THE EFFECT OF A FUNGICIDE, A HERBICIDE, AND SEEDING METHODS ON STAND ESTABLISHMENT OF TWO GRASSES FOR SOIL EROSION CONTROL

By

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CHAPTER I

INTRODUCTION

The establishment and maintenance of grass stands along highway rights-of-way is a vital part of soil erosion control. It is important that a good stand of adapted grass be established as quickly as possible before erosion becomes severe. Many methods of seeding roadsides are in use with little knowledge of which ones may give the best stand. Determination of the best planting method is very important. The possibility exists for one method greatly exceeding another in ability to establish stands of grass. If this is found, a uniform adaptation of the method to most areas might be possible. Stand establishment may be increased by a herbicide or fungicide treatment. The type of grass seeded may play an important part in producing a good stand. It is important that we find out if any of these factors significantly contribute to change in the plant population.

This investigation was initiated to determine which seeding method gives the best stand of grass. A John Deere drill, a Brillion seeder, a Nisbet grass seeder, and a hand broadcast method with a brush-drag covering were used in seeding weeping lovegrass, Eragrostis curvula (Schrad.) Nees., and an unnamed Asiatic bluestem, Bothriochloa intermedia var. indica (R. Br.) A. Camus, referred to locally as "B" blend. The effects of a herbicide, propazine, and a fungicide, Tersan, on stand establishment were also studied.

CHAPTER II

LITERATURE REVIEW

The planting of grass seed is usually done in one of two ways. It is either planted with some type of disk drill or some type of broadcasting mechanism. In order to determine the influence of common types of drills on the establishment of grass, Stark, Toevs, and Hafenrichter (15) used a single disk, a double disk, a deep-furrow-press (disk type), and a beet drill. Analyses of the data showed that there were no significant differences among the drills used. Stands were exceptionally uniform, and no differences resulted from depth of seeding. Barnes, Lang, and Beetle (1) obtained similar results.

Reynolds and Springfield (11), Hull et al. (7), and Plummer et al. (10) indicate that drilling is the best method of obtaining uniform distribution and covering of seed. Reynolds found that drilling proved superior to broadcasting ahead of the plow, broadcasting after the plow, and covering broadcast seed with a disk harrow on an experimental site where big sagebrush was eliminated by plowing. On a pinyon-juniper experimental site, drilling produced better stands than either broadcasting and covering with a harrow or planting with a cultipacker. They also found drilling gives more efficient use of seed and better establishment than broadcasting.

Although drilling is usually the most dependable seeding method, Lavin (8) found that broadcasting on a loose, well prepared seedbed will

often give as good results. On poor seedbeds, however, the benefits of drilling were more marked. There the drilled areas produced more than twice as much as the broadcast. Lavin's results also indicate that drilling cannot entirely compensate for poor seedbed preparation. Broadcasting is also competitive with drilling when moisture is plentiful. Gjertson (6) indicates covering of the seed is not necessary unless seeding on a dry site.

Dalrymple (4) reports that cultipacker planters, such as Brillion seeders, should be used only on firm, smooth, friable seedbeds since stands on rough seedbeds, cloddy soil, sticky clay, or soils inclined to severely crust have been unsatisfactory.

In stand establishment studies through the years 1960, 1961, and 1962, grass drills reportedly (5) established better stands than grain drills or broadcasts in the Oklahoma-Kansas-Texas area. The bluestem species studied, especially native bluestems, seemed to be better adapted to stand establishment than the lovegrass species.

Weeping lovegrass, according to Zak and Bredakis (16) in Massachusetts, became well established during all of the seasons. It was planted May 26, July 8, and August 27. In two studies by Richardson and Diseker (12) (13), weeping lovegrass germinated rapidly giving good cover, and of the warm season perennials weeping lovegrass ranked second to common bermuda as the most desirable ground cover plant. Cummings (3) investigated seedings of 22 grasses and leguminous cover plants. Of the 22 plants tested, weeping lovegrass seedings produced the best protective cover for bare, exposed sites on infertile strongly acid subsoils.

Lee (9) found that competition in new grass seedings often causes

such severe retarding and weakening of the crop plants that the stand may be lost or several years may elapse before the crop becomes well enough established to withstand the application of herbicides for weed control. As a result of weed competition, an estimated 15 to 20 percent of the new grass seedings in Western Oregon are plowed up before seed production. Lee also found that even with a thin stand of grass (his thinnest stand was one plant every 2.4 inches) without competition from weeds, plants soon filled vacant spots and made a solid row. He concluded that under these conditions one plant every six inches would probably be sufficient. Bryan and McMurphy (2) also found weed competition to severely retard and weaken crop plants. In their study weed competition was primarily crabgrass in "M" blend Asiatic bluestem. The second year's forage production of all species was reduced 28 to 70 percent of the production from weed free plots.

CHAPTER III

METHODS AND MATERIALS

In June, 1970, an area which had been worked with a disk plow was selected, and a program for the evaluation of planting methods, herbicide effect, fungicide treatment, and kind of grass on stand establishment was initiated. This area was located on the Oklahoma State University Agronomy Research Station at Stillwater.

The investigation was arranged in a completely randomized block design having three replications. A total of 32 treatments were included in each replication, and the plots were six feet by ten feet in size. The treatments were all combinations of four planting methods, two herbicide levels, two fungicide levels, and two kinds of grasses. The four planting methods were a John Deere drill, a Brillion seeder, a Nisbet grass seeder, and a method designated as a brush-drag. This method consisted of hand broadcast seed covered by dragging some brush across the plot. The John Deere drill and the Nisbet grass seeder were set at a planting depth of 1/2 inch. The pre-emergence herbicide, propazine, was applied at the rate of 1 lb. active ingredient/acre on half the plots, and the remainder were untreated. Weeping lovegrass, Eragrostis curvula (Schrad.) Nees., was seeded at the rate of 5.4 lbs. (2465.2 grams) bulk seed/acre, or 5 lbs. pure live seed/acre. The "B" blend Asiatic bluestem, Bothriochloa intermedia var. indica (R. Br.) A. Camus, was seeded at the rate of 7 lbs. (3178 grams) bulk seed/A. or

2 lbs. pure live seed/A. Both grasses were seeded at the rate generally recommended by the Oklahoma State Department of Highways for soil erosion control. The fungicide, Tersan, which is 75 percent thiram was used in excess on one-half of the seedings with the remainder untreated. Ten pounds of bulk "B" blend Asiatic bluestem seed were treated with 76.8 grams of Tersan. Ten pounds of bulk weeping lovegrass seed were treated with 38.4 grams of Tersan. The 32 treatments are presented in Table I.

