SURVEY OF WEED MANAGEMENT PRACTICES IN PASTURES AND RANGELANDS IN OKLAHOMA AND SELECTIVITY OF VARIOUS HERBICIDE TREATMENTS ON CULTIVARS OF FORAGE BERMUDAGRASS (*Cynodon dactylon)*

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INTRODUCTION

Chapter I of this thesis is a summary of a survey that will be reproduced in the form of a circular by the Oklahoma Cooperative Extension Service.

Chapter II is a manuscript to be submitted for publication in the Journal of Production Agriculture, published by: American Society of Agronomy, Crop Science of America, and Soil Science of America.

CHAPTER I

SURVEY OF WEED MANAGEMENT PRACTICES IN PASTURES AND RANGELANDS IN OKLAHOMA

SURVEY OF WEED MANAGEMENT PRACTICES IN PASTURES AND RANGELANDS IN OKLAHOMA

Marty G. New, Jim T. Criswell, and Jim F. Stritzke*

ABSTRACT

A pasture and range mail survey was conducted to determine current weed problems, weed control practices, and other management practices currently used on various pasture types in Oklahoma. The purpose was to identify potential areas where education and research efforts are needed. Of the 8,500 surveys mailed to livestock producers by Oklahoma Agricultural Statistics Service on 23 January 1996, 24.7% were returned. Acreage devoted to forage production by respondents was divided into native rangeland (71%), bermudagrass (14%), bermudagrass-fescue-legume (4%), and Old World bluestem (4%). Weed control with herbicides was the most common management practice used on native rangeland, while fertilizing was the primary management practice on bermudagrass. The most commonly used herbicide in Oklahoma in 1995 was 2,4-D. It was frequently used alone and in combination with picloram (Grazon P+D) or dicamba (Weedmaster). Western ragweed (*Ambrosia psilostachya*) and cocklebur (*Xanthium spp.*) were the two most often listed among the top five common and difficult to control weeds.

INTRODUCTION

In Oklahoma, there are 7.1 and 15.1 million acres of improved pastures and rangelands, respectively (Bernardo, 1986). Vegetation on these lands is very diverse and

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weeds often are present. Rice et al. (1989) reported that grasslands in Oklahoma often had excessive populations of weeds.

Weed management in improved pastures and rangelands involves various management practices (Miller and Stritzke, 1995). Proper grazing management can increase quality and quantity of forage produced and is often the most economical way to manage weeds. Proper fertilizing is critical for competitive growth of improved pastures. Mowing almost always improves the appearance of pastures but often does not kill many of the undesirable plants present. However, repeated mowing decreases vigor of tall growing perennials (Vallentine, 1989; Ashton and Monaco, 1991). Burning is the oldest known practice used by humans to manipulate vegetation on rangelands (Vallentine, 1989). Burning can control weeds, increase herbage yield, increase utilization, and increase forage availability (Wright and Bailey, 1980). However, herbicides are often the best choice for weed control in pastures and rangelands (Rice and Stritzke, 1989; Miller and Stritzke, 1995). They are effective, selective, and can be a profitable alternative when integrated with other management practices.

One way to estimate current weed management practices on pastures and rangelands is to conduct a survey. In 1987, Boyd published results from a survey of 780 beef and dairy producers in Arkansas. They used three primary grass types for forage, including tall fescue (29%), bermudagrass (26%), and native grass (21%). Of the acres surveyed, 38% was fertilized annually and 29% was fertilized every two to three years, 41% was mowed annually and 15% was mowed more than once per year, and 23% received herbicides annually. Of the acres treated, 61% used 2,4-D, 2,4-D + dicamba

(Weedmaster) was used on an additional 26% of treated acres, and other herbicides on the remaining acres treated (13%). Weed control equipment owned by producers included mowers (86%), cluster sprayers (39%), boom sprayers (36%), and tractor sprayers with handguns (25%). The four most troublesome weeds reported in Arkansas were buttercups (*Ranunculus spp.*) reported by 21% of respondents, bitter sneezeweed (*Helenium amarum*) reported by 14%, thistles (*Carduus nutans* and *Cirsium spp.*) reported by 10%, and ragweed (*Ambrosia spp.*) reported by 8%. Six topics that Arkansas producers wanted more information about included herbicide use, weed identification, economics of weed control, brush control, poisonous weeds, and sprayer setup.

A similar survey was conducted by Watson et al. (1988) in Mississippi. Native grasses represented 28% of the reported acres with bermudagrass, bahiagrass and tall fescue representing 19%, 18%, and 17% respectively. Management practices used included; 47% of acres fertilized annually and 28% of acres fertilized every two-three years; 62% of acres mowed annually and 28% of acres mowed more than once; 24% of acres were treated with herbicides once annually and 1% more than once. Weedmaster and 2,4-D were used on 46% of the treated acres and other herbicides on the remaining 6%. Type of weed control equipment owned by producers included pasture mower reported by 85% of respondents with boom sprayers, cluster sprayers, and tractor sprayers with handgun only were reported by 49%, 25%, and 20% of producers, respectively. The four most troublesome weeds in Mississippi included dogfennel, bitterweed, buttercup, and horsenettle (*Solanum spp.*). Forty-five percent of Mississippi producers wanted more

information about economics, 42% requested more information about herbicide use, 39% requested weed identification, 34% inquired about poisonous weeds, and 33% and 19% requested more information on brush control and sprayer setup respectively.

In 1988, the Oklahoma Agricultural Statistics Service and Oklahoma State University Pesticide Impact Assessment Program conducted a survey on pastures and rangelands (unpublished data). Native grass represented 48% of the reported acres while bermudagrass and Old World bluestem represented 19% and 16% of the reported acres respectively. Bermudagrass and tall fescue mixtures represented 8% of the reported acres and bermudagrass and legume mixture represented 7% of the reported acres. Management practices included; 4% of acres mowed, 8% of acres burned, and 18% of acres treated with herbicides. Of the acres treated, 56% was treated with 2,4-D and 17% with atrazine.

Producers reported owning several types of weed control equipment. Their responses indicated that 22% own boom sprayers, 9% own cluster nozzle type sprayers, 6% own handgun equipment sprayers, and 18% own pasture mowers. Forty-two percent of the producers reported ragweeds difficult to control, 33% reported broomweed, and 13% reported blackberry (*Rubus spp.*) and persimmon (*Diospyros virginiana*) as difficult to control. Between 34% and 28% of the producers requested information on the following topics; pasture fertilization and grazing, brush control, weed identification, and economics of weed control.

Objectives of this project were to document current weed management practices on various vegetation types and to identify potential areas where education and research

efforts are needed. Using a direct mail survey, producers were asked about their weed management practices on various pasture types, including how herbicides were applied and what type of weed control equipment they owned. They were also asked to identify specific weed problems and asked to identify topics which they desired more information.

MATERIALS AND METHODS

In December of 1995, a survey (Appendix A) was designed by M.G. New, Graduate Student; J.T. Criswell, Extension Pesticide Coordinator; J.F. Stritzke, Forage Weed Control Specialist; W.D. Warde, Professor of Statistics; B.L. Bloyd, State Statistician; and J.D. Cole, Deputy State Statistician. Support for this effort was through the United States Department of Agriculture's National Agricultural Pesticide Impact Assessment Program grant 92-34050-7182. On 23 January 1996, the survey was mailed to 8,500 randomly selected livestock producers which represent 15.5% of Oklahoma Agricultural Statistics Service's livestock producer database. Livestock producers were provided a postage paid envelop addressed to: Oklahoma State University, Department of Entomology, 127 NRC, Stillwater, Oklahoma 74078. A follow-up reminder post card was sent on 31 January 1996. Upon return, an identification number and date received was recorded on each questionnaire.

Producers were asked to identify acreages of each pasture type and the following management practices; acres fertilized, acres mowed, acres burned, acres sprayed with herbicide, method of herbicide application, and who applied the herbicide. Other information requested included county, do they soil test and fertilize according to soil test, types of pasture spraying equipment owned, and what pasture management topic(s) they

would like to learn more about. The survey was designed to provide district level information and utilized the Oklahoma Cooperative Extension Service administrative districts as the selected districts (Figure 1). Producers were asked to identify the county where their operation was located and this information was used to assign the data into the appropriate district. Questionnaires not listing a county were placed into a category described as "other". Forage types were classified as follows native rangeland, bermudagrass (>75% bermudagrass), bermudagrass-legume, bermudagrass-fescue-legume, fescue (>75% fescue), fescue-legume, fescue-bermudagrass (26 - 74% fescue), lovegrass, Old World bluestem, and others. All information collected from completed questionnaires was compiled and subjected to analysis of variance. Chi-Square tests were performed on soil test related questions and on areas of pasture management respondents requested more information.

RESULTS AND DISCUSSION

A total of 2,100 completed and usable questionnaires were returned for a response rate of 24.7%. The number of returned surveys peaked in week 2 (Figure 2). Indicating a positive effect that the reminder post cards had on producers.

