COMPARISON OF 2,4-D AND ATRAZINE ON FORBS IN RANGELANDS AND PASTURES

By

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COMPARISON OF 2,4-D AND ATRAZINE ON

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

This thesis is a manuscript to be submitted for publication in The Journal of Range Management and is in partial fulfillment for the Degree of Master of Science.

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ABSTRACT

Atrazine applied at 1.12 and 2.24 kg/ha in April was compared with 2,4-D applied at 0.56 and 1.12 kg/ha in May for the control of heath aster (*Aster ericoides*), western ragweed (*Ambrosia psilostachya*), and lanceleaf ragweed (*Ambrosia bidentata*) at three locations. Data were taken in the form of forbs/m^2, forb production in kg/ha, and grass production in kg/ha. All three of the major forb species tested were significantly reduced by the herbicide applications, however, heath aster (location I) and lanceleaf ragweed (location III) were more susceptable to applications of 2.4-D than to atrazine while western ragweed (location II) was more susceptable to the atrazine application. These differences in susceptability and degree of control, did not however, prove to effect the amount of grass released by atrazine and 2,4-D. When comparing herbicide treatments with the untreated check, there was an average increase in grass production of 71% (1065 kg/ha) for the three studies in 1984. Due to the forb populations in the herbicide treated plots in 1985, there were significant reductions of common broomweed (*Xanthocephalum dracunculoides*) populations at location I and western ragweed populations at location III, after retreatment with the 1.12 kg rate of atrazine. Herbicide retreatments did

not, however, result in increased grass production. The average carry-over effect in 1985 from herbicide treatment in 1984 was an increase of 1320 kg/ha of grass (this represents a 59% average increase over the untreated areas).

INTRODUCTION

Over-grazing has resulted in major undesirable forb problems in Oklahoma pastures and rangelands. Simms and Dwyer(1965) observed that unpalatable annual forb species first increased under progressively heavier grazing and that unpalatable perennial forbs also increased with continued over-grazing. These increasing numbers of undesirable forbs then became serious competitors with the desirable grasses for soil nutrients, light, and soil water. Dwyer(1958) observed reduced grass yields by 68 and 55 % from competitive rhizomatous forbs such as heath aster (*Aster ericoides*) and western ragweed (*Ambrosia psilostachya*), respectively.

The use of 2,4-D[(2,4-dichlorophenoxy)acetic acid] on pasture and rangeland has been the major tool employed by ranchers to combat problem forbs. Hyder(1971) found that spraying mixed grass prairies with 2,4-D improved range conditions and increased useable forage. Powell et al.(1982) observed a decrease in forb production as the rate of 2,4-D increased from 0.28 to 1.68 kg/ha and this resulted in a corresponding increase in grass production.

Atrazine also has shown promise as a means of controlling undesirable weeds in forages. Kay(1971) observed a quadrupled production of wheatgrass coupled with fertilization when atrazine was used for controlling downy brome (*Bromus tectorum*). Waller and Schmidt(1983) observed that treating pastures with atrazine stimulated a rapid recovery of warm-season grass remnants on over grazed native pastures in eastern Nebraska and they attributed this to the reduction of competition of cool-season grasses. The recent labeling of atrazine for controlling cool-season grasses and annual forbs has prompted questions by producers as to its effectiveness in controlling various annual and perennial forbs. Houston(1977) indicated that there was definitely a difference in susceptibility of annual and perennial forbs to atrazine. Of the 27 species tested, all 10 of the annuals were highly susceptible to 2.0 kg/ha of atrazine applied in late fall. However, only two of the 17 perennial species, evening primrose (*Oenothera albicaulis*) and bottlebrush squirreltail (*Sitanion hystrix*), were highly susceptible. Baker et al.(1980) concluded that atrazine improved range condition and palatability of herbage by reducing the amount of prairie three-awn (*Aristida oligantha*) and by controlling western ragweed. Peterson et al.(1983) indicated that for the southern rolling plains of Texas, both 2,4-D and atrazine had the ability of shifting the competitive advantage toward more desirable forage plants when applied on rangeland forbs such as common broomweed (*Xanthocephalum* *dracunculoides*), vervain (*Verbena bipinnatifida*), redseed plantain (*Plantago rhodosperma*), and heartleaf nettle (*Urtica chamaedryoides*). McGinnies(1984) reported that atrazine was more effective than 2,4-D for controlling annual forbs. He attributed the poor control with 2,4-D to moisture stress on the forbs at the time of the 2,4-D application.

The major objective of this study was to compare forb control and subsequent grass release with 2,4-D and atrazine on three forb infested sites. The secondary objective of the study was to determine the carry-over effects of herbicide treatments on forb populations and grass production into 1985 and to compare the results with retreatment.