Planting began June 19 when the two grasses were seeded with the Brillion seeder and the brush-drag method. A 0.23 inch rain fell that night so seeding with the John Deere drill and the Nisbet grass seeder was not finished until June 22. Since the Brillion seeder had no agitators, the "B" blend Asiatic bluestem had to be sown by hand, and then the Brillion seeder was run across the plot. A grass seed box attachment with an agitator was not available for the John Deere drill so constant seed agitation by hand was necessary when "B" blend Asiatic bluestem was seeded. Hand seeding was used in the brush-drag method, and a tree limb was drug across the plots to cover the seed. The preemergence herbicide, propazine, was applied June 22 after all seeding had been completed, and then approximately one-quarter inch of water was applied by sprinkler irrigation.

Determinations of stand establishment were made by counting the actual number of plants in 144 square inches of area. Three random areas of 144 square inches were counted from each plot. On the brush-drag seeded plots and the Brillion seeded plots a quadrate twelve inches by twelve inches was used. The same quadrate was used on the Nisbet drilled plots. When used here, the quadrate was kept parallel to the

TABLE I

SEEDING METHODS, HERBICIDE AND FUNGICIDE TREATMENTS, AND GRASS SPECIES INCLUDED IN AN INVESTIGATION OF STAND ESTABLISHMENT FOR SOIL EROSION CONTROL

Treatment Number	Seeding Method	Herbicide (Propazine)	Kind of Grass	Fungicide (Tersan)
1	John Deere	Present	"B" blend Asiatic bluestem	Present
2	"	"	Weeping lovegrass	"
3	"	"	"	Absent
4	"	"	"B" blend Asiatic bluestem	"
5	"	Absent	"	"
6	"	"	"	Present
7	"	"	Weeping lovegrass	Absent
8	"	"	"	Present
9	Brillion	Present	"B" blend Asiatic bluestem	"
10	"	"	Weeping lovegrass	"
11	"	"	"	Absent
12	"	"	"B" blend Asiatic bluestem	"
13	"	Absent	"	"
14	"	"	"	Present
15	"	"	Weeping lovegrass	Absent
16	"	"	"	Present
17	Nisbet	Present	"B" blend Asiatic bluestem	"
18	"	"	Weeping lovegrass	"
19	"	"	"	Absent
20	"	"	"B" blend Asiatic bluestem	"
21	"	Absent	"	"
22	"	"	"	Present
23	"	"	Weeping lovegrass	Absent
24	"	"	"	Present
25	Brush-drag	Present	"B" blend Asiatic bluestem	"
26	"	"	Weeping lovegrass	"
27	"	"	"	Absent
28	"	"	"B" blend Asiatic bluestem	"
29	"	Absent	"	"
30	"	"	"	Present
31	"	"	Weeping lovegrass	Absent
32	"	"	"	Present

rows. A quadrate of the dimensions twenty-four inches by six inches was used on the John Deere drilled plots. Here again, the quadrate was kept parallel to the rows in the plot with the twenty-four inch length running parallel to the rows. A twelve inch by twelve inch quadrate was used in all plots to determine weed populations. Three random samples were taken from each plot in weed population counts. The grass population was determined on September 13, and weed population counts were made on July 22 and August 10.

In the statistical analyses of the data, the transformation, $Z = \log (x + 1)$, where x equals the plant count in a quadrate, was made in order to stabilize the variance as described by Snedecor and Cochran (14).

CHAPTER IV

RESULTS AND DISCUSSION

A highly significant difference in grass population resulted from the use of the pre-emergence herbicide, propazine, and the kind of grass that was seeded. As can be seen in Figure 1, the plots with no herbicide treatment had an average of 6.3 grass plants per 144 square inches; whereas, those treated with propazine had an average of 12.4 plants. It was noted that by midsummer seedlings in the weedy plots were smaller, less robust, less vigorous, and shorter than the seedlings in the plots where the weeds were controlled. Signs of moisture stress in the form of leaf wilting in the seedlings having weed competition were observed. No signs of moisture stress in the seedlings with no weed competition were observed. This is in agreement with the results obtained by Bryan and McMurphy (2). When "B" blend Asiatic bluestem and weeping lovegrass plant populations were compared, a highly significant difference at the one percent level was observed as shown in Figure 2. The plots seeded with "B" blend Asiatic bluestem had an average of 2.4 plants per 144 square inches as compared to 27.6 plants per 144 square inches in those plots seeded with weeping lovegrass.

Weeping lovegrass produced better stands of grass then "B" blend Asiatic bluestem. This was true in all seeding methods, with or without fungicide, and with or without herbicide, as indicated in Figures

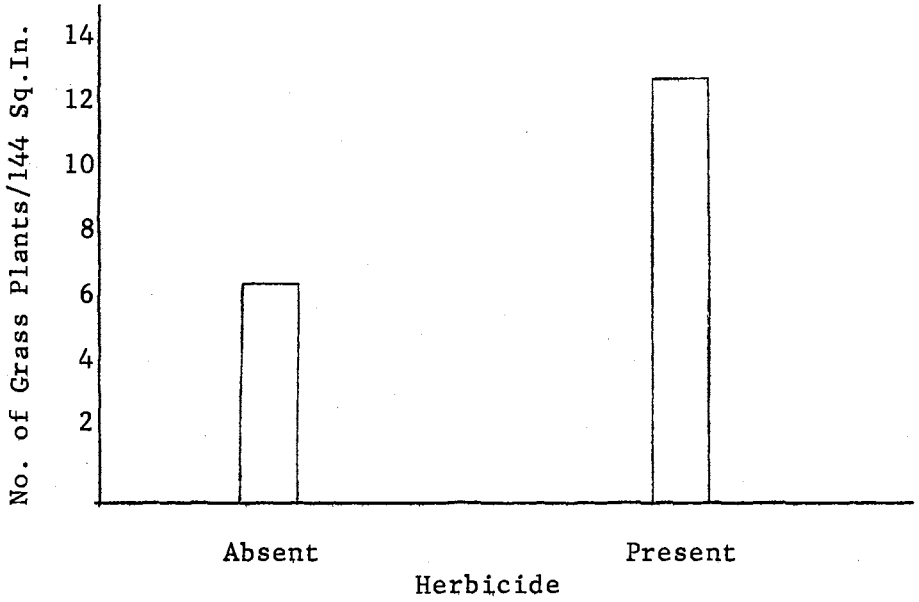

Figure 1. The Average Number of Grass Plants Per 144 Square Inches of Area in All Herbicide Plots