Management Practices on Pastures and Rangeland in Oklahoma

Native rangeland comprised 71% of the reported acres and was the dominate pasture type in all four districts in Oklahoma (Table 1). Although the number of native rangeland pastures reported was similar for all districts, average unit size in the northwest district was significantly larger than unit sizes in other districts (Table 2). The primary management practice on native rangeland was spraying for weed control with herbicides

applied to 17% of reported acres. Aerial applicators applied herbicides to more than half the reported acres sprayed (Table 1). Less than 10% of native rangeland was burned or mowed annually (Table 1). However, the percent of producers reporting burning and mowing varied with district. In the northeast district, 19% of the producers burned native rangeland in 1995, compared to only 5% in the southwest district. The average unit size of the burned area was also much larger in the northeast district (543 acres versus 235 acres or less for other districts). The unit size for burned units are larger than "not burned" units in the northeast district, but for the other districts, size of burned units are much smaller than size of "not burned" units. Mowing is practiced by 57% and 59% of the producers in the northeast and southeast respectively. However, mowing was reported primarily by small producers since the average unit size mowed in both districts was about 100 acres, compared to 952 and 668 acres for units "not mowed" in northeast and southeast districts respectively. Three percent of the producers reported fertilizing native rangeland (Table 1). Within districts the percent of producers reporting fertilizing native rangeland varied from 13% in the northwest to 31% in the southeast (Table 2). Unit size of native rangeland "not fertilized" was approximately seven times larger than fertilized acreages in all districts (Table 2).

Bermudagrass was the most frequently reported improved pasture type and accounted for 14% of the state reported acres. Mean bermudagrass pasture size in the northwest district was significantly less than mean pasture size in other districts (41 acres versus 68 acres or more) (Table 3). Fertilizing was the primary management practice reported on bermudagrass with 52% of the acreage fertilized (Table 1). However, only

36% of bermudagrass acres were fertilized in the southeast district. Weeds were sprayed on 40% of the reported bermudagrass acreage with the majority of the acres (67%) sprayed by producers with ground equipment. Producers reported mowing 12% of their bermudagrass in the northwest versus 31% in the southeast. Also, average unit size mowed in the northwest was significantly less than the other districts (40 acres versus 73 or more) (Table 3). Bermudagrass was burned by 10% of producers in the northwest, compared to only 4% of the producers burning in each of the other districts. The size of burned and "not burned" pastures was similar in all districts except that in the southwest district the average size of burned pastures was 176 acres, compared to 77 acres for "not burned" pastures.

Bermudagrass-fescue-legume pasture type comprised 4% of the total reported acres with essentially all acres located in the eastern half of the state (62% in northeast and 33% in the southeast districts) (Table 4). Average size of this pasture type varied from 74 acres in southwest district to 160 acres in southeast district. Mowing and fertilizing were the most commonly reported management practices used on this pasture type (44% and 41% respectively) (Table 1). The average size of mowed and fertilized pastures was one-fourth to one-half the size of "not mowed" and "not fertilized" pastures. Nineteen percent of the reported acres were treated with a herbicide, of which 94% of the acres were applied by the producer.

Old World bluestem pasture type occupied 4% of the reported state acres (Table 1). Old World bluestem is concentrated in the western one-half of the state with 35% located in the northwest district and 46% located in the southwest district. The most

frequently reported management practice on Old World bluestem was fertilization, with 50% of the acreage fertilized in the northwest district and 58% of the producers fertilized in the southwest district. Spraying for weed control was also an important management practice with 30% of reported acres sprayed, primarily by ground (Table 1). The percent of producers mowing this type of pasture varied from 21% in the northwest district to 39% in the northeast district. Average unit size of mowed pastures was smaller than "not mowed" pastures in all districts. In the northeast district 20% of the acres were burned compared to only 5% or less for other districts.

Spraying Equipment and Herbicide Usage

Three major types of spray equipment were reported owned by Oklahoma livestock producers. Sprayer types were boom sprayer, cluster type sprayer, and sprayer with handgun (Figure 3). Ownership of various spraying equipment in Oklahoma was generally less common than ownership of spray equipment in Arkansas and Mississippi. For example, ownership of cluster sprayers by survey respondents in Arkansas and Mississippi was 39% and 25% respectively, compared to only 16% owned by Oklahoma livestock producers responding. Decreased ownership of spray equipment in Oklahoma may be attributed to the fact that 71% of Oklahoma producers have native rangeland with over 50% of the rangeland acres sprayed by air.

The survey was designed to allow for two entries for the number of acres treated with herbicides. The first was on the front of the survey for method of application and the second under specific pasture types for type of herbicide used and acres treated. This allows for different totals for acres receiving herbicide treatments. Question 4 of the

survey allowed producers to indicate the method of application and whether the producer applied the herbicide to native rangeland and/or each pasture type. Table 6 presents results from the second method (Question 7 from the survey) which allowed for specific herbicide identification. Major herbicide treatments used for pasture weed control in Oklahoma included; 2,4-D, Grazon P+D, and Weedmaster (42%, 39%, and 12% respectively for the acres reported sprayed) (Table 6). The major herbicide used on all pasture types was 2,4-D. This herbicide was used alone on 42% of the total acres reported sprayed and was the leading herbicide treatment for all pasture types except native rangeland (Tables 7, 8, and 9). In addition, Grazon P+D contains 80% 2,4-D and Weedmaster contains 75% 2,4-D. Thus 2,4-D was applied to 93% of the sprayed acres.

Producers reported applying Grazon P+D to 45% of the native rangeland and 2,4-D to 36% of the native rangeland. A large portion (44%) of acres treated with Grazon P+D were located in the northeast district (Table 7). The greater use of Grazon P+D (67%) in native rangeland and in the northeast district in particular was attributed to aerial applicators using Grazon P+D. The average acres of native rangeland sprayed in northeast Oklahoma with Grazon P+D was 587 acres compared to 142 acres sprayed with 2,4-D.

Weed control with 2,4-D was most often reported as "good", but ranged from poor to excellent for all pasture types (Tables 7, 8, and 9). Weed control ratings for Grazon P+D and Weedmaster were usually good or excellent with only about 12% to 14% rating as fair.

Herbicides were most frequently applied in May. Exceptions for 2,4-D and Grazon P+D applications included June applications to bermudagrass-fescue-legume pastures. Delayed spraying of pastures with legumes is understandable since recommendations are to delay spraying until June or when seedheads have formed.

Ally, a relative new herbicide labeled for use on pastures, was applied on 3% of the native rangeland and bermudagrass pastures. Ally was most commonly applied in May, but there were several exceptions. Weed control with Ally was very similar to that reported for 2,4-D. The majority reported good results, but ratings varied from poor to excellent.

Reasons for Spraying Herbicide, Types of Weed Problems, and Types of Management Information Needed

Approximately 48% of the producers listed reasons for spraying their pastures. Weed control was listed 85% of the time as the primary reason for spraying. Improving pasture production was listed by 13%, followed by cattle performance (1%) and aesthetic reasons (1%).

Producers were asked the most common and most difficult to control weeds/trees for native rangeland, bermudagrass, fescue, and other pasture types. The five most common and most difficult to control weeds/trees are listed in Table 10. Western ragweed (*Ambrosia psilostachya*) was listed in the top five for all pasture types in both common and difficult category. Cocklebur (*Xanthium spp.*) was the second most common weed. This compares to buttercup and dogfennel as the most troublesome weeds in Arkansas and Mississippi respectively.

More information about pasture fertilization was desired by 40% of respondents, weed control with herbicides by 40% and grazing management by 38% (Figure 4). The high percent listing pasture fertilization was surprising since 75% indicated they do not soil test their pastures, however, 36% of producers soil testing have improved pastures. For those that soil test their pastures, 50% of the respondents indicated they followed soil fertility recommendations (Figure 5). As to how often producers followed soil test recommendations, the response "mostly" was the only response with a significant difference. The northwest district producers reported following soil test recommendations less than the other districts (Table 11). Five intermediate topics were listed 29% to 35% of the time. These included economics of weed control, herbicide use, brush control, hay production, and weed identification.

There were significant differences on how topics of safety and environmental issues, sprayer setup and calibration, brush control, and hay production were rated in various districts (Table 12). Differences could have occurred when the northeast and southeast districts of the state were compared to the northwest and southwest districts. This may be due to the northwest and southwest having more acres of cropland than the northeast and southeast districts.

Herbicide applicators in the northwest and southwest districts should have more experience and knowledge regarding herbicide applications to cropland and thus safety concerns, sprayer setup and calibration, and hay production are better known. Burning differences could have occurred when the southwest and southeast districts of the state were compared to the northwest and northeast districts due to the tall grass prairie located

in Osage county with large tracts of land and the northwest district having vast acres of all three grass types (Figure 6).

SUMMARY

Grasslands in Oklahoma are 71% native rangeland and 22% bermudagrass or bermudagrass mixtures. Herbicide application was the primary management practice on 17% of the native rangeland with most acres sprayed by aerial applicators. Fertilizing and spraying for weed control were the primary management practices on bermudagrass (52% and 40% respectively). The predominant herbicide used was 2,4-D, whether used alone or in combination with picloram (Grazon P+D) or dicamba (Weedmaster). Grazon P+D was used on more acres of native rangeland and primarily applied aerially. Weed control was listed as the primary reason for spraying pastures. Western ragweed was listed in the top five for each pasture type as most common and difficult to control, followed by cocklebur as the second most common weed. Pasture fertilization (40%), weed control with herbicides (40%), and grazing management (38%) were the major topics producers were interested in obtaining more information about in Oklahoma, 1995.

