HERBICIDE EVALUATION FOR THE SELECTIVE CONTROL OF SANDBUR IN BERMUDAGRASS TURF

By

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CHAPTER I

INTRODUCTION

Sandbur (Cenchrus pauciflorus Benth.) has been a menace to bermudagrass turf for many years. This semi-decumbent annual grass is adapted to sandy soils and is predominant in areas in which the desired turf has deteriorated due to improper maintenance.

Areas such as parks, highway rest areas, lawns, athletic fields, and other recreational areas are severely damaged, in regard to utilization and appearance, due to the spiny burs that are produced by this plant. These burs contain one to three seeds, usually two, and aid in the dissemination and protection of the enclosed seeds. The plant stems vary in length from six to eighteen inches and will form a mat-like growth when subjected to mechanical mowing.

The plants undesirable appearance and spiny burs, which are harmful to animals as well as humans, makes it imperative that this plant be controlled in areas that are utilized for recreational or general turf purposes.

CHAPTER II

LITERATURE REVIEW

Efforts to control the sandbur plant, either by mechanical or chemical means, have been reported successful to varying degrees. Everist (4) reported that regular mowing operations will give satisfactory control. Dunham (2) classified sandbur as being not easily killed, but the control of seed production is possible which would eventually eliminate the plant. Usually this type control only reduces the amount of burs produced and not the plant population which affords competition to the desired grasses. Hoatson (6) and Green (5) suggested that cultivation prior to seeding an area was the most economical method of control. Again this cannot be considered as a satisfactory control in established bermudagrass turf.

The use of pre-emergence herbicides would be a practical method for sandbur control. This would eliminate the contact injury to the bermudagrass that often occurs with some post-emergence materials. Dybing et al. (3) used chlordane at 30, 23, 15, and 7.5 pounds active ingredient per acre and had little or no effect on sandbur emergence. They also applied CBP (Chlorobromopropane) and P-162 (hexachlorocyclopentadiene) at 15 and 7.5 pounds of active ingredient per acre and again were unable to effect germination or later growth. The CBP, when applied at higher rates, two gallons per 100 square feet, completely inhibited germination causing a soil sterilant effect.

The post-emergence herbicides are seemingly the most effective method of controlling sandbur in established bermudagrass turf. However, some of the materials, such as dalapon and TCA (trichloroacetic acid), are not selective in bermudagrass turf and must be applied with prior knowledge of the herbicidal activity. Everist (4) obtained satisfactory control using dalapon, TCA, and sodium chlorate. Hoatson (6) also obtained satisfactory control for individual spot treatments using dalapon at one pound in 12 gallons of water and TCA at one pound in three gallons of water. Green (5) recommended sodium chlorate, dalapon and waste oil in areas that could not be cultivated.

Davidson (1) used dalapon at 3, 5, 10, 20, and 40 pounds active ingredient per acre on sandbur at an early stage of growth and received satisfactory control at the 20 and 40 pound rates. These rates were much less effective when applied after the plant had formed seed stalks.

CHAPTER III

METHODS AND MATERIALS

These studies were conducted on highway shoulders at two locations within the state, one in northcentral Oklahoma [State Highway 33, 7.8 (Study I) and 3.5 miles (Study II) west of U. S. 177 intersection] and the other in southwestern Oklahoma [S. H. 152, 8 (Study III and IV) and 9 miles (Study V) west of Binger]. The soils at each location are sandy, sparsely covered with bermudagrass and heavily infested with sandbur. Neither area had received corrective maintenance, such as the addition of fertilizer, since the establishment of the bermudagrass.