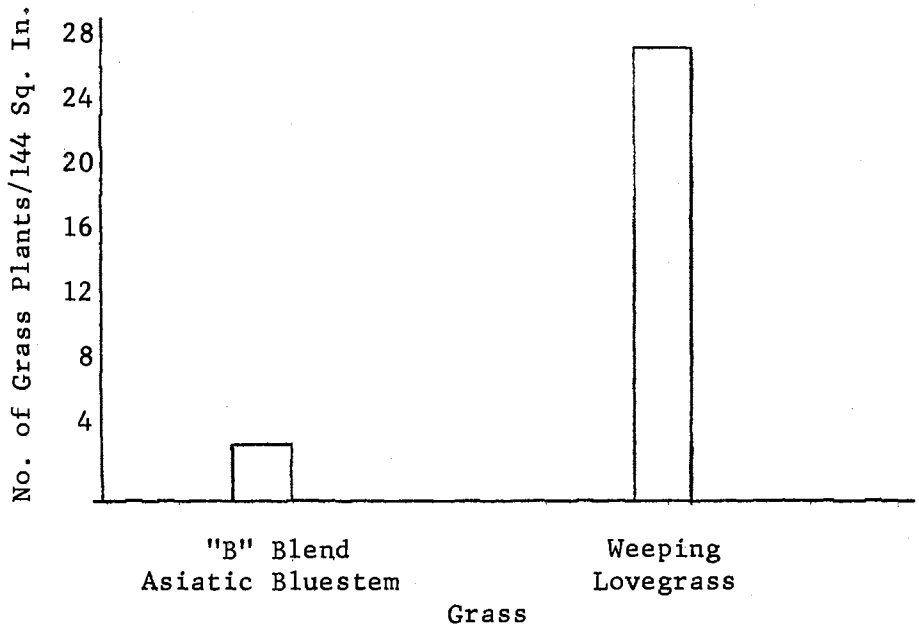

Figure 2. The Average Number of Grass Plants Per 144 Square Inches of Area in All Weeping Lovegrass and "B" Blend Asiatic Bluestem Plots

3, 4, and 5. In every case where propazine was used, the stands produced were better than the stands where no herbicide was used as shown in Figures 5, 6, and 7. There was not much difference in the effect of the fungicide level on the stand of grass as shown in Figure 8. A slightly better stand by about one plant per 144 square inches was obtained with no fungicide. The stand of weeping lovegrass was reduced by 16.9 percent for some unexplainable reason when a fungicide was added as Figure 4 shows. The addition of a fungicide to "B" blend Asiatic bluestem did not change the stand.

Although there were no significant differences among the four planting methods, the John Deere seeding method ranked first with brush-drag second, Brillion seeder third, and Nisbet grass seeder last as can be seen in Figure 9. A possible explanation for the reason that no differences were found between planting methods is that the seedbed was well prepared and adequate moisture was available during the establishment period of the grass. A total of 4.78 inches of precipitation was received in July as compared to a 30 year average of 3.69 inches for the month.[1] The daily rainfall for the months of June, July, and August for 1970 at Stillwater, Oklahoma, is presented in Table II.

In the presence of propazine the Brillion seeder, although not significantly different, produced the best stands with the John Deere drill second. In the absence of a herbicide the John Deere drill produced the best stands. With a fungicide present the brush-drag method proved best, and without a fungicide John Deere was best. In the Brillion and brush-drag methods the addition of a fungicide increases

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[1] U. S. Department of Commerce, Environmental Science Services Administration, Climatological Summary 1938-1967.

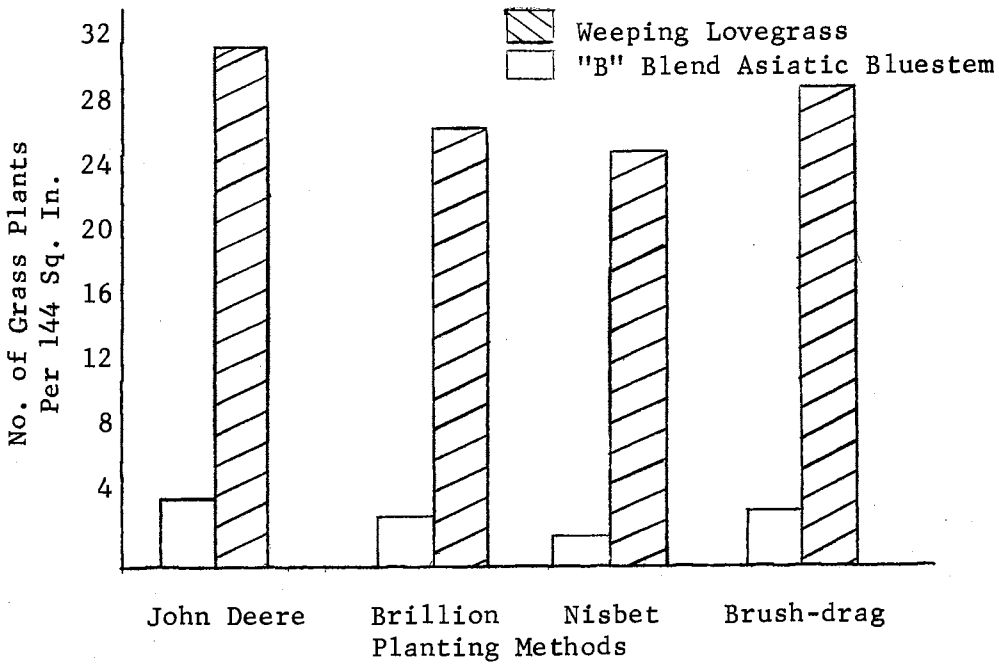

Figure 3. The Effect of Planting Methods and Kind of Grass on Stand Establishment