Outreach programs through the cooperative extension service can be used to address various topics of interest. Since most herbicides were applied by producers, the Pesticide Applicator Education and various forage programs through the extension service can be used to address safety and environmental issues, hay production, and sprayer setup and calibration. Burning practices and brush control can also be addressed targeting specific vegetation types in each district.

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Table 1. Summary of total acres reported, and acres fertilized, burned, mowed, and sprayed with herbicide for various pasture types in Oklahoma in 1995.†

Pasture type	Total reported†	Management practice††				How herbicides were applied		
		Fertilized	Burned	Mowed	Sprayed	Air	Ground	
							Custom	Self
	acres	acres				acres		
Native rangeland	733,185 (71%)	24,165 (3%)	69,024 (9%)	62,328 (8%)	125,894 (17%)	67,296	18,154	40,444
Bermudagrass	147,507 (14%)	76,127 (52%)	9,615 (7%)	40,174 (27%)	58,486 (40%)	5,534	13,632	39,320
Bermudagrass-legume	22,830 (2%)	8,869 (39%)	770 (3%)	8,186 (36%)	4,255 (19%)	25	215	4,015
Bermuda-fescue-legume	44,148 (4%)	18,034 (41%)	601 (1%)	19,375 (44%)	12,384 (3%)	420	1,239	10,725
Fescue	12,397 (1%)	4,874 (39%)	0 (0%)	6,253 (50%)	1,286 (10%)	20	156	1,110
Fescue-legume	2,791 (0.2%)	1,301 (47%)	0 (0%)	981 (35%)	700 (25%)	100	0	600
Fescue - bermudagrass	18,388 (2%)	6,640 (36%)	55 (0.2%)	7,229 (39%)	3,638 (20%)	100	224	3,314
Lovegrass	8,549 (1%)	4,133 (48%)	1,830 (21%)	1,616 (19%)	1,149 (13%)	173	256	720
Old World bluestem	39,724 (4%)	19,368 (49%)	2,440 (6%)	6,911 (17%)	10,143 (30%)	1,970	5,209	4,934
Others	8,426 (1%)	3,501 (41%)	90 (1%)	2,636 (31%)	1,607 (19%)	20	790	797
Total	1,037,945	167,012 (16%)	84,425 (8%)	155,689 (15%)	219,542 (21%)	75,658	39,875	105,979

†Percentages down total reported acres column are the percent of each pasture type.

††Percentages of acres fertilized, burned, mowed, or sprayed for the various pasture types are listed across under acres of the various management practices respectively.

Table 2. Total acres of native rangeland reported, number responding, and average size; plus listing of number and average size fertilized and not fertilized, burned and not burned, and mowed and not mowed in each of the four Oklahoma Cooperative Extension Service administrative districts in 1995.*

	Management practice†														
	Reported for district			Fertilized		Not fertilized		Burned		Not burned		Mowed		Not mowed	
District	Total	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size
	acres		acres		acres		acres		acres		acres		acres		acres
NW	226,056	328	689 a	43 (13%)	94 a (2%)	285	779	39 (12%)	189 b (3%)	289	757	81 (25%)	65 a (2%)	247	894
NE	201,636	435	464 b	107 (25%)	81 a (4%)	328	588	82 (19%)	543 a (22%)	353	445	250 (57%)	102 a (13%)	185	952
SW	186,937	397	471 b	65 (16%)	67 a (2%)	332	550	18 (5%)	235 ab (2%)	379	482	115 (29%)	74 a (5%)	282	633
SE	113,851	332	343 b	103 (31%)	67 a (6%)	229	467	52 (16%)	228 ab (10%)	280	364	195 (59%)	115 a (20%)	137	668

* Means in same column with the same letter are not significantly different using $p>0.05$.

no. = number of reports.

† Percentages of pastures fertilized, burned, or mowed in each district are listed under the number of the various management practices. Percentages of acres fertilized, burned, or mowed in each district are listed under the average size of the various management practices.

Table 3. Total acres of bermudagrass reported, number responding, and average size; plus listing of number and average size fertilized and not fertilized, burned and not burned, and mowed and not mowed in each of the four Oklahoma Cooperative Extension Service administrative districts in 1995.*

	Management practice†															
	Reported for district			Fertilized		Not fertilized		Burned		Not burned		Mowed		Not mowed		
District	Total	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	
	acres		acres		acres		acres		acres		acres		acres		acres	
NW	14,769	362	41 b	112 (31%)	78 a (59%)	250	24	35 (10%)	54 a (13%)	327	39	45 (12%)	40 b (12%)	317	41	
NE	47,053	696	68 a	223 (32%)	111 a (52%)	473	47	29 (4%)	72 a (4%)	667	67	186 (27%)	84 a (33%)	510	61	
SW	39,798	498	80 a	197 (40%)	132 a (65%)	301	46	21 (4%)	176 a (9%)	477	77	99 (20%)	73 a (18%)	425	77	
SE	45,157	522	87 a	172 (33%)	94 a (36%)	350	83	20 (4%)	91 a (4%)	502	86	162 (31%)	93 a (33%)	429	70	

* Means in same column with the same letter are not significantly different using $p>0.05$.

no. = number of reports.

† Percentages of pastures fertilized, burned, or mowed in each district are listed under the number of the various management practices. Percentages of acres fertilized, burned, or mowed in each district are listed under the average size of the various management practices.

Table 4. Total acres of bermudagrass-fescue-legume mixture reported, number responding, and average size; plus listing of number and average size fertilized and not fertilized, burned and not burned, and mowed and not mowed in each of the four Oklahoma Cooperative Extension Service administrative districts in 1995.*

	Management practice†															
	Reported for district			Fertilized		Not fertilized		Burned		Not burned		Mowed		Not mowed		
District	Total	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	
	acres		acres		acres		acres		acres		acres		acres		acres	
NW	575	5	115 a	1 (20%)	160 a (28%)	4	103	1 (20%)	75 a (13%)	4	125	1 (20%)	160 a (28%)	4	103	
NE	27,530	189	146 a	101 (53%)	116 a (42%)	45	353	9 (5%)	32 a (1%)	137	199	115 (61%)	114 a (47%)	31	466	
SW	588	8	74 a	3 (38%)	97 a (49%)	5	60	1 (13%)	1 a (0%)	7	84	4 (50%)	77 a (52%)	4	70	
SE	14,754	92	160 a	56 (61%)	101 a (38%)	36	253	6 (7%)	38 a (2%)	86	169	60 (65%)	97 a (40%)	32	279	

* Means in same column with the same letter are not significantly different using $p>0.05$.

no. = number of reports.

† Percentages of pastures fertilized, burned, or mowed in each district are listed under the number of the various management practices. Percentages of acres fertilized, burned, or mowed in each district are listed under the average size of the various management practices.

Table 5. Total acres of Old World bluestem reported, number responding, and average size; plus listing of number and average size fertilized and not fertilized, burned and not burned, and mowed and not mowed in each of the four Oklahoma Cooperative Extension Service administrative districts in 1995.*

	Management practice†															
	Reported for district			Fertilized		Not fertilized		Burned		Not burned		Mowed		Not mowed	
District	Total	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size	no.	Avg. size
	acres		acres		acres		acres		acres		acres		acres		acres
NW	13,858	107	130 a	60 (56%)	115 a (50%)	47	148	5 (5%)	98 a (4%)	102	131	23 (21%)	51 a (8%)	84	151
NE	4,403	54	82 a	18 (33%)	86 a (35%)	36	79	4 (7%)	219 a (20%)	50	71	21 (39%)	54 a (26%)	33	99
SW	18,161	157	116 a	92 (59%)	114 a (58%)	65	119	10 (6%)	87 a (5%)	147	118	48 (31%)	85 a (22%)	109	129
SE	2,937	31	95 a	13 (42%)	34 a (15%)	18	137	2 (6%)	45 a (3%)	29	98	11 (35%)	36 a (14%)	20	127

*Means in same column with the same letter are not significantly different using $p>0.05$.

no. = number of reports.

† Percentages of pastures fertilized, burned, or mowed in each district are listed under the number of the various management practices. Percentages of acres fertilized, burned, or mowed in each district are listed under the average size of the various management practices.

Table 6. Acres reported sprayed and percent of acres treated with various herbicide treatments on all pasture types in Oklahoma in 1995.

Herbicide treatment	Reported sprayed	
	acres	%
2,4-D	101,308	42
Grazon P+D	94,351	39
Weedmaster	30,081	12
Ally	9,154	4
Other	6,835	3

Table 7. Acres reported sprayed and time applied for 2,4-D, Grazon P+D, Weedmaster, and Ally; and number of responses in four weed control ratings when used on native rangeland in the four Oklahoma Cooperative Extension administrative districts in 1995.