METHODS

Three sites were selected in the spring of 1984 that had very low populations of annual grasses and had high densities of undesirable forbs. Location I and II were located on the range research station west of Stillwater Oklahoma. Location III was located at the range research station at Pawhuska Oklahoma. The experimental design for all three studies in 1984 consisted of a randomized complete block, with 5 treatments and 4 replications. The plot size was 9 x 12 meters. In the spring of 1985 the first year's biomass was removed while plants were still dormant with a flail mower. Experimental plots were then split in half,length wise, and randomly assigned either no treatment or retreatment of the original treatment applied. The five treatments included atrazine at 1.12 and 2.24 kg/ha, 2,4-D butoxyethyl ester at 0.56 and 1.12 kg/ha, and an untreated check.

LOCATION I

Location I was a heavily over-grazed range site on a Granola-lucien sandy clay soil. The area had a naturally occurring population (35 stems/m^2) of heath aster. Other major species present at the site included common broomweed, western ragweed, southwestern carrot (*Daucus pusillus*), big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), downy brome, windmillgrass (*Chloris verticillata*), witchgrass (*Panicum capillare*), prairie three-awn, blue grama (*Bouteoua gracilis*), and sideoats grama (*B. curtipendula*).

Treatments in 1984 were applied with a tractor mounted spray boom delivering 187 liters/hectare through 8003 flat fan nozzle tips. Atrazine applications were made on April 17 when heath aster was 3 cm in height. 2,4-D was applied on May 14 when asters were 15 to 25 cm in height. Environmental conditions for 1984 herbicide applications are listed in Table 1.

Retreatments of 1/2 of the main plot area in 1985 were applied with a compressed air bicycle sprayer delivering 178 liters/hectare through 11003 flat fan nozzle tips. Atrazine applications were made on March 14 when heath asters were dormant. 2,4-D was applied on May 8 when heath asters were

25 to 35 cm in height. Environmental conditions for 1985 herbicide applications are listed in Table 1.

LOCATION II

Location II was an unmanaged bermudagrass (*Cynodon dactylon*) area located on a Stephensville fine sandy loam soil. The area had a naturally occurring population of western ragweed (65 stems/m^2). Other major species present included southwestern carrot, sericea lespedeza (*Lespedeza cuneata*), kobe lespedeza (*Lespedeza striata*), bermudagrass, little bluestem, and prairie dropseed (*Sporobolus heterolepis*).

Treatments in 1984 were applied with a tractor mounted spray boom delivering 187 liters/hectare through 8003 flat fan nozzle tips. Atrazine applications were made on April 17 when western ragweed was in the 4-leaf stage and 8 cm in height. 2,4-D was applied on May 14 when western ragweed was in the 8- to 10-leaf stage and 25 cm in height. Environmental conditions for 1984 herbicide applications are listed in Table 1.

Retreatments in 1985 were applied with a compressed air bicycle sprayer delivering 178 liters/hectare through 11003 flat fan nozzle tips. Atrazine applications were made on March 14 when western ragweed was dormant. 2,4-D was applied on May 8 when the western ragweed was in the 4- to 8-leaf stage and 15 cm in height. Environmental conditions for 1985 herbicide applications are listed in Table 1.

LOCATION III

Location III was a native range area in good range condition on a Parsons-carytown, silty clay loam soil. The area had a naturally occurring population (154 plants/m^2) of lanceleaf ragweed (*Ambrosia bidentata*). The other major species present included heath aster, southwestern carrot, big bluestem, little bluestem, switchgrass (*Panicum virgatum*), and indiangrass (*Sorghastrum nutans*).

Treatments in 1984 were applied with a compressed air bicycle sprayer delivering 187 liters/hectare through 11003 flat fan nozzle tips. Atrazine applications were made April 11 when lanceleaf ragweed was from cotyledon to 4-leaf stage and was from 3 to 6 cm in height. 2,4-D was applied on May 14 when lanceleaf ragweed was in the 4- to 6-leaf stage and 8 to 10 cm in height. Environmental conditions for 1984 herbicide applications are listed in Table 1.

Retreatments in 1985 were applied with a compressed air bicycle sprayer delivering 178 liters/hectare through 11003 flat fan nozzle tips. Atrazine applications were made on March 15 when lanceleaf ragweed was dormant. 2,4-D was applied on May 2 when lanceleaf ragweed was in the 4- to 6-leaf stage and 8 to 15 cm in height. Environmental conditions for 1985 herbicide applications are listed in Table 1.

DATA COLLECTION

Forb counts and forb and grass forage yields were taken both years at all three locations (dates are listed in Table

1). Forb counts were taken by randomly sampling six 0.15 m^2 quadrats and counting the number of stems for each weed species present. Results were then converted to stems/m^2. Forb and grass production was also determined from these six quadrats. Forb and grass production was then determined for each of the 0.15 m^2 quadrats by using modified weight-estimate (Pechanec and Pickford 1937). One of the six subsamples was then randomly selected, clipped, hand separated, and weighed. All estimates were then adjusted by the use of a conversion factor obtained by comparing the estimated wt. with the true wt. of the randomly selected quadrat. The clipped sample was then oven dried and re-weighed. Green weights were converted to dry matter in kg/ha.