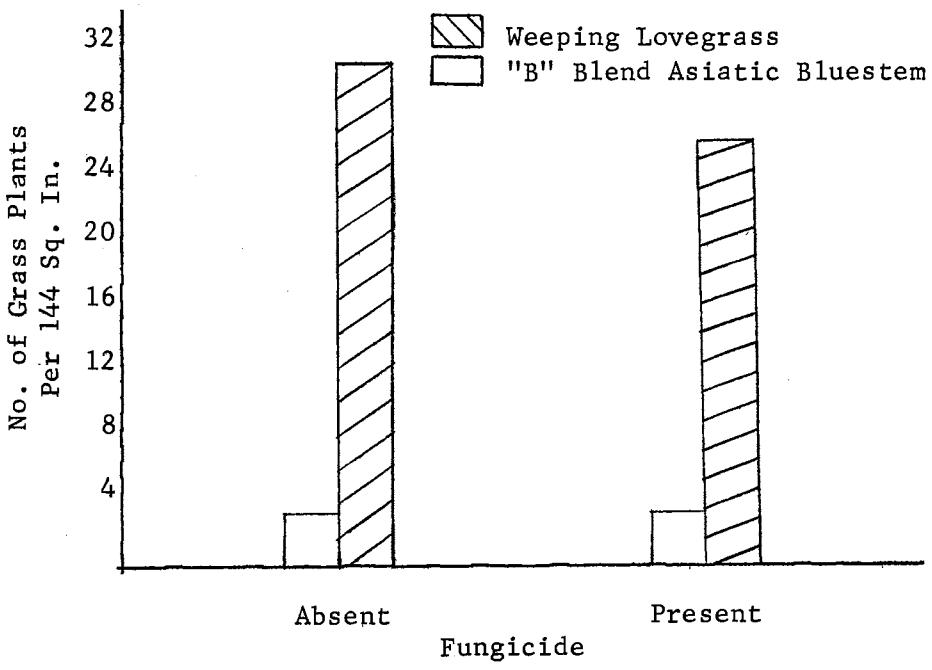

Figure 4. The Effect of Fungicide Treatments and Kind of Grass on Stand Establishment

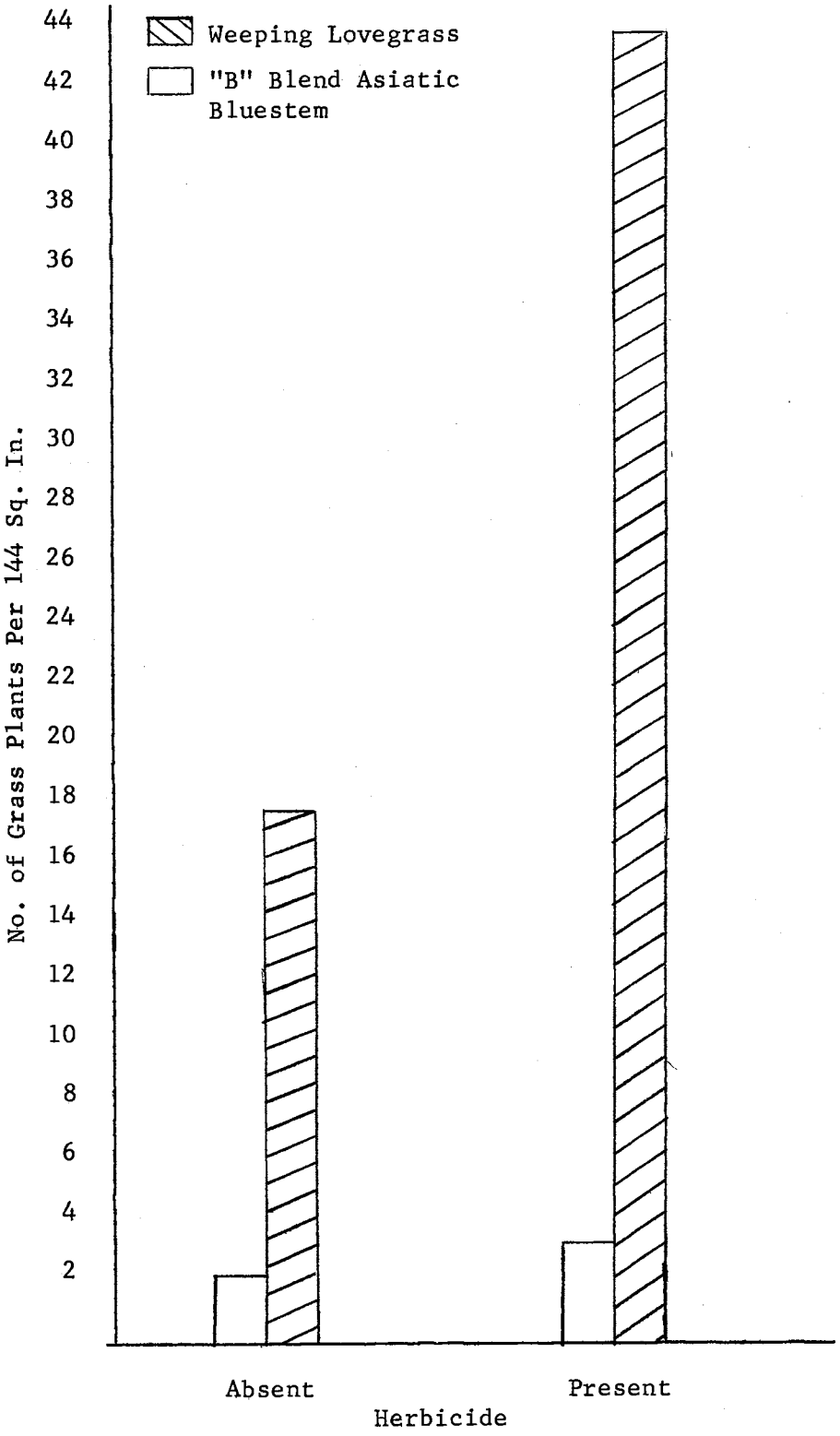

Figure 5. The Effect of Herbicide Treatments and Kind of Grass on Stand Establishment