District	Reported sprayed	Time applied	Weed control rating			
			Excellent	Good	Fair	Poor
	acres	month	number responding			
			2,4-D			
NW	10,174	May	11	32	10	3
NE	14,905	May	15	62	25	3
SW	12,072	May	4	26	13	2
SE	9,048	May	8	42	22	4
			Grazon P+D			
NW	9,935	May	21	42	2	0
NE	25,232	May	13	25	5	0
SW	15,757	May	20	37	9	0
SE	6,812	May	9	22	4	0
			Weedmaster			
NW	6,363	May	7	13	5	2
NE	5,953	May	6	5	0	1
SW	7,320	May	7	18	2	0
SE	540	April	0	2	3	0
			Ally			
NW	1,386	April	4	9	2	0
NE	310	July	1	2	0	0
SW	1,926	May	0	10	2	4
SE	0	--	0	0	0	0

Table 8. Acres reported sprayed and time applied for 2,4-D, Grazon P+D, Weedmaster, and Ally; and number of responses in four weed control ratings when used on bermudagrass in the four Oklahoma Cooperative Extension administrative districts in 1995.

District	Reported sprayed	Time applied	Weed control rating			
			Excellent	Good	Fair	Poor
	acres	month	number responding			
			2,4-D			
NW	1,759	May	11	16	3	0
NE	16,546	May	22	83	28	2
SW	6,531	May	12	29	9	9
SE	14,481	May	20	63	27	1
			Grazon P+D			
NW	4,980	May	28	28	2	0
NE	9,434	May	21	31	5	0
SW	11,515	May	19	48	10	1
SE	6,931	May	11	30	8	0
			Weedmaster			
NW	1,247	May	7	4	2	1
NE	477	June	1	5	0	0
SW	4,514	May	10	16	0	0
SE	1,355	May	3	6	3	0
			Ally			
NW	721	May	6	4	1	0
NE	320	May	0	1	0	0
SW	747	May	1	9	2	0
SE	492	April	0	4	1	0

Table 9. Acres reported sprayed and time applied for 2,4-D, Grazon P+D, Weedmaster, and Ally; and number of responses in four weed control ratings in Oklahoma in 1995 when used on various pasture types other than native rangeland and bermudagrass.

Herbicide	Reported sprayed	Time applied	Weed control rating			
			Excellent	Good	Fair	Poor
	acres	month	number responding			
Fescue						
2,4-D	2,131	May	7	19	3	0
Grazon P+D	215	May	1	4	2	0
Weedmaster	505	May	0	6	0	0
Ally	0	--	0	0	0	0
Bluestem						
2,4-D	6,109	May	18	20	10	2
Grazon P+D	1,951	May	9	8	1	0
Weedmaster	831	May	3	11	2	0
Ally	2,668	April	8	8	4	2
Bermudagrass-fescue-legume						
2,4-D	3,991	June	4	15	5	0
Grazon P+D	120	June	1	0	1	0
Weedmaster	60	March	0	1	0	0
Ally	75	May	1	0	0	0
Fescue-bermudagrass						
2,4-D	1,374	May	3	8	3	0
Grazon P+D	229	June	1	2	1	0
Weedmaster	0	--	0	0	0	0
Ally	0	--	0	0	0	0
Lovegrass						
2,4-D	392	May	1	6	1	0
Grazon P+D	107	May	2	1	0	4
Weedmaster	186	May	1	2	0	1
Ally	20	April	0	1	0	0
Bermudagrass-legume						
2,4-D	695	May	0	6	4	0
Grazon P+D	0	--	0	0	0	0
Weedmaster	0	--	0	0	0	0
Ally	0	--	0	0	0	0
Fescue-legume						
2,4-D	250	May	1	2	0	0
Grazon P+D	0	--	0	0	0	0
Weedmaster	0	--	0	0	0	0
Ally	0	--	0	0	0	0
Other grasses						
2,4-D	600	June	4	3	3	1
Grazon P+D	319	May	1	2	0	0
Weedmaster	445	May	0	4	1	0
Ally	110	October	0	1	0	0

Table 10. Five most frequently reported common and difficult to control weeds/trees in native rangeland, bermudagrass, fescue, and other pasture types.

Native rangeland		Bermudagrass	
Common	Difficult	Common	Difficult
Western Ragweed	Cedar	Western Ragweed	Sandburs
Broomweed	Sandburs	Cocklebur	Musk Thistle
Cocklebur	Broomweed	Lanceleaf Ragweed	Persimmons
Lanceleaf Ragweed	Persimmons	Broomweed	Blackberry
Cedar	Western Ragweed	Sandburs	Western Ragweed

Fescue		Other	
Common	Difficult	Common	Difficult
Cocklebur	Blackberry	Western Ragweed	Sandburs
Western Ragweed	Musk Thistle	Broomweed	Western Ragweed
Lanceleaf Ragweed	Persimmons	Cocklebur	Musk Thistle
Blackberry	Western Ragweed	Sandburs	Broomweed
Persimmons	Cocklebur	Lanceleaf Ragweed	Threeawn

Table 11. Percent of yes response for pasture fertilization according to soil test results for each of the four Oklahoma Cooperative Extension administrative districts in 1995, plus Chi-Square p-values.

	Response			
District	Always	Mostly	Sometimes	Never
	% yes			
NW	9.0	11.6	12.3	14.9
NE	34.3	36.1	36.6	31.3
SW	23.9	24.2	21.7	25.4
SE	32.8	28.1	29.4	28.4
p-value	0.212	0.031*	0.068	0.698

*Indicates significance at the 0.05 level of confidence.

Table 12. Respondents wanting information about the various pasture management topics for each of the four Oklahoma Cooperative Extension administrative districts, plus Chi-Square p-values.

	District				
Topics	NW	NE	SW	SE	p-value
	% yes				
Safety & environmental issues	12.9	35.4	21.4	30.3	0.036*
Sprayer setup & calibration	14.1	35.1	19.7	31.1	0.018*
Weed control with herbicides	16.6	32.9	23.7	26.8	0.547
Economics of weed control	17.8	32.1	22.9	27.2	0.481
Pasture fertilization	17.0	24.4	34.6	24.0	0.660
Burning	20.8	34.8	22.3	22.1	0.090
Herbicide use	15.8	32.4	23.4	28.4	0.153
Brush control	16.4	36.1	19.9	27.6	0.003*
Grazing management	18.0	36.0	22.2	23.8	0.172
Hay production	15.3	38.0	18.3	28.4	<0.001*
Poisonous weeds	18.8	32.4	19.7	29.1	0.140
Weed ID	18.7	32.7	22.1	26.5	0.335

*Indicates significance at the 0.05 level of confidence.

Figure 1. Oklahoma Cooperative Extension Service administrative districts.

