	1.5441	5.9984
4# neburon	0.0000	0.6021	0.3010	1.1461	2.0492
6# neburon	0.0000	0.0000	0.0000	0.0000	0.0000
1# endothol	2.2305	2.2355	2.1367	2.0569	8.6596
2# endothol	2.0969	2.1106	2.1492	1.8261	8.1828
4# endothol	1.8808	2.1523	2.0414	1.6990	6.7735
check	2.1703	2.3404	2.2989	2.0531	8.8627
Total	43.4798	47.2352	43.9114	44.2152	178.8416

*Counts taken from eight square feet of each plot.

APPENDIX TABLE VIII

LOG OF (JULY 13 CRABGRASS COUNT + 1) MINUS THE LOG OF (JUNE 30 COUNT + 1)*

Treatment	Rep. I	Rep. II	Rep. III	Rep. IV	Sum
2# CDAA	-0.3517	-0.2298	-0.2247	-0.4679	-1.2741
4# CDAA	-0.1947	-0.2629	-0.3205	-0.3358	-1.1139
6# CDAA	0.2109	-0.0902	-0.2304	-0.3010	-0.4107
½# diuron	-0.1841	-0.2954	-0.1357	-0.1611	-0.7763
1# diuron	-0.3010	0.0969	0.0000	0.3010	0.0969
2# diuron	0.0000	-0.2219	0.0000	0.3010	0.0791
½# monuron	-0.3332	-0.2218	-0.1549	-0.2145	-0.9244
1# monuron	0.4771	-0.3540	0.1761	-0.0792	0.2200
2# monuron	-0.1761	-0.0969	-9.1761	-0.1761	-0.6252
2# NPA	-0.0555	0.1339	-0.4771	-0.1170	-0.5157
4# NPA	-0.0446	-0.0271	0.4873	-0.2678	0.1478
6# NPA	0.2688	0.1627	0.1127	-0.0669	0.4773
2# falone	0.5772	0.4574	-0.1992	0.1280	0.9634
4# falone	1.0792	0.7270	0.3158	0.2616	2.3836
6# falone	0.9778	0.6320	0.6154	0.1908	2.4160
1# EPTC	0.0261	0.4456	-0.2762	-0.0274	0.1681
2# EPTC	-0.2281	-0.1761	0.2839	0.3010	0.1807
4# EPTC	0.0348	-0.3010	0.3424	0.9542	1.0304
½# simazin	-0.2553	-0.2632	0.0000	-0.1954	-0.7139
1# simazin	-0.4771	0.3010	0.0000	0.0000	-0.1761
2# simazin	0.0000	-0.6990	0.0000	0.0000	-0.6990
3# DNBP	-0.3365	-0.2757	-0.1941	-0.2638	-1.0701
6# DNBP	-0.2959	-0.1944	-0.2319	2.1038	1.3816
9# DNBP	0.0000	0.0000	-0.2159	-0.1963	-0.4122
½# atrazine	-0.2603	-0.0543	-0.1803	-0.2925	-0.7874
1# atrazine	-0.8451	0.1249	-0.4772	-0.5835	-1.7809
2# atrazine	0.0000	-0.6990	-0.3010	-0.6021	-1.6021
2# neburon	-0.0367	-0.0138	0.0335	-0.0241	-0.0411
4# neburon	0.0000	-0.0969	-0.1761	0.1461	-0.1269
6# neburon	0.0000	0.0000	0.0000	0.0000	0.0000
1# endothol	-0.2509	-0.2869	-0.2963	-0.3178	-1.1519
2# endothol	-0.1703	-0.1398	-0.1932	-0.3323	-0.8356
4# endothol	0.3126	0.0589	-0.3315	-0.3384	-0.2984
check	-0.2891	-0.2540	-0.3264	-0.3161	-1.1856
Total	-1.1217	-2.1138	-2.7516	-0.9895	-6.9766

*Counts taken from eight square feet of each plot.

VITA

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