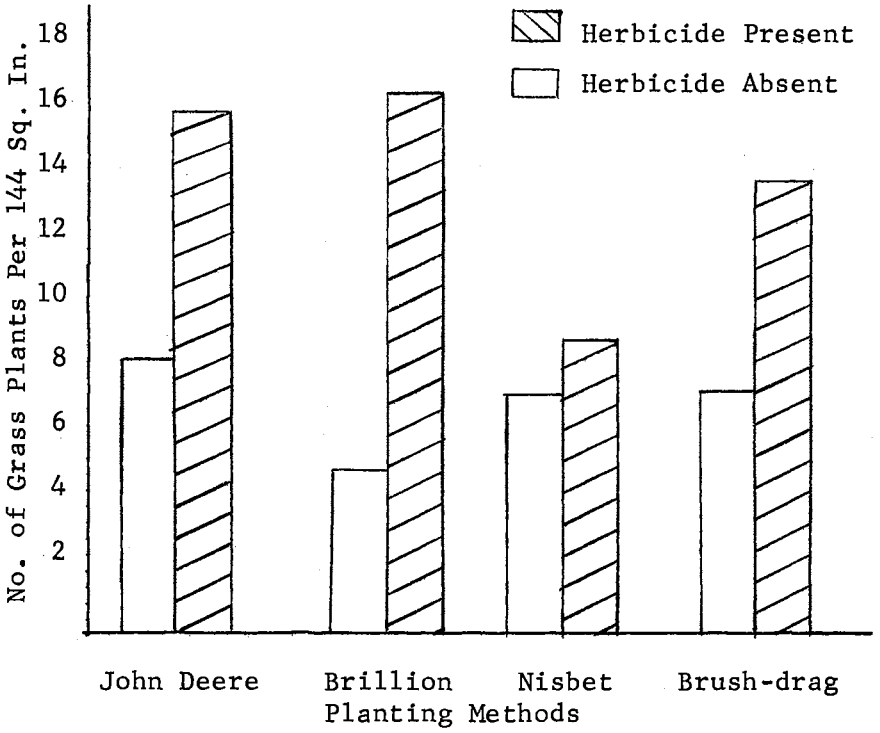

Figure 6. The Effect of Planting Methods and Herbicide Treatments on Stand Establishment

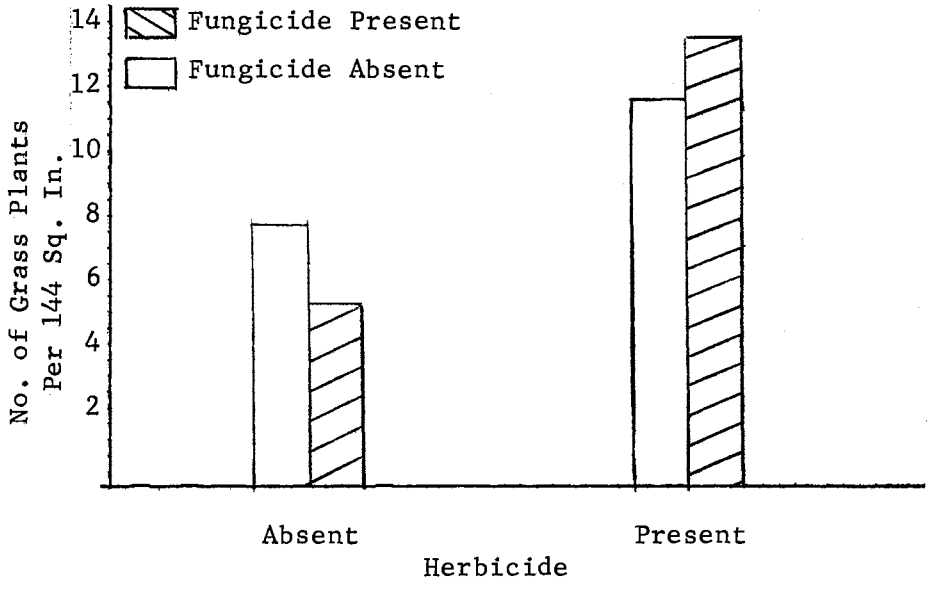

Figure 7. The Effect of Fungicide and Herbicide Treatments on Stand Establishment

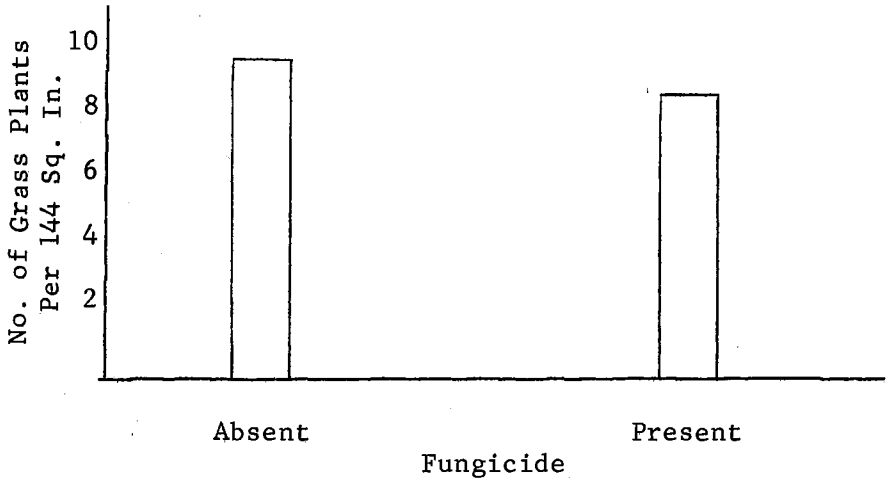

Figure 8. The Effect of Fungicide Treatments on the Number of Grass Plants Per 144 Square Inches of Area