In 1966 the area in northcentral Oklahoma was selected for the evaluation of pre-emergence and post-emergence herbicides and their combinations for the control of sandbur (Study I). The pre-emergence materials were applied in March using a total volume of 30 gallons per acre. These materials and rates were Simazine at 3.0 lbs., Atrazine 3.0 lbs., Zytron 15.0 lbs., Betasan 20.0 lbs., and Dacthal 10.0 lbs. a.i. (active ingredient) per acre. The post-emergence herbicides and rates were AMA (ammonium methanearsonate) at 3.8 lbs., CMA (calcium methanearsonate) 2.7 lbs., MSMA (monosodium methanearsonate) 2.0 lbs., and a pre-emergence plus post-emergence combination of CMA at 2.7 lbs. and Betasan at 40 lbs. a.i. per acre. The initial application of these materials was made in May using a total volume

of 30 gallons per acre. Due to unfavorable weather conditions they did not receive the retreatment on the desired interval of seven to twenty days after initial treatment. The initial treatments, with the exception of CMA and Betasan combination, were applied again on September 1 and retreated with the same rates per acre on September 19.

In 1967 Studies II, III, IV and V were initiated in both areas using only the post-emergence herbicides that were used in the 1966 study with the addition of DSMA (disodium methanearsonate) at 2.5 lbs. and Monex (MSMA plus diuron) at 1.2 lbs. a.i./acre. Again these materials received one retreatment, 7-20 days after the initial treatment, using the same rate and volume per acre, 40 gallons, as the initial treatment.

In Study V, to further evaluate these herbicides for the control of sandburs, they were applied at the following rates: CMA at 1.8, 3.7, and 7.4 lbs. a.i./acre, AMA at 1.9, 3.8, and 7.6 lbs. a.i./acre, MSMA at 1.0, 2.0, and 4.0 lbs. a.i./acre, DSMA at 1.2, 2.5, and 5.0 lbs. a.i./acre, and Monex at 0.6, 1.2, and 2.5 lbs. a.i./acre. The two lower rates were retreated 7 days after the initial treatment using the same rate and volume per acre.

All rates were reported as pounds of active ingredient per acre. The post-emergence materials that did not contain a surfactant, such as CMA, AMA, and DSMA, in the manufacturers formulation received one percent by volume prior to application.

All the materials were applied with a piston type pump and spray bar containing flood type nozzles that were calibrated for the desired volume per acre.

Each plot had 300 square feet (10 feet wide and 30 feet long) and was designed as a randomized block with three replications. The plots were evaluated by counting the live sandbur plants within a one foot quadrat at 10 random locations within each plot three to four weeks after the final treatment. The data were analyzed using Friedman two-way analysis of variance by ranks (7, 8). For an example of the procedure see Appendix Tables I and II. The percent control for each treatment was derived by subtracting the mean number of live sandbur plants per 10 square feet from the mean number of live sandbur plants for the check, divided by the latter, times 100.

CHAPTER IV

RESULTS AND DISCUSSION

The statistical analysis of the pre-emergence and post-emergence study (Study I) showed the post-emergence materials to be more effective than the pre-emergence materials for the control of sandburs in bermudagrass turf. The herbicides are ranked in order of effectiveness according to Friedman rank analysis as well as showing the average number of live sandbur plants per 10 square feet in Tables I, II, III, IV and V.

In Study I AMA at 3.8 pounds a.i./acre showed the best control with MSMA and CMA slightly lower (Table I). The post-emergence combination treatment of CMA at 3.7 lbs. a.i./acre and Betasan at 40 was used in an attempt to control the existing plants as well as the seeds that germinated throughout the season. As indicated in Table I, this combination was only partially effective leaving 22.6 plants per 10 square feet as compared to 54 plants per 10 square feet in the check plot. The pre-emergence material had little or no effect on the emergence or germination of the sandbur.

The most effective herbicide in Study II also was AMA at 3.8 lbs. a.i./acre (Table II) with an average of 1.0 sandbur plants per 10 square feet. The ranking order was AMA, MSMA, Monex, CMA and DSMA, then control.