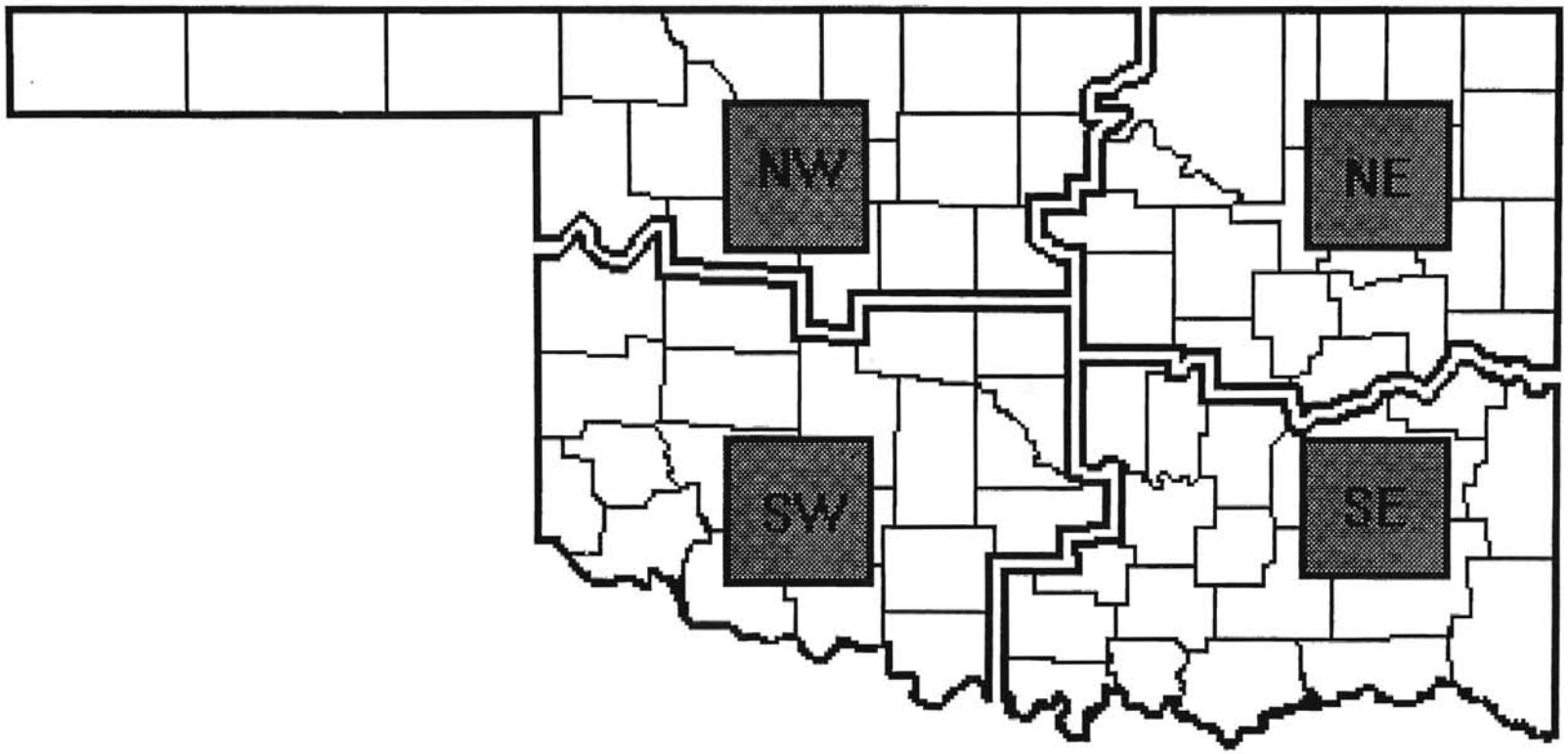

Figure 2. Total number of surveys received by weeks.

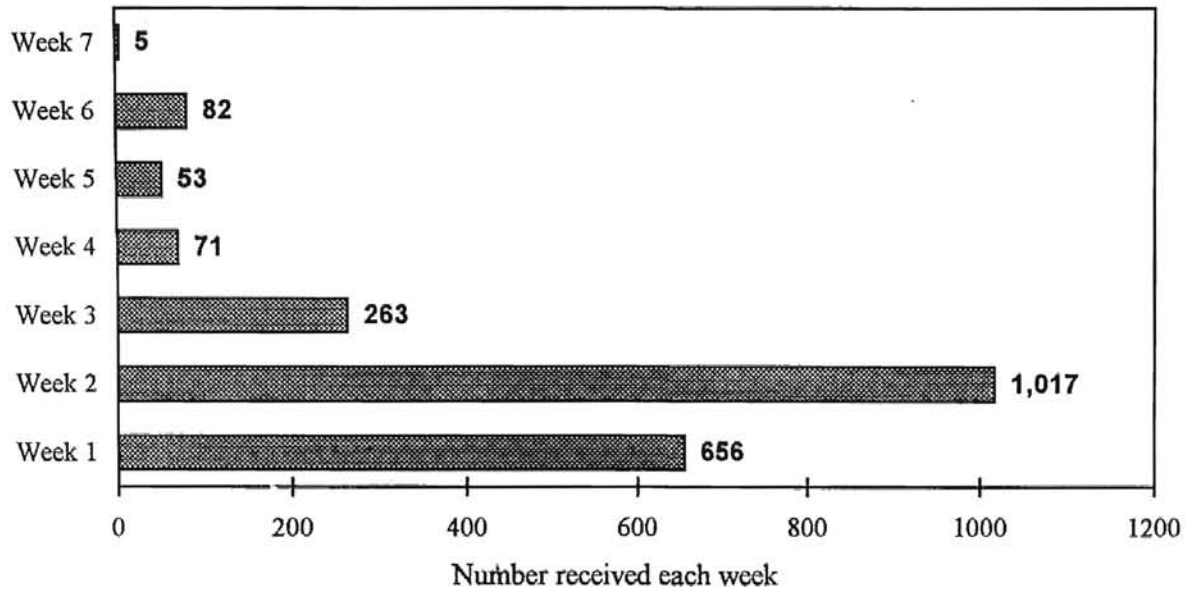

Figure 3. Percent of producers having various types of spray equipment.

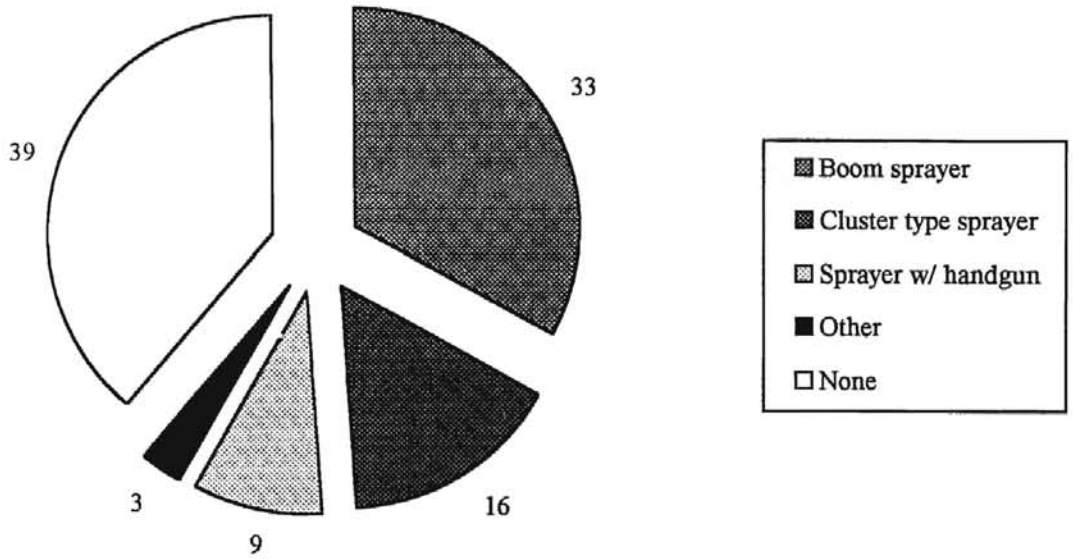

Figure 4. Percent of responses for various pasture management topics.

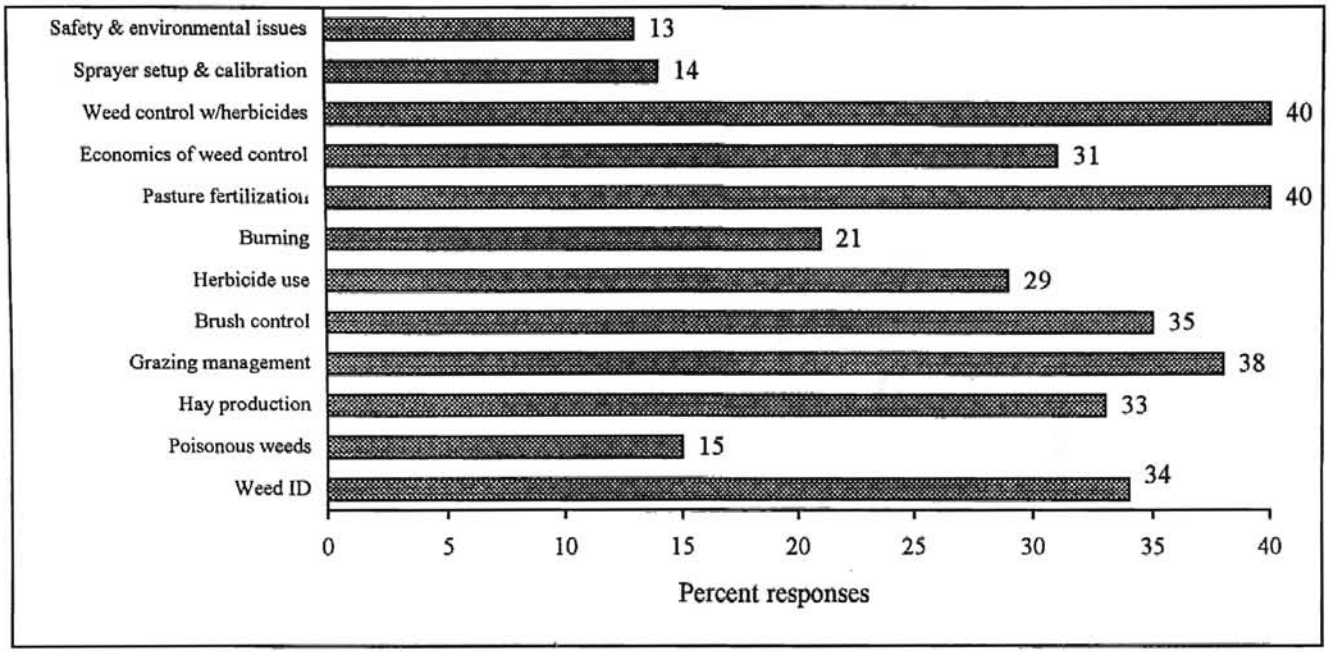

Figure 5. Percent of producers that fertilize according to soil test results.