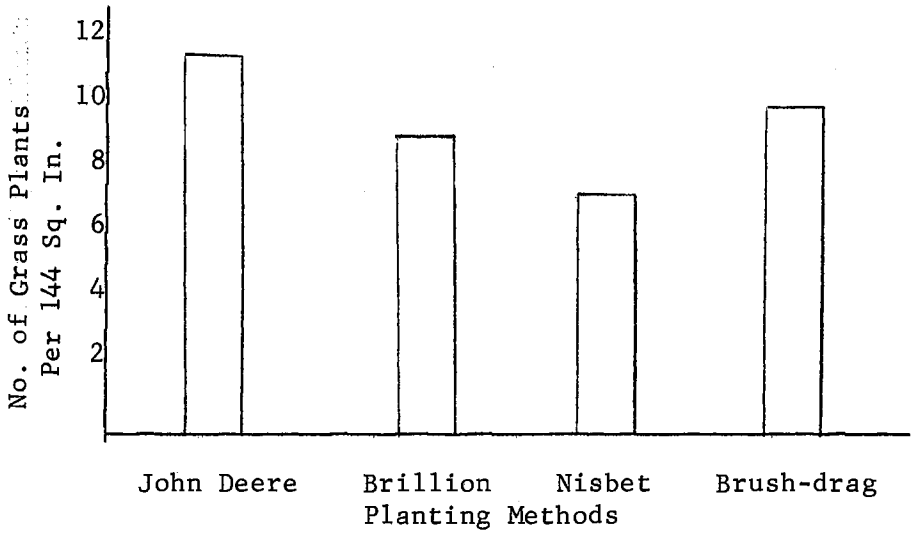

Figure 9. The Effect of Different Planting Methods on the Number of Grass Plants Per 144 Square Inches of Area

TABLE II

PRECIPITATION RECORD FOR THE MONTHS OF JUNE, JULY, AND AUGUST, 1970, AT STILLWATER, OKLAHOMA

June, 1970		July, 1970		August, 1970	
Day	Precipitation (Inches)	Day	Precipitation (Inches)	Day	Precipitation (Inches)
1	0.20	1		1	0.50
2	0.27	2		2	
3	0.57	3		3	
4	0.06	4		4	
5	0.12	5		5	
6		6		6	
7		7		7	
8		8		8	
9		9		9	0.03
10		10		10	
11	0.17	11	0.56	11	
12		12	1.15	12	
13		13		13	
14		14		14	
15		15	2.50	15	
16		16		16	
17		17		17	
18		18		18	
19		19	0.04	19	0.06
20	0.23	20	0.18	20	
21		21		21	0.04
22		22		22	0.69
23		23		23	0.07
24	0.21	24		24	
25		25		25	
26		26		26	
27		27		27	
28		28	0.35	28	
29		29		29	
30		30		30	
31		31		31	

the grass population, whereas in the John Deere and Nisbet methods, the addition of fungicide decreases the grass population. The reason for these responses to fungicide cannot be explained. This interaction effect is shown in Figure 10.

The effect of the weed population on the grass stands was also studied. As would be expected the presence of propazine drastically decreased the weed population. The average number of weeds, which is shown in Figure 11, in plots not treated with a herbicide was 14.6 per 144 square inches as compared to 1.7 weeds in plots treated with propazine. The weeds present in the plots were hairy crabgrass, Digitaria sanguinalis (L.), flower-of-an-hour, Hibiscus trionum (L.), field bindweed, Convolvulus arvensis (L.), and Eragrostis spp. (Beauv.). The weed population was also affected by the type of grass present. Weeping lovegrass with an average of 4.7 weeds per 144 square inches showed a significant ability to decrease weed population as shown in Figure 12. In contrast the "B" blend Asiatic bluestem plots averaged 6.5 weeds per 144 square inches. The "B" blend Asiatic bluestem plots which had no herbicide treatment had only 1.9 grass plants per 144 square inches. Those grass plants present were small and chlorotic with few tillers. In contrast the weeping lovegrass plots with no herbicide treatment had 17.4 grass plants per 144 square inches. The plots seeded with a Brillion seeder had the most weeds per 144 square inches with a 6.1 average as shown in Figure 13. The brush-drag seeded plots had only 5.1 weeds per 144 square inches which was the lowest average. The Brillion and brush-drag averages were not statistically different. The presence of Tersan as perhaps should be expected had little effect on the weed population as can be seen in Figure 14. The average number

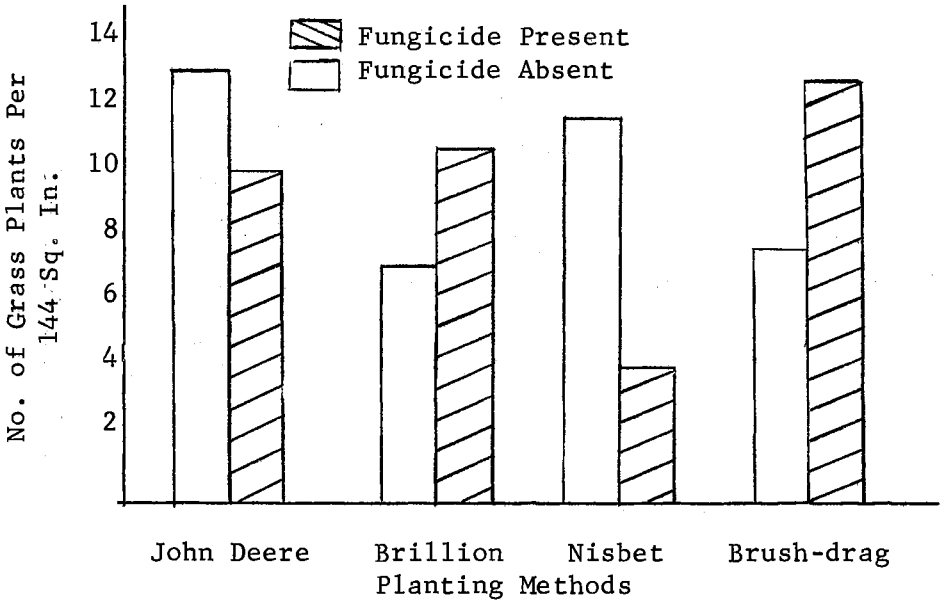

Figure 10. The Effect of Fungicide Treatments and Planting Methods on Stand Establishment