Stem counts and production in kg/ha were analyzed for the three locations utilizing analysis of variance. Selected means were compared with orthogonal contrasts to determine treatment response of forbs and grasses.

RESULTS

Total rainfall at location I and II for March thru June of 1984 was 61 mm above the 86 mm average. This resulted in good soil moisture availability during the early growing season. Similarly, good rainfall resulted in the March thru June period in 1985 with the total precipitation being 122 mm above average. Location III received for this same period 119 mm in 1984 and this was close to the average of 89 mm.

In 1985, at location III, the rainfall for this four month period was 464 mm above average.

LOCATION I

1984

There was good control of common broomweed and heath aster with herbicide applications(Table 2). Herbicide treatments resulted in a 65% average reduction in forb biomass (337 kg/ha reduction). Associated with this forb reduction, there was an increase of 55% in grass production (794 kg/ha increase). Atrazine treatments were not as effective at reducing stem numbers of heath aster or production of the forbs as the 2,4-D the treatments. However, there was no difference in grass production between the two herbicides. Comparisons of control of heath aster with atrazine based on stems and production indicated that the 1.12 kg rate was not as effective as the 2.24 kg rate. However, there was no significant difference in grass production between the two rates. Comparisons of the two levels of 2,4-D treatment indicated no differences in control of the forb species present or the grass production associated with the two rates. This indicated that the 0.56 kg rate of 2,4-D was sufficient to control the undesirable forbs.

1985

There where significant interactions associated with number of stems and production of heath aster and other forbs when comparing check versus herbicide across retreatment (Table 3). This was due to the high variability of these two forb populations between the two check treatments as indicated in the comparison of heath aster populations in Figure 1. There were also some significant interactions observed when comparing atrazine versus 2,4-D across retreatment. This interaction is illustrated in Figure 2. There were fewer plants in the 2,4-D plots that were not retreated, than in the atrazine plots. This may have been due to the better control of these weeds in 1984 with 2,4-D and as a result, less seed production in 2,4-D plots (Table 2). A lack of complete control with atrazine in 1984 allowed reseeding of the plots and this contributed to a higher population of weedy forbs in 1985. Although there were some significant interactions and reductions in weedy forb populations and production due to retreatment, their effect on grass production in 1985 was minor since there was no significant interaction with total grass production in 1985. This would indicate that retreatment would not be necessary since both rates of 2,4-D and atrazine gave sufficient weed control in the second year,1985, from a single application in 1984.

The main effects of herbicide treatment indicated good reductions in numbers and production of heath aster and other forbs. There was an 81% reduction in weed production (698 kg/ha) associated with spraying. This resulted in a 56% increase in grass production (1145 kg/ha). Comparisons of atrazine versus 2,4-D indicated that 2,4-D was more effective on common broomweed and heath aster but differences in control was not important for grass production since grass yields were equal. The rates of atrazine and 2,4-D also had some significant effects on weed counts and production, but differences did not have a significant effect on grass production with either herbicide.

LOCATION II

1984

There was a 78% average decrease of western ragweed population associated with herbicide treatments and this corresponded to an 87% reduction in western ragweed biomass (Table 4). The use of herbicides resulted in an average increase of 87% in grass production for the herbicide plots over the untreated check. Atrazine treatments controlled western ragweed better than 2,4-D. This difference was attributed to poor control of western ragweed with the 0.56 kg/ha rate of 2,4-D. There were no significant differences associated with any of the variables measured when comparing the two atrazine rates. This indicates that the 1.12 kg/ha rate was adaquate to control the weed species present on this fine sandy loam soil. Comparisons of the forage production between the two 2,4-D rates revealed no differences in grass yields. However, there was less western ragweed production and more lespedeza production with the higher rate of 2,4-D. The poor control of western ragweeds at the lower rate of 2,4-D was also reflected in the large number of western ragweed plants remaining in the 0.56 kg/ha plots.

1985

The only significant interaction associated with retreatment was with western ragweed production for the 0.56 kg rate of 2,4-D verses the 1.12 kg/ha rate of 2,4-D. This was attributed to the increase in control of western ragweed associated with retreatment of the 0.56 kg rate of 2,4-D.

Since there were no significant interactions associated with grass production and the other orthogonal comparisons, it is possible to look at the main effects. The comparison of main effect check versus herbicide treatment indicated an 83% decrease in the number of western ragweed stems with herbicide treatments. This corresponded to a 85% reduction in biomass of western ragweeds (452 kg/ha reduction). The herbicide treatments resulted in an increased grass production of 1242 kg/ha for the herbicide treated plots. Comparisons of atrazine versus 2,4-D indicated no significant differences in any of the variables measured. This indicates that both herbicides were equally effective in reducing western ragweed populations and increasing grass yields the second year. There were no differences between the two rates of atrazine in any of the variables measured, nor were there any differences in rates of 2,4-D in either control of undesirable forbs or grass release. However, there was a significant increase in lespedeza production associated with the .56 kg rate of 2,4-D. In 1984, much of the lespedeza production was kobe lespedeza, however in 1985, most of the lespedeza production was due to sericea lespedeza. This would indicate that selective release of sericea lespedeza might be possible with the use of 0.56 kg/ha of 2,4-D.