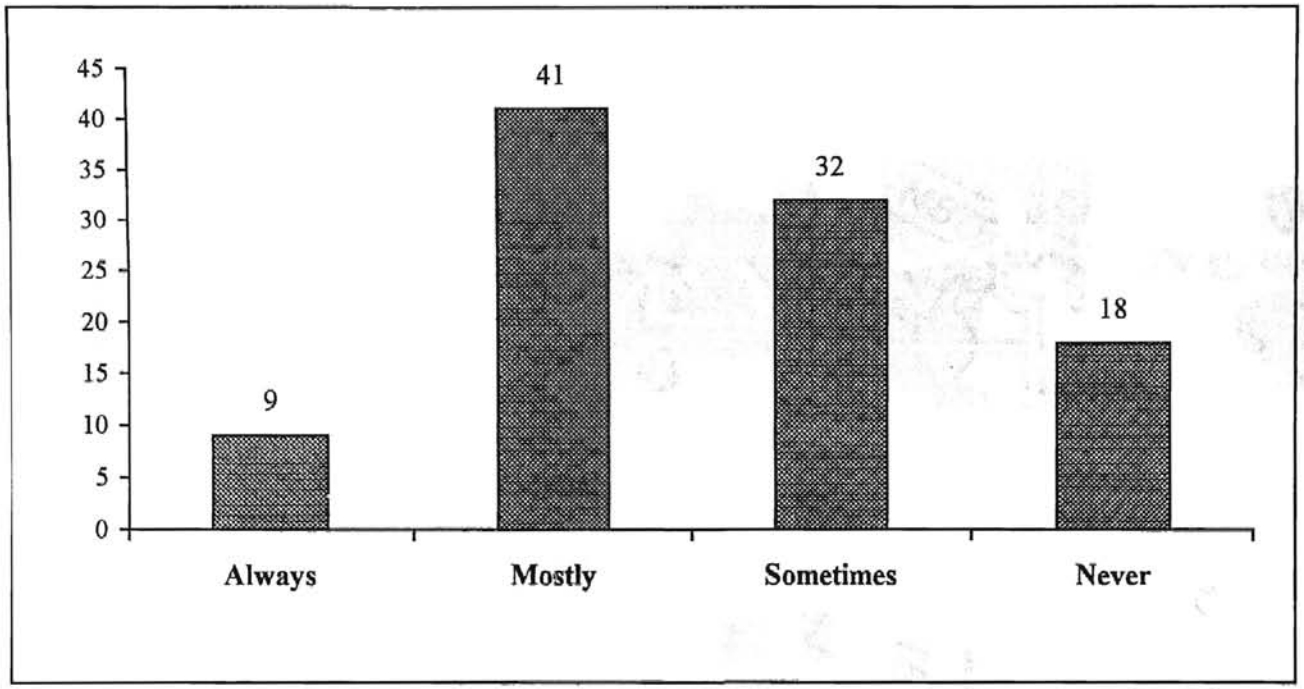

Figure 6. Grasslands of Oklahoma.

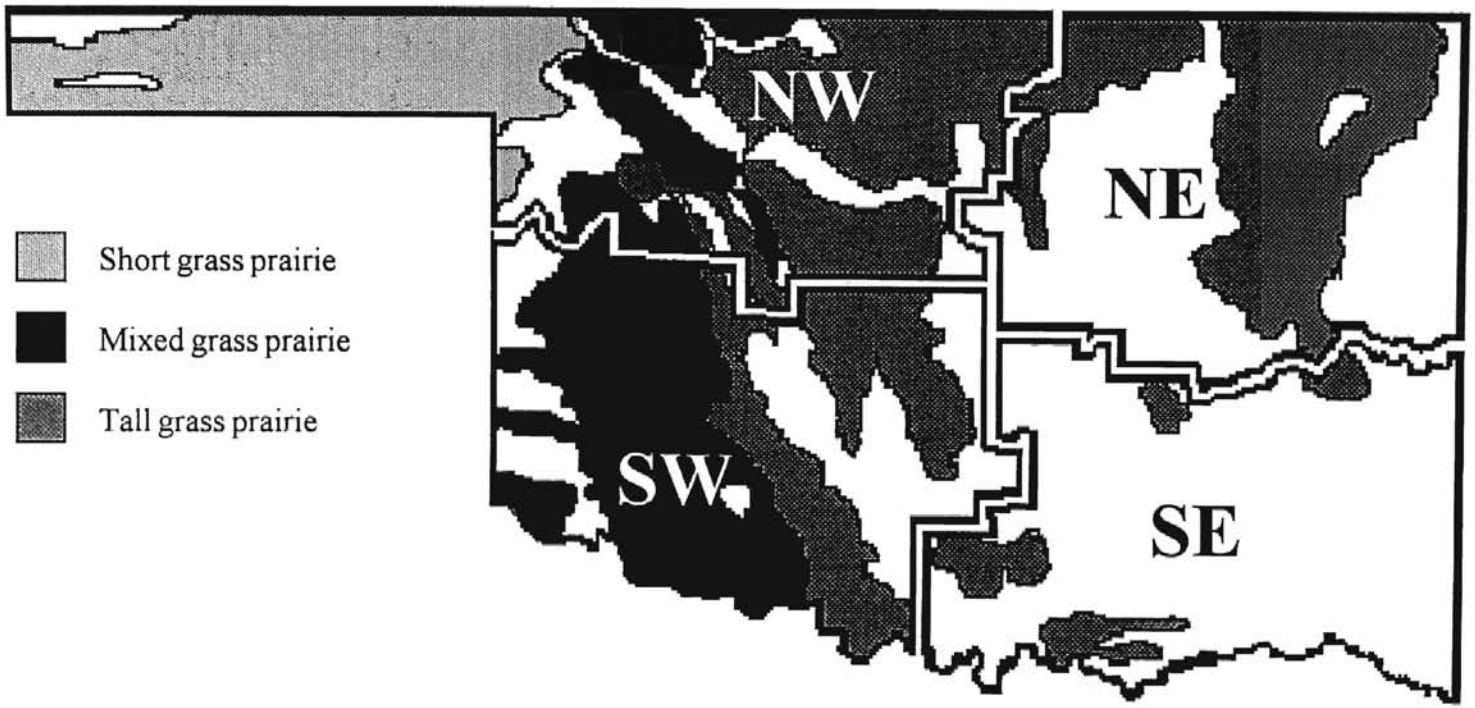

Figure redrawn from J.K. McPherson. Grasslands of Oklahoma. In: R.J. Tyrl and J.R. Estes. Grassflora of Oklahoma. Unpublished manuscript.

APPENDIXES

APPENDIX A

1995 Range and Pasture Survey

Oklahoma Cooperative Extension Service
Department of Entomology
Oklahoma State University
Stillwater, Oklahoma

January 1996

1. County:_____

2. Do you soil test your pastures? Yes_____ No _____ **(If "No," go to Question 4).**

3. Do you fertilize pastures according to your soil test results? **Circle one:**

   Always Mostly Sometimes Never

4. We would like a summary of your **1995** fertility and weed control practices for pastures and native rangeland under your management (owned and leased).

Pasture Type	List Total Acres	List Acres Fertilized	List Acres Burned	List Acres Mowed	List Acres Sprayed with Herbicides		
					Air	Ground	
						Custom	Self
Native Rangeland							
Bermudagrass >75% Bermudagrass							
Bermudagrass and Legume							
Bermuda-Fescue and Legume							
Fescue >75% Fescue							
Fescue and Legume							
Fescue and Bermudagrass 26-74% Fescue							
Lovegrass							
Old World Bluestem							
Others?							

5. What areas of pasture management would you like to learn more about? **Please Circle all that apply.**

a. Weed ID
b. Poisonous Weeds
c. Hay Production
d. Grazing Management
e. Brush Control
f. Herbicide Use
g. Burning
h. Pasture Fertilization
i. Economics of Weed Control
j. Weed Control with Herbicides
k. Sprayer Setup and Calibration
l. Safety and Environmental Issues

To receive information on marked topics, list your name and address. **(Please Print)**

Name:_____
Address:_____
City:_____ State:_____ Zip:____

6. What type of equipment do you use for pasture spraying? **Circle appropriate one(s):**

Boom Sprayer Cluster Type Sprayer Sprayer with handgun only

List Others: _____

7. We would like to know what herbicides you are using and how satisfied you are with their performance. Please answer the following for your sprayed pastures in 1995.

NATIVE RANGELAND

Herbicide Used	List Acres Sprayed	List Month of Application	Check Weed Control Rating			
			Excellent	Good	Fair	Poor
Grazon P+D						
Weedmaster						
2,4-D, Amine						
2,4-D LV Ester						
Ally						
Other?						

BERMUDAGRASS PASTURE

Herbicide Used	List Acres Sprayed	List Month of Application	Check Weed Control Rating			
			Excellent	Good	Fair	Poor
Grazon P+D						
Weedmaster						
2,4-D, Amine						
2,4-D LV Ester						
Ally						
Other?						

FESCUE PASTURE

Herbicide Used	List Acres Sprayed	List Month of Application	Check Weed Control Rating			
			Excellent	Good	Fair	Poor
Weedmaster						
2,4-D, Amine						
2,4-D LV Ester						
Ally						
Other?						

Other pasture type: _____ (From Page 1, Question 4).