TABLE I

A COMPARISON OF PRE-EMERGENCE AND POST-EMERGENCE HERBICIDES FOR CONTROL OF SANDBUR PLANTS IN BERMUDAGRASS TURF - STUDY I

Chemical	Rate lbs. a.i./acre 3/30/66	5/25/66	9/1/66	9/19/66	Mean Number of Live Plants/10 Sq.Ft.	Percent Control
AMA*		3.8	3.8	3.8	0.0	100.0
MSMA*		2.0	2.0	2.0	0.6	98.9
CMA*		3.7	3.7	3.7	1.3	97.6
CMA & Betasan*		3.7 4.0			22.6	57.6
Zytron	15.0				36.0	33.3
Atrazine	3.2				45.3	16.1
Simazine	3.2				45.3	16.1
Betasan	20.0				45.6	15.6
Dacthal	10.0				68.0	-25.9**
Check					54.0	

*Post-emergence application.

χ^2 Significance at the 0.5% level.

**No control was exhibited by Dacthal.

TABLE II

THE EFFECTS OF POST-EMERGENCE HERBICIDES ON THE CONTROL OF SANDBUR PLANTS IN BERMUDAGRASS TURF - STUDY II

Chemical	Rate lbs. a.i./acre		Mean Number of Live Plants/10 Sq.Ft.	Percent Control
	6/21/67	6/30/67		
AMA	3.8	3.8	1.0	98.7
MSMA	2.0	2.0	2.3	97.0
Monex	1.2	1.2	3.7	95.1
CMA	3.7	3.7	6.0	92.0
DSMA	2.5	2.5	7.0	90.7
Check			75.0	

χ^2 Significance at the 0.5% level.

The results from Study III (Table III) indicated AMA and DSMA to be equally effective in the control of sandburs leaving only 0.66 plants per 10 square feet. MSMA and CMA also were equally effective; they left 1.0 plant per 10 square feet. Monex was slightly lower leaving an average of 1.3 plants.

In Study IV AMA, MSMA and CMA all were equally effective leaving an average of 0.3 plants per 10 square feet (Table IV). DSMA and Monex were less effective and left 2.7 and 4.0 plants per 10 square feet respectively.

The effectiveness of AMA at 3.8 lbs. a.i./acre with one retreatment 7 days after initial treatment was indicated again in Study V in which an average of 0.3 sandbur plants were left per 10 square feet (Table V). MSMA at 4.0 lbs. a.i./acre with only the initial application was considerably more effective than either the 1 lb. or 2 lbs. rate with one retreatment.

CMA at 3.7 and DSMA at 2.5 lbs. a.i./acre, with one retreatment, were more effective than either the lower rates with retreatments or the higher rates with only the initial treatments. The remainder of the materials were ranked in order of best control to least averaging from 3.0 to 16.6 sandbur plants as compared to an average of 50.3 sandburs per 10 square feet in the untreated area.

TABLE III

THE EFFECTS OF POST-EMERGENCE HERBICIDES ON THE CONTROL OF SANDBUR PLANTS IN BERMUDAGRASS TURF - STUDY III

Chemical	Rate lbs. a.i./acre 6/15/67	Rate lbs. a.i./acre 7/10/67	Mean Number of Live Plants/10 Sq.Ft.	Percent Control
AMA	3.8	3.8	0.66	99.0
DSMA	2.5	2.5	0.66	99.0
MSMA	2.0	2.0	1.00	98.4
CMA	3.7	3.7	1.00	98.4
Monex	1.2	1.2	1.33	97.9
Check			61.33	

χ^2 Significance at the 0.5% level.

TABLE IV

THE EFFECTS OF POST-EMERGENCE HERBICIDES ON THE CONTROL OF SANDBUR PLANTS IN BERMUDAGRASS TURF - STUDY IV

Chemical	Rate lbs. a.i./acre		Mean Number of Live Plants/10 Sq.Ft.	Percent Control
	6/30/67	7/13/67		
AMA	3.8	3.8	0.3	99.7
MSMA	2.0	2.0	0.3	99.7
CMA	3.7	3.7	0.3	99.7
DSMA	2.5	2.5	2.7	97.3
Monex	1.2	1.2	4.0	96.0
Check			97.6	

χ^2 Significance at the 0.5% level.