LOCATION III

1984

Herbicide treatments in 1984 gave significant decreases in both plant numbers and biomass production of all forb present (Table 6). There was an average biomass reduction of 79% (941 kg/ha less biomass). This corresponded to a 73% increase in grass production for herbicide treated plots (1109 kg/ha more). Treatments with 2,4-D, gave better control of all forbs, than atrazine. Although control of undesirable forbs was better with 2,4-D, the resulting grass production was not statistically different from yields from atrazine plots. Comparisons of the two rates of atrazine indicated that the 2.24 kg rate gave better control of lanceleaf ragweed and this resulted in a 34% increase in grass production. Evidently the higher rate of atrazine was necessary on this higher clay content soil to adaquately control the weed species present. There were no significant differences associated with any of the variables measured when comparing the 0.56 kg rate of 2,4-D verses the 1.12 kg rate of 2,4-D indicating that the lower rate was sufficient for controlling the undesirable forbs.

1985

Some significant interactions were observed due to retreatment with all of the orthogonal comparisons except the 2,4-D rate comparisons (Table 7). Some of these interactions may be related back to the lack of control of the undesirable forbs with the 1.12 kg/ha rate of atrazine in 1984 (Table 6). As noted in Figure 3, there is a significant interaction associated with the total grass production with the atrazine rate orthogonal comparison. Comparisons of the interactions with the 1.12 and the 2.24 kg rates of atrazine indicated significant interaction for populations of western ragweed and other forbs, and production of other forbs. This was also probably due to the effectiveness of retreatment with the 1.12 kg rate of atrazine.

Since there was no significant interaction associated with production of grass and forbs for check versus herbicide orthogonal comparison, it is possible to compare main effects. There was good reduction of lanceleaf ragweed and heath aster production (75%) associated with herbicide treatments (Table 7). This corresponded to a 79% increase in grass production due to herbicide treatment (1575 kg/ha). Comparisons of forb control with atrazine that had no interactions indicate that both lanceleaf ragweed and heath aster were controlled better with the 2.24 kg rate. There were no significant differences in either forb population or production of forbs or grass associated with the two rates of 2,4-D. This indicates that the 0.56 kg/ha rate was sufficient for controlling the weed species present at the site.

CONCLUSION

Both 2,4-D and atrazine can be effectively used to control undesirable forbs. Most of the major forbs were significantly reduced by the herbicide applications. Heath aster (location I) and lanceleaf ragweed (location III) were controlled better with 2,4-D than atrazine, while western ragweed at location II was controlled better with atrazine. These differences in susceptability, which resulted in varying amounts of forb biomass, had no significant effect on the amount of grass released, however there was a significant increase in lespedeza production due to the 1.12 kg rate of 2,4-D at location II. For the three studies in 1984, there was an average increase in grass production of 71% (1065 kg/ha) when herbicides were applied.

Due to the forb populations in the herbicide treated plots in 1985, there were significant reductions of common broomweed populations at location I and western ragweed populations at location III, after retreatment with the 1.12 kg rate of atrazine. Treatment of 2,4-D at location II resulted in significant increases in lespedza production associated with the 0.56 kg rate, due to a shift from kobe lespedeza to sericea lespedeza. Retreatment with herbicide in 1985 did not result in increased grass production at any of the locations. This indicates that treating for 2 years in sequence would not be necessary. There was however a grass response in 1985 due to herbicide treatment in 1984 that resulted in an average increase of grass production of 59% (1320 kg/ha).

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Table 1. Environmental conditions for herbicide applications and harvest dates at locations I, II, and III.

	LOCATION					
	I		II		III	
	1984	1985	1984	1985	1984	1985
Atrazine						
Appl. date	4/17	3/14	4/17	3/14	4/11	3/15
Air temp.(C)	14	16	14	16	16	13
Humidity(%)	56	68	56	68	49	68
Soil temp.(C)	16	10	16	10	18	9
2,4-D						
Appl. date	5/14	5/8	5/14	5/8	5/14	5/2
Air temp.(C)	22	24	22	24	23	24
Humidity(%)	56	70	56	70	54	62
Soil temp.(C)	21	20	21	20	20	21
Harvest dates	6/16	6/21	6/23	6/22	6/18	6/17

Table 2. 1984 forb counts and forb and grass production for location I.[1]

	Plants/M²			Production			
	GUEDR	ASTER	OF	TOTG	GUEDR	ASTER	OF
				--------kg/ha------------			
ORTHOGONAL COMPARISONS							
No herbicide	8***	35***	7	1422	46***	361***	108
X Herbicide	0	7	5	2216***	3	84	91
Atrazine	1	15***	5	2313	6***	168***	129**
X 2,4-D	0	0	5	2120	0	0	53
Atrazine 1.12kg	2	25***	5	2226	11	309***	140
X 2.24kg	0	4	5	2400	0	26	118
2,4-D 0.56kg	0	0	3	2187	0	0	28
X 1.12kg	0	0	6	2054	0	0	78

*,**,*** = Significant at the 0.10, 0.05, and 0.01 levels, respectively.