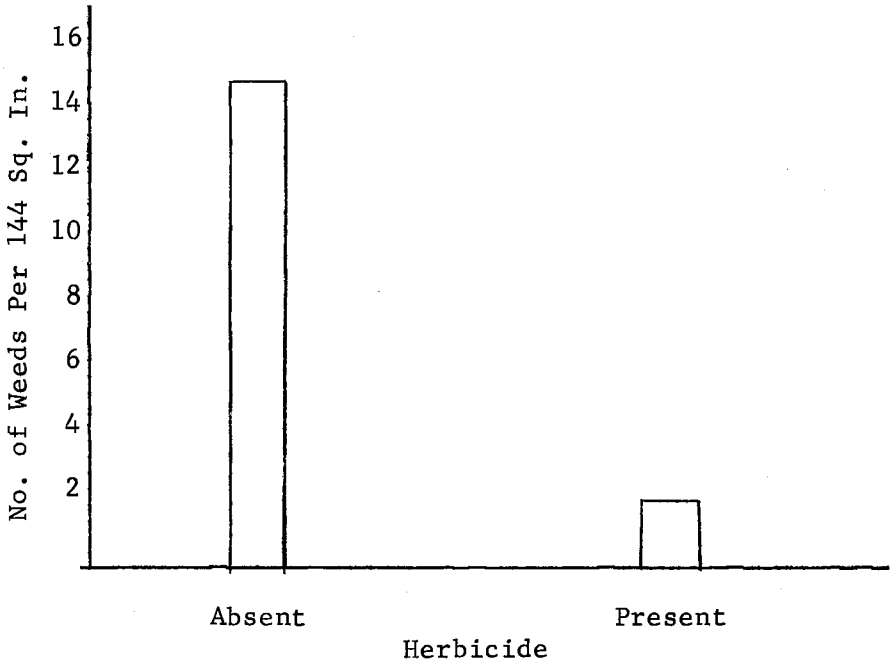

Figure 11. The Effect of Herbicide Treatments on the Number of Weeds Present Per 144 Square Inches of Area

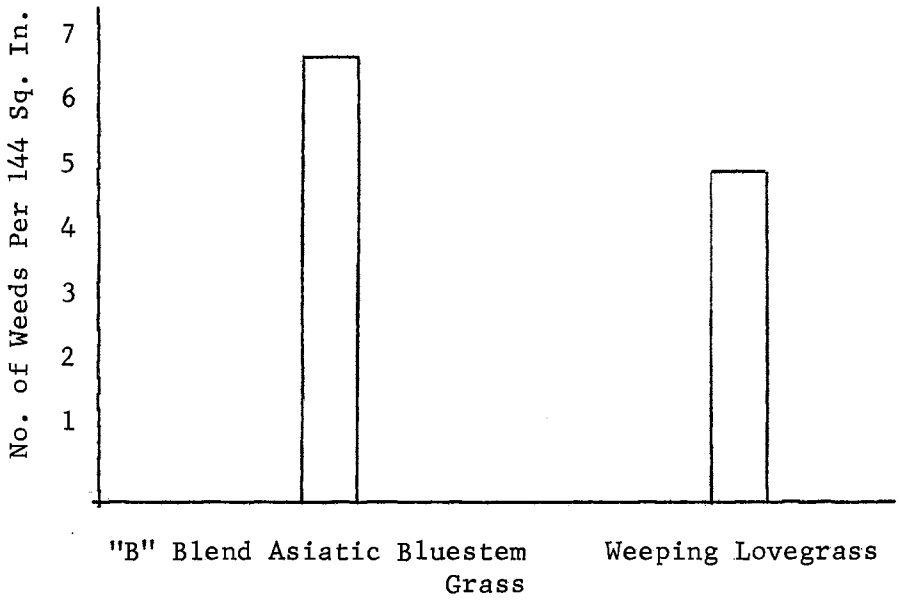

Figure 12. The Effect of Grass Stands on the Number of Weeds Present Per 144 Square Inches of Area

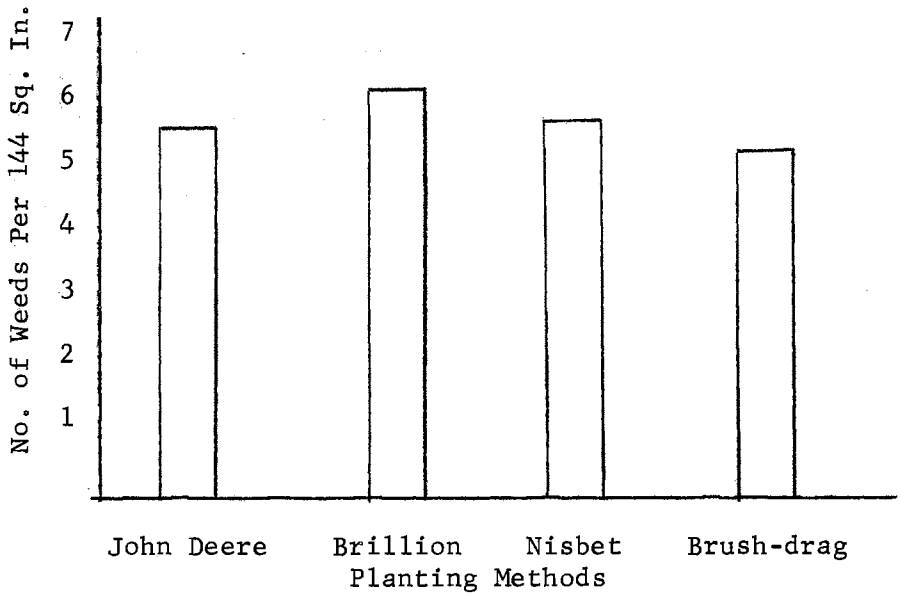

Figure 13. The Effect of Different Grass Seeding Methods on the Number of Weeds Present Per 144 Square Inches of Area

of weeds in 144 square inches in plots not treated with fungicide was 5.3, and plots which had seed treated with Tersan averaged 5.8 weeds per 144 square inches.

The difference in the weed population was studied at two different dates of counting. The planting methods, herbicide treatment, fungicide treatment, and kinds of grass were compared to each date to determine their effect on the weed population. According to the statistical analyses, the difference in the weed count from one date to the next was significant at the five percent level. There were 5.1 weeds per 144 square inches on July 22, and when counted on August 10, there were 6.0 weeds per 144 square inches. These readings are shown in Figure 15. As shown in Figure 16, the presence of a herbicide drastically decreased the weed population at both dates of counting when compared to the untreated plots. In the untreated plots the number of weeds per 144 square inches decreased slightly from 15.2 on July 22 to 14.0 on August 10. In the plots where the herbicide was present, the weed population increased slightly from 1.3 weeds per 144 square inches on July 22 to 2.2 weeds per 144 square inches on August 10. In the untreated plots the decrease was probably due to competition among the weeds and competition between the weeds and grass. In the herbicide treated plots the slight increase in the weed population might be due to the degradation of the propazine.