Herbicide Used	List Acres Sprayed	List Month of Application	Check Weed Control Rating			
			Excellent	Good	Fair	Poor
Weedmaster						
2,4-D, Amine						
2,4-D LV Ester						
Ally						
Other?						

Please list your primary reason for spraying these types of pasture(s)?

Native Rangeland: _____

_____

Bermudagrass: _____

_____

Fescue: _____

_____

Others: _____

8. We would like to know what weed problem you have in your various type of pasture. Please check the most **common weeds/trees** from the following table for your particular type pasture. We would also like for you to check which weeds you feel are **difficult** to control for your type of pasture.

Weeds/Trees	Native Rangeland		Bermudagrass		Fescue		Other _____	
	Common	Difficult	Common	Difficult	Common	Difficult	Common	Difficult
Bitter Sneezeweed								
Blackberry								
Broomweed								
Buckbrush								
Buttercup								
Cedar								
Cocklebur								
Crotons (Doveweeds)								
Dock								
Downy Brome (Wintergrass)								
Horsenettle								
Ironweed								
Lanceleaf Ragweed								
Late Euportorium								
Little Barley								
Musk Thistle								
Oaks								
Persimmons								
Pigweeds (Carelessweeds)								
Sandburs								
Sericea Lespedeza								
Threeawn (Wiregrass)								
Waxed Goldenweed								
Western Ragweed								

Is there anything else that you would like to tell or ask us about weed control in pastures? Write comments below.

_____

_____

_____

APPENDIX B

HERBICIDE COMMON NAMES AND TRADE NAMES

COMMON NAME	*TRADE NAME*
2,4-D	Many
2,4-D + picloram	Grazon P+D
picloram	Tordon 22K
2,4-D + dicamba	Weedmaster
dicamba	Banvel
metsulfuron	Ally

APPENDIX C

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 11-13-96 **IRB#: AG-97-006**

Proposal Title: 1995 RANGE AND PASTURE SURVEY.

Principal Investigator(s): Jim T. Criswell, Marty G. New

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR ONE CALENDAR YEAR AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval are as follows:

Signature: _____ Date: November 15, 1996

Chair of Institutional Review Board

cc: Marty G. New

CHAPTER II

SELECTIVITY OF VARIOUS HERBICIDE TREATMENTS ON CULTIVARS OF FORAGE BERMUDAGRASS

SELECTIVITY OF VARIOUS HERBICIDE TREATMENTS ON CULTIVARS OF FORAGE BERMUDAGRASS

Marty G. New, Jim F. Stritzke, and Jim T. Criswell*

ABSTRACT

Field studies were conducted to determine the effects of 13 herbicide treatments on height and yield of established bermudagrass (*Cynodon dactylon* L.) cultivars 'Midland', 'Tifton 44', and 'Hardie'. Postemergence applications of labeled rates of dicamba, 2,4-D, metsulfuron, triasulfuron, and norflurazon had no effect on height or forage yield of any cultivar. Picloram or dicamba applied with 2,4-D did not effect forage yield. Picloram at 0.25 lb ae /acre reduced stem height of Hardie but did not effect regrowth after clipping. Triclopyr at 1.0 lb ae /acre decreased height of all cultivars and yield of Midland and Hardie.

INTRODUCTION

Bermudagrass (*Cynodon dactylon* L.) cultivars have been selected for grazing, hay, and turf in the southern half of the United States (Magness et al. 1971). Major cultivars developed for forage production include; 'Coastal', 'Midland', 'Tifton 44', 'Hardie', 'Alicia', and 'Lancaster'. Coastal bermudagrass is a productive cross between 'Tift' and a bermudagrass introduced from South Africa that is adapted to the southern United States (Harlan et al. 1954; Powell et al. 1972; Burton, 1973; Kimbrough, 1996). Midland

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bermudagrass is a cross between Coastal and common bermudagrass that is more cold tolerant than Coastal.

Hardie bermudagrass, released in 1974, is a cross between Oklahoma Cynodon L.C. Rich. accessions 9945A and (8153 X 9953). Hardie is more vigorous, upright, and grows longer during the season than Midland, but is very susceptible to drought and heat (Taliaferro and Richardson, 1980).

Tifton 44, released in 1978, is a cross between Coastal bermudagrass and a bermudagrass from Berlin, Germany. Compared to Coastal, Tifton 44 is darker green, has finer stems that cure faster when cut for hay, and makes a denser sod. When compared to Midland, Tifton 44 is more resistant to foliar diseases and can be more productive. Tifton 44 begins growing earlier in the spring than most other cultivars (Burton et al. 1978; Mueller, 1992; Kimbrough, 1996).

Weeds reduce bermudagrass yield and quality (Burton, 1983; Kimbrough, 1996). In most cases, maintaining an adequate fertility program and using proper harvest management will keep bermudagrass competitive enough that weeds will not be a problem (Kimbrough, 1996). Control of weeds with herbicides is usually recommended in pastures when weed production makes up approximately 20% of the total forage production (Stritzke et al. 1989). In addition, control of some weed species is necessary since they are toxic to livestock and can cause short and long term health effects that could result in weight loss (Ashton and Monaco, 1991).

Herbicide selection is primarily dependent on weed species present, and herbicide application rate and timing can be critical for good weed control (Ashton, 1991). Herbicides

currently labeled for weed control in bermudagrass used for forage include the synthetic auxin type herbicides (2,4-D, dicamba, picloram, and triclopyr), the sulfonylurea herbicides (metsulfuron, and triasulfuron), and the photosynthesis inhibitors (terbacil and hexazinone). The most widely used postemergent herbicide for weed control in pastures is 2,4-D (Boyd, 1987; Watson et al. 1988). Often, 2,4-D is mixed with other herbicides to increase the spectrum of weed control. Two examples are picloram + 2,4-D (sold commercially as Grazon P+D) and 2,4-D + dicamba (sold commercially as Weedmaster) (Crop Protection Reference, 1995). Triclopyr is used primarily for control of woody plants. It is important to apply 2,4-D and other auxin type herbicides when weeds are actively growing (Crop Protection Reference, 1995).

Metsulfuron and triasulfuron, are most effective when applied early postemergence to small annual weeds (Crop Protection Reference, 1995). Although norflurazon is primarily used for control of grasses and broadleaf weeds in cotton, peanuts, and soybeans, Smith et al. (1992) reported good control of crabgrass in Coastal bermudagrass with norflurazon at rates as high as 2 lb/acre with no damage or decrease yield to bermudagrass (Ashton, 1991; Crop Protection Reference, 1995).

Recently, concerns have been raised about the tolerance of some bermudagrass cultivars to labeled herbicides. Bovey et al. (1974) evaluated the tolerance of bermudagrass to herbicides and reported that forage yields of common, Coastal, and a Coastal-cross were not reduced by 2,4-D and dicamba. However, picloram at 1 lb/acre or less caused transient injury to bermudagrass. Smith (1993) reported that picloram + 2,4-D at rates as low as 0.068 + 0.25 lb ae/acre applied in July reduced yield of Coastal bermudagrass. However, 2,4-D, 2,4-D +

dicamba at 0.75 + 0.25 lb ae/acre, dicamba at 0.5 lb ae/acre, and metsulfuron-methyl at less than 0.025 lb ai/acre did not damage Coastal bermudagrass. Eichorn (1994) evaluated a number of postemergence herbicides on Coastal bermudagrass, including dicamba at 0.5 lb ae/acre, 2,4-D at 1.0 and 2.0 lb ae/acre, 2,4-D + dicamba at 0.75 + 0.25 and 1.5 + 0.5 lb ae/acre, picloram + 2,4-D at 0.136 + 0.5 and 0.26 + 1.0 lb ae/acre, metsulfuron at 0.013 and 0.019 lb ai/acre and triasulfuron at 0.026 and 0.053 lb ai/acre. None of these treatments affected hay production of Coastal bermudagrass. Brooks et al. (1996) evaluated the following herbicide treatments on field plots of Tifton 85, Jiggs, and Coastal; picloram + 2,4-D at 0.068 + 0.25 and 0.136 + 0.5 lb ae/acre, dicamba + 2,4-D at 0.375 + 0.125 and 0.750 + 0.250 lb ae/acre, 2,4-D at 0.5 and 1.0 lb ae/acre, metsulfuron at 0.0038 and 0.0075 lb ai/acre, triasulfuron at 0.0131 and 0.0253 lb ae/acre, picloram at 0.125 lb ae/acre, dicamba at 0.25 lb ae/acre, and glyphosate at 0.5 lb ae/acre. Forage height, density, and yield data indicated that only glyphosate reduced yield and forage height of Jiggs and Tifton 85. Coastal was uninjured. In greenhouse studies these treatments did not reduce yield 12 days after treatment (DAT) in the Tifton 85 cultivar, however 26 DAT, significant dry matter reduction did result with picloram + 2,4-D (0.635 lb ae/acre) and glyphosate (0.5 lb ae/acre) treatments. In the Jiggs cultivar, data collected from clippings indicated significant growth reductions from all treatments 12 and 26 DAT for the low rates of metsulfuron, triasulfuron, and 2,4-D. Picloram, dicamba, and glyphosate reduced growth of Coastal at 12 and 26 DAT. Triasulfuron at 0.0131 lb ai/acre and metsulfuron at 0.0075 lb ai/acre caused no yield reductions at 12 or 26 DAT.