[1]GUEDR = common broomweed, ASTER = heath aster, OF = other forbs, TOTG = total grasses

Table 3. 1985 forb counts and forb and grass production for location I.[1]

	Plants/M^2			Production			
	GUEDR	ASTER	OF	TOTG	GUEDR	ASTER	OF
				----------kg/ha------------			
TREATMENT MEANS(for 1 and 2 years treatment)							
Treated in 1984							
No herbicide	5	26	12	2096	208	389	205
Atrazine 1.12kg	7	19	5	3192	89	277	73
Atrazine 2.24kg	9	1	4	3069	182	12	35
2,4-D 0.56kg	2	1	1	2647	19	3	168
2,4-D 1.12kg	1	0	1	3175	5	0	77
Treated in 1984 and 1985							
No herbicide	1	45	14	1968	16	550	363
Atrazine 1.12kg	0	14	4	3341	64	178	84
Atrazine 2.24kg	0	2	1	3411	0	17	40
2,4-D 0.56kg	0	0	1	3210	2	0	35
2,4-D 1.12kg	0	0	1	3406	0	0	4
ORTHOGONAL MAIN EFFECTS(Pooled over 1 and 2 years treatment)							
No herbicide	3	36***	13***	2032	112	470***	284***
X Herbicide	2	5	4	3181***	45	58	65
Atrazine	4***	9*	4	3253	84*	121**	59
X 2,4-D	1	0	5	3109	6	1	71
Atrazine 1.12kg	4	17**	5	3267	77	228***	79
X 2.24kg	5	1	2	3240	91	15	38
2,4-D 0.56kg	1	0	6*	2928	10	2	101
X 1.12kg	1	0	3	3290	2	0	40
ORTHOGONAL INTERACTION							
No herbicide X Herbicide	ns	***	**	ns	ns	***	***
Atrazine X 2,4-D	***	ns	**	ns	ns	ns	**
Atrazine 1.12kg X 2.24kg	ns	ns	ns	ns	ns	ns	ns
2,4-D 0.56kg X 1.12kg	ns	ns	ns	ns	ns	ns	ns

*,**,*** = Significant at the 0.10, 0.05, and 0.01 levels, respectively. ns = no sign. interaction due to retreatment in 1985

[1]GUEDR = common broomweed, ASTER = heath aster, OF = other forbs, TOTG = total grasses

Table 4. 1984 forb counts and weed and grass production for location II.[1]

	Plants/M²		Production			
	AMBPC	OF	TOTG	AMBPC	OF	LS
			----------kg/ha----------			
ORTHOGONAL COMPARISONS						
No herbicide	64***	2*	1479	413***	12	227
X Herbicide	10	0	2771***	55	12	140
Atrazine	4	0	2983*	18	0	5
X 2,4-D	16**	1	2559	93**	25	276***
Atrazine 1.12kg	5	0	2997	27	0	9
X 2.24kg	2	0	2969	8	0	0
2,4-D 0.56kg	27***	2	2597	157**	49	209
X 1.12kg	5	0	2521	29	0	343**

*,**,*** = Significant at the 0.10, 0.05, and 0.01 levels, respectively.

[1] AMBPC = western ragweed, OF = other forbs, TOTG = total grasses, LS = lespedeza sp.

Table 5. 1985 forb counts and forb and grass production for location II.[1]

	Plants/M²		Production			
	AMBPC	OF	TOTG	AMBPC	OF	LS
			-----------kg/ha----------			
TREATMENT MEANS(for 1 and 2 years treatment)						
Treated in 1984						
No herbicide	44	8	1803	623	29	113
Atrazine 1.12kg	8	2	3228	102	52	67
Atrazine 2.24kg	5	6	2793	70	75	31
2,4-D 0.56kg	19	6	2294	275	212	571
2,4-D 1.12kg	9	5	2709	90	37	53
Treated in 1984 and 1985						
No herbicide	36	4	1763	439	39	111
Atrazine 1.12kg	4	3	3590	26	23	0
Atrazine 2.24kg	1	2	3186	10	29	0
2,4-D 0.56kg	5	3	2997	51	58	695
2,4-D 1.12kg	1	1	3410	10	23	30
ORTHOGONAL MAIN EFFECTS(Pooled over 1 and 2 years treatment)						
No herbicide	40***	6	1783	531***	34	112
X Herbicide	7	3	3025***	79	64	180
Atrazine	5	3	3199	52	44	24
X 2,4-D	9	3	2852	106	82	337
Atrazine 1.12kg	6	2	3409	64	37	33
X 2.24kg	3	4	2989	40	52	15
2,4-D 0.56kg	12	4	2645	163	135	633**
X 1.12kg	5	3	3059	50	30	42
ORTHOGONAL INTERACTION						
No herbicide X herbicide	ns	ns	ns	ns	ns	ns
Atrazine X 2,4-D	ns	ns	ns	ns	ns	ns
Atrazine 1.12kg X 2.24kg	ns	ns	ns	ns	ns	ns
2,4-D 0.56kg X 1.12kg	ns	ns	ns	*	ns	ns

*,**,*** = Significant at the 0.10, 0.05, and 0.01 levels, respectively. ns = no sign. interaction due to retreatment in 1985

[1] AMBPC = western ragweed, OF = other forbs, TOTG = total grasses, LS = lespedeza sp.