TABLE V

THE EFFECT OF DIFFERENT RATES OF POST-EMERGENCE HERBICIDES ON CONTROL OF SANDBUR PLANTS IN BERMUDAGRASS TURF - STUDY V

Chemical	Rate lbs. a.i./acre 8/18/67	8/25/67	Mean Number of Live Plants/10 Sq.Ft.	Percent Control
AMA	3.8	3.8	0.33	99.4
MSMA	4.0		1.66	96.7
CMA	3.7	3.7	2.00	96.0
DSMA	2.5	2.5	2.33	95.4
AMA	1.9	1.9	2.33	95.4
CMA	7.4		3.00	94.0
AMA	7.6		3.33	93.4
DSMA	5.0		4.33	91.4
CMA	1.85	1.85	5.00	90.0
Monex	1.2	1.2	7.00	86.0
DSMA	1.25	1.25	7.33	85.4
MSMA	1.0	1.0	7.66	84.7
MSMA	2.0	2.0	8.33	83.4
Monex	2.4		12.33	75.4
Monex	0.6	0.6	16.66	66.8
Check			50.33	

χ^2 Significance at the 0.5% level.

CHAPTER V

SUMMARY AND CONCLUSIONS

Sandbur (Cenchrus pauciflorus) control in bermudagrass turf was evaluated in 1966 using pre-emergence and post-emergence herbicides and again in 1967 using only post-emergence materials. Simazine, Atrazine, Dacthal, Zytron, and Betasan were applied as pre-emergence treatments in March, 1966. Calcium acid methanearsonate (CMA), monosodium acid methanearsonate (MSMA), ammonium methanearsonate (AMA) and CMA plus Betasan were applied as post-emergence treatments in May, 1966, followed by retreatments of CMA, MSMA, and AMA on September 1 and September 19. In 1967 CMA, MSMA, AMA, Monex (MSMA plus diuron), and disodium methanearsonate (DSMA) were applied with retreatment on 7 to 20 day intervals.

The results of these investigations indicated the pre-emergence herbicides did not give satisfactory control of the sandbur plant. Satisfactory control was obtained, however, from the post-emergence materials with one retreatment 7 to 20 days after the initial application. Of these materials, AMA at 3.8 lbs. a.i./acre was consistently the most effective.

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A P P E N D I X

APPENDIX TABLE I

RANKING OF THE THREE BLOCKS USING THE NUMBER OF LIVE SANDBUR PLANTS PER TREATMENT PER 10 SQUARE FEET OF AREA IN STUDY I

(7.8 miles west of US-177 and SH-33 Intersection)

Blocks	Herbicides									
	Simazine	Atrazine	Zytron	Dacthal	Betasan	CMA	MSMA	AMA	CMA and Betasan
1	8[1] (48)[2]	5 (33)	6 (38)	9 (81)	7 (42)	3 (4)	1.5*(0)	1.5*(0)	4 (32)
2	4 (23)	8 (54)	6 (48)	7 (50)	9 (61)	1.5*(0)	3 (2)	1.5*(0)	5 (24)
3	4 (65)	7 (49)	5 (23)	9 (73)	6 (34)	2* (0)	2* (0)	2* (0)	4 (12)
R_j	16	20	17	25	22	6.5	6.5	5	13

*Indicates those herbicides that obtained equal control. The mean of the tied ranks then becomes the new value used.

[1] Ranking based upon the Friedman two-way analysis of variance.

[2] Numbers in parentheses indicate the number of live sandbur plants per treatment per 10 square feet of plot area 18 days after final treatment.

APPENDIX TABLE II

STATISTICAL PROCEDURE USED IN COMPUTING χ^2_R VALUES OF APPENDIX TABLE I DATA

Formula:

$$\chi^2_R = \frac{12}{Nk(k+1)} \sum_{j=1}^{k} (R_j)^2 - 3N(k+1)$$

where:

N = number of rows

k = number of columns

R_j = sum of ranks in j^{th} column

$\sum_{j=1}^{k} R_j^2$ = sum the squares of the sums of ranks over all k conditions

$$\chi^2_R = \frac{12}{3(9)(9+1)} (2568.50) - 3(3)(9+1) = 110.04$$

This value is significant at the .005 level using $k - 1 = (9 - 1)$ degrees of freedom.

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