The three improved bermudagrass cultivars primarily grown in Oklahoma are Midland, Tifton 44, and Hardie. The objective of this research was to evaluate the tolerance of these

three improved bermudagrass cultivars to some of the standard and new herbicides used in bermudagrass for weed control.

MATERIALS AND METHODS

Sites selected for these studies were intensively managed bermudagrass pastures and hay fields that had a good stand of bermudagrass with few weed problems. Midland was evaluated at sites near El Reno and Lahoma, Oklahoma. Tifton 44 was evaluated at Lahoma and Perkins, and Hardie was evaluated at Lahoma only. The experimental design of all studies was a randomized complete block with four replications. Plot size was 7 ft by 25 ft. Data was collected from May to August, 1995. Herbicide treatments used in all studies are listed in Table 1.

Herbicides were applied using a CO_2 backpack sprayer traveling at 3.3 mph with water as the carrier. All applications were made at 35 psi. Herbicide treatments were applied on 22 May 1995 at El Reno, 1 June 1995 at Lahoma, and 3 June 1995 at Perkins. Heights of 20 randomly selected stems were determined in each plot at the time of treatment and at time of first forage harvest. Bermudagrass at El Reno and Perkins sites was harvested 37 and 25 DAT, respectively. Forage yields at these two sites were estimated by clipping forage from two 18 by 36 in. quadrats randomly placed in each plot. Harvested samples were bagged and oven dried at 118°F. Dry weights from each plot were used to calculate forage yield. Plots at El Reno were reharvested 49 DAT. Plots at Perkins could not be reharvested because cattle were allowed to graze the study site.

Forage yield in the three studies at Lahoma was determined 26 DAT by harvesting using a flail harvester at 3.25 x 8.13 ft area. The wet weight for each sample was

recorded and a sample was oven dried to determine dry matter. Plots were reharvested 50 DAT at Lahoma.

Stem heights and forage yields of all treatments were compared using analysis of variance procedure and significant effects separated by LSD (0.05) for a randomized complete block design.

RESULTS

There was visible stunting of Midland bermudagrass in triclopyr treated plots at El Reno 30 DAT. However, by harvest 37 DAT, there were no significant affects of any herbicide treatment on stem height and forage yield of Midland bermudagrass (Table 2). However, at Lahoma, triclopyr significantly reduced stem height and forage yield of Midland 26 DAT. Forage yields of regrowth after clipping were not affected by any treatment (data not shown).

The response of Tifton 44 was similar to Midland. No treatments affected stem heights or forage yields at Lahoma (Table 3). Triclopyr reduced stem height at Perkins, but forage yield was not significantly reduced. Regrowth of Tifton 44 was not affected by any herbicide treatment at Lahoma (data not shown) and regrowth was not taken at Perkins because of cattle grazing.

Stem height and forage yield of Hardie were significantly reduced by triclopyr and picloram + 2,4-D at 0.14 + 0.50 lb ae/acre (Table 4). Picloram + 2,4-D at 0.20 +0.75 lb ae/acre also reduced stem height but forage yield was not reduced (Table 4). Regrowth of Hardie was not affected by the herbicide treatments after the first clipping (data not shown).

CONCLUSIONS

Bermudagrass cultivars evaluated were tolerant to most herbicide treatments evaluated with the exception of triclopyr. Hardie appeared to be more sensitive to triclopyr than the two other cultivars used in this study. However, effects on all cultivars were short-lived since forage yield of regrowth after first clipping was not reduced.

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Table 1. Rate of active ingredient, trade name, and rate of product for herbicide treatments used in this study.

Herbicide treatment	Rate of active ingredient/acre	Trade name	Rate of product/acre
Picloram + 2,4-D	0.068 + 0.25 lb ae	Grazon P+D	1 pt
Picloram + 2,4-D	0.136 + 0.50 lb ae	Grazon P+D	2 pt
Picloram + 2,4-D	0.204 + 0.75 lb ae	Grazon P+D	3 pt
2,4-D + dicamba	0.375 + 0.125 lb ae	Weedmaster	1 pt
2,4-D + dicamba	0.750 + 0.250 lb ae	Weedmaster	2 pt
2,4-D + dicamba	1.125 + 0.375 lb ae	Weedmaster	3 pt
2,4-D	0.95 lb ae	Weedone	2 pt
Metsulfuron	0.011 lb ai	Ally	0.3 oz
Triasulfuron	0.020 lb ai	Amber	0.42 oz
Norflurazon	0.786 lb ai	Zorial	1 lb
Dicamba	0.5 lb ae	Banvel	1 pt
Picloram	0.25 lb ae	Tordon 22K	1 pt
Triclopyr	1.0 lb ae	Remedy	2 pt

Table 2. Stem height and forage yield of Midland bermudagrass harvested 37 and 26 days after application of herbicides at El Reno and Lahoma, respectively.

Herbicide treatment	Application rate	Site†			
		El Reno		Lahoma	
		Stem height	Forage yield	Stem height	Forage yield
	lb ae or ai/acre	in	lb/acre	in	lb/acre
No herbicide		18	3200	15 a	3600 a
2,4-D	0.95	18	3200	14 ab	3200 a
Picloram	0.25	16	2900	14 ab	2400 a
Picloram + 2,4-D	0.07 + 0.25	17	2800	15 a	3300 a
	0.14 + 0.50	17	3200	15 a	2900 a
	0.20 + 0.75	17	2700	15 a	2900 a
Dicamba	0.5	18	3100	15 a	3400 a
2,4-D + dicamba	0.38 + 0.13	19	3500	15 a	3500 a
	0.75 + 0.25	18	3300	15 a	3700 a
	1.13 + 0.38	18	3300	16 a	3000 a
Triclopyr	1.0	17	2700	11 b	900 b
Metsulfuron	0.011	17	3400	15 a	3500 a
Triasulfuron	0.020	17	3100	17 a	3200 a
Norflurazon	0.786	18	3400	14 ab	2900 a
LSD (0.05)		NS	NS	3.0	1400

† Plots at El Reno were harvested on 28 June 1995 [37 days after treatment (DAT)], and plots at Lahoma were harvested on 27 June 1995 (26 DAT).

Table 3. Stem height and forage yield of Tifton 44 bermudagrass harvested 26 and 25 days after application of herbicides at Lahoma and Perkins, respectively.

		Site†			
		Lahoma		Perkins	
Herbicide treatment	Application rate	Stem height	Forage yield	Stem height	Forage yield
	lb ae or ai/acre	in	lb/acre	in	lb/acre
No herbicide		19	4300	17 a	3500
2,4-D	0.95	19	4300	17 a	3600
Picloram	0.25	19	4800	17 a	3500
Picloram + 2,4-D	0.07 + 0.25	20	5400	17 a	3200
	0.14 + 0.50	20	3400	17 a	3400
	0.20 + 0.75	20	3700	17 a	3100
Dicamba	0.5	19	4400	18 a	3200
2,4-D + dicamba	0.38 + 0.13	21	5000	18 a	3600
	0.75 + 0.25	19	3600	18 a	3900
	1.13 + 0.38	20	4300	17 a	3300
Triclopyr	1.0	16	3100	14 b	2900
Metsulfuron	0.011	19	4400	17 a	3500
Triasulfuron	0.020	18	3800	17 a	3500
Norflurazon	0.786	18	4500	18 a	3500
LSD (0.05)		NS	NS	1.36	NS

† Plots at Lahoma were harvested on 27 June 1995 (26 DAT), and plots at Perkins were harvested on 28 June 1995 (25 DAT).

Table 4. Stem height and forage yield of Hardie bermudagrass harvested 26 days after application of herbicides at Lahoma.†

Herbicide treatment	Application rate	Stem height	Forage yield
	lb ae or ai/acre	in	lb/acre
No herbicide		24 a	7500 a
2,4-D	0.95	25 a	8100 a
Picloram	0.25	16 b	5500 a
Picloram + 2,4-D	0.07 + 0.25	24 a	6800 a
	0.14 + 0.50	20 b	3600 b
	0.20 + 0.75	17 c	4500 a
Dicamba	0.5	25 a	4500 a
2,4-D + dicamba	0.38 + 0.13	25 a	5400 a
	0.75 + 0.25	25 a	5100 a
	1.13 + 0.38	24 a	6800 a
Triclopyr	1.0	15 b	2800 b
Metsulfuron	0.011	24 a	4400 a
Triasulfuron	0.020	24 a	6000 a
Norflurazon	0.786	25 a	7400 a
LSD (0.05)		2.02	2700

† Plots were harvested 27 June 1995 (26 DAT).

APPENDIX A

Soil types and rainfall at experiment sites

	Rainfall		
Month	El Reno	Lahoma	Perkins
		in.	
May	6.77	4.81	7.39
June	8.82	8.45	9.39
July	3.05	2.95	
August	3.80	8.71	
	Soil type		
	Silt loam	silt loam	loam

VITA

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