Table 6. 1984 forb counts and forb and grass production for location III.[1]

	Plants/M²				Production				
	AMBBI	ASTER	AMBPC	OF	TOTG	AMBBI	ASTER	AMBPC	OF
					------------kg/ha----------				
ORTHOGONAL COMPARISONS									
No herbicide	154***	19***	16***	18***	1502	814***	153***	150**	67**
X Herbicide	19	6	6	5	2611***	109	39	67	28
Atrazine	29**	11***	11***	9**	2449	177***	77***	130***	50***
X 2,4-D	9	0	0	1	2774	41	2	4	7
Atrazine 1.12kg	52***	14	16**	7	2085	327***	88	199***	39
X 2.24kg	5	8	6	10	2814**	28	67	62	60
2,4-D 0.56kg	0	0	0	1	2967	0	0	0	9
X 1.12kg	17	0	1	1	2581	82	3	8	5

*,**,*** = Significant at the 0.10, 0.05, and 0.01 levels, respectively.

[1] AMBBI = lanceleaf ragweed, ASTER = heath aster, AMBPC = western ragweed, OF = other forbs, TOTG = total grasses

Table 7. 1985 forb counts and forb and grass production for location III.[1]

	Plants/M²				Production (kg/ha)				
	AMBBI	ASTER	AMBPC	OF	TOTG	AMBBI	ASTER	AMBPC	OF
TREATMENT MEANS(for 1 and 2 years treatment)									
Treated in 1984									
No herbicide	113	12	5	1	1899	910	172	59	15
Atrazine 1.12kg	44	23	6	5	3521	453	260	110	118
Atrazine 2.24kg	7	13	4	1	3746	158	166	63	23
2,4-D 0.56kg	6	0	1	1	3682	135	0	5	13
2,4-D 1.12kg	35	2	1	1	3231	274	15	10	13
Treated in 1984 and 1985									
No herbicide	105	17	5	2	2098	690	208	58	0
Atrazine 1.12kg	9	18	4	3	3032	91	208	50	46
Atrazine 2.24kg	1	4	1	3	4023	13	60	6	70
2,4-D 0.56kg	0	0	0	1	3682	0	0	0	3
2,4-D 1.12kg	7	1	1	1	3669	103	14	4	6
ORTHOGONAL MAIN EFFECTS(Pooled over 1 and 2 years treatment)									
No herbicide	109***	14***	5**	1	1998	800***	190***	59	8
X Herbicide	14	8	2	1	3573***	153	91	31	37
Atrazine	15	15***	4***	2***	3580	179	174***	58**	64***
X 2,4-D	12	1	0	0	3566	128	8	5	9
Atrazine 1.12kg	26*	21***	5*	3***	3276	272	234***	80	82
X 2.24kg	4	9	2	1	3885***	85	113	35	46
2,4-D 0.56kg	3	0	0	0	3682	67	0	3	8
X 1.12kg	21	2	1	0	3450	188	15	7	10
ORTHOGONAL INTERACTION									
No herbicide X Herbicide	ns	*	**	ns	ns	ns	ns	ns	ns
Atrazine X 2,4-D	ns	ns	***	ns	ns	ns	ns	***	ns
Atrazine 1.12kg X 2.24kg	ns	ns	*	***	**	ns	ns	ns	***
2,4-D .56kg X 1.12	ns	ns	ns	ns	ns	ns	ns	ns	ns

*,**,*** = Significant at the 0.10, 0.05, and 0.01 levels, respectively. ns = no sign. interaction due to retreatment in 1985

[1] AMBBI = lanceleaf ragweed, ASTER = heath aster, AMBPC = western ragweed, OF = other forbs, TOTG = total grasses

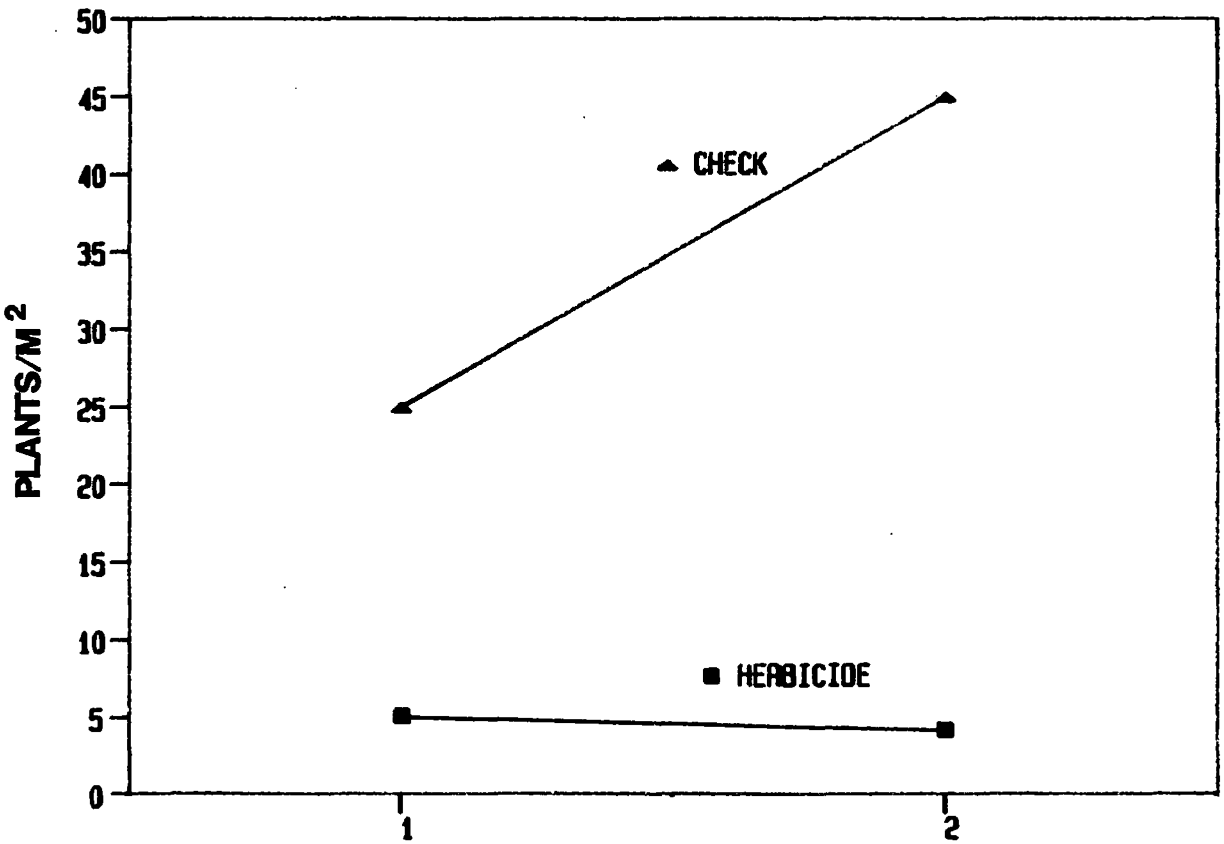

Fig. 1. The interaction associated with 1 and 2 years treatment of herbicide versus the untreated check on heath aster populations for location I.

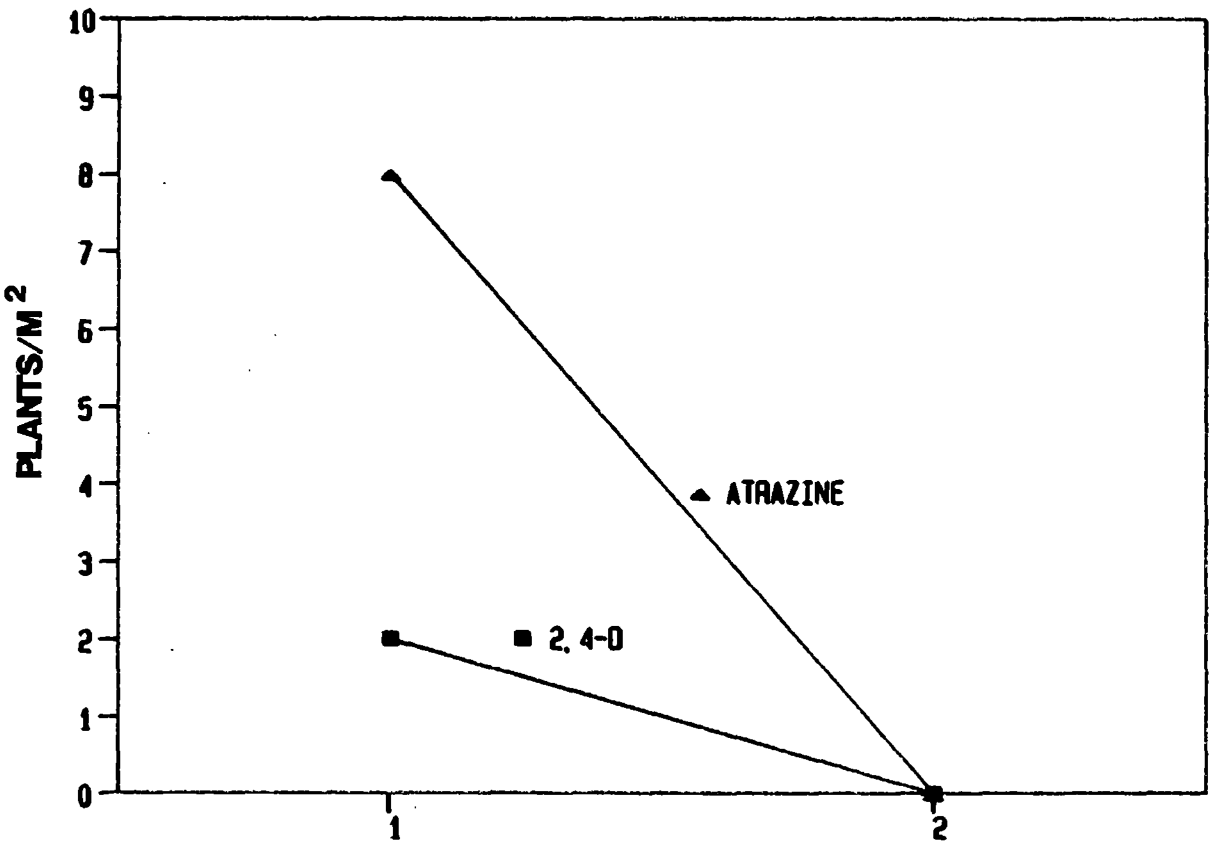

Fig. 2. The interaction associated with 1 and 2 years treatment of atrazine and 2,4-D on broomweed populations for location I.

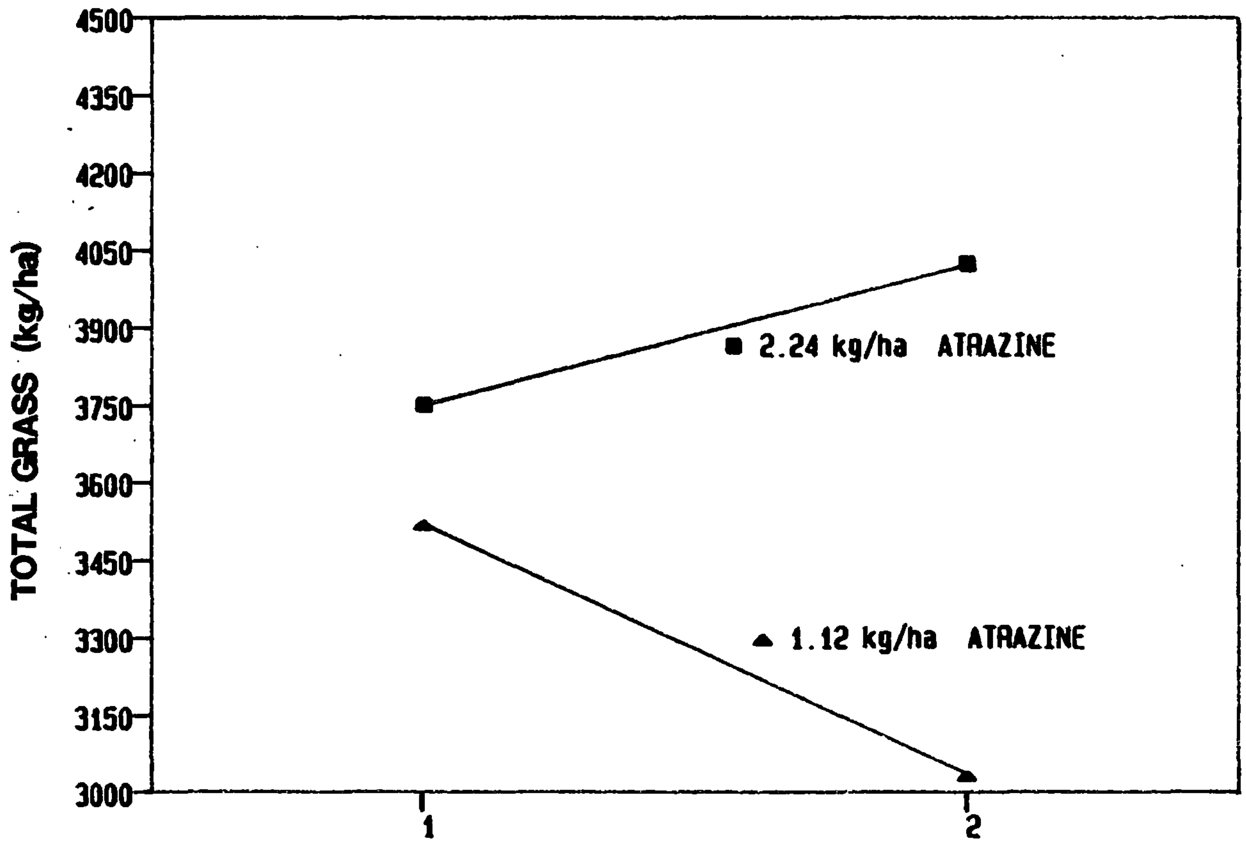

Fig. 3. The interaction associated with 1 and 2 years application of 1.12 and 2.24 kg/ha atrazine on total grass production at location III.

VITA

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