Figure 17 shows the interaction of dates and kinds of grass. Weeping lovegrass plots had fewer weeds than the "B" blend Asiatic bluestem plots at both counting dates. On July 22 the weeping lovegrass plots had 4.8 weeds per 144 square inches while 5.4 weeds per 144 square inches were found in the "B" blend Asiatic bluestem plots. On August

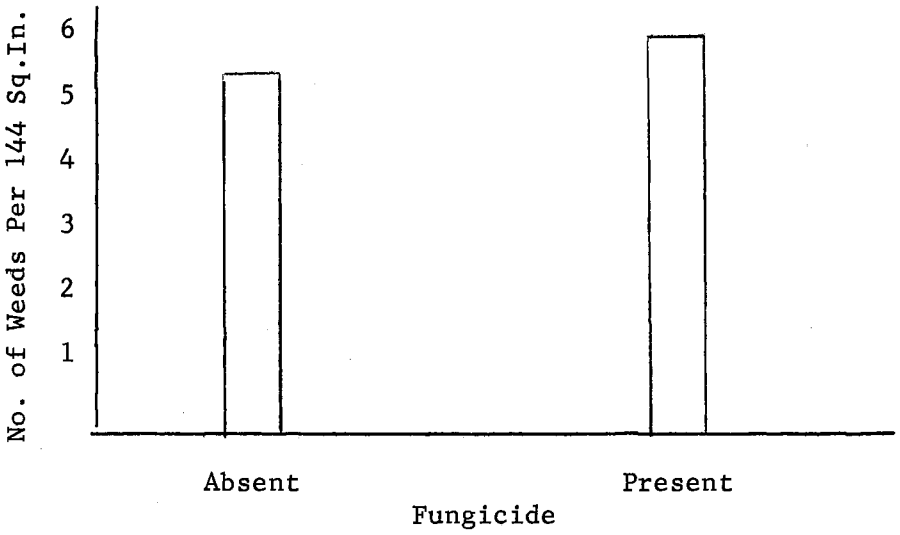

Figure 14. The Effect of Fungicide Treatments of the Grass Seeds on the Number of Weeds Present Per 144 Square Inches of Area

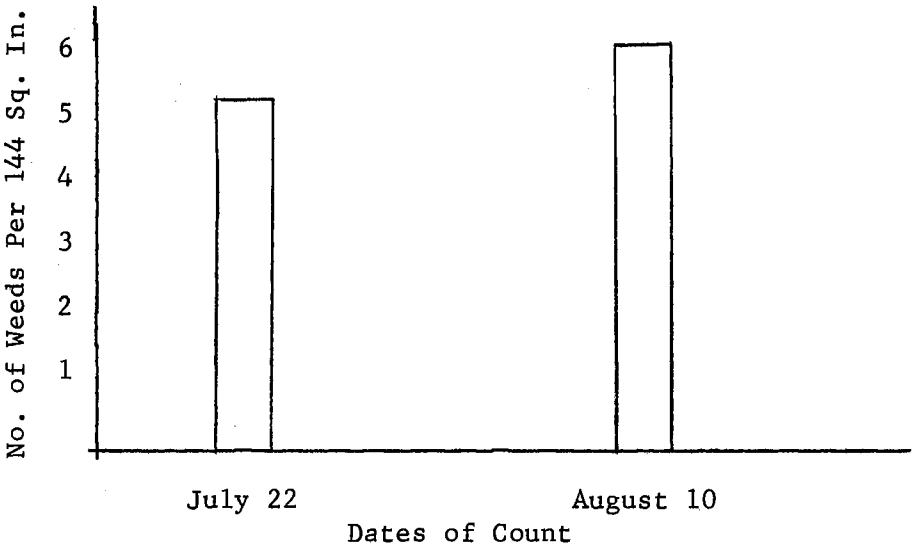

Figure 15. A Comparison of the Average Weed Populations in All Treatments at the Different Dates of Count

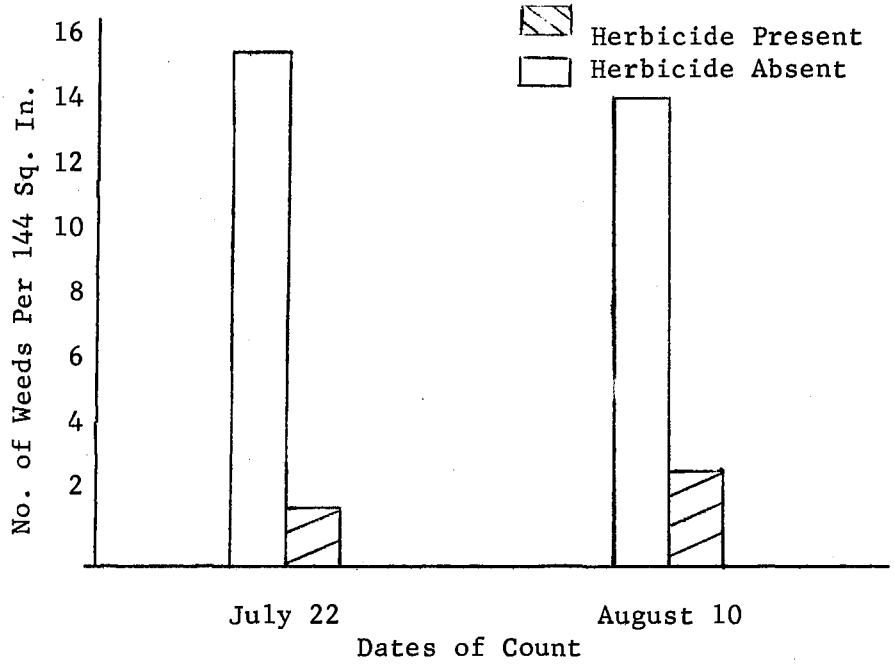

Figure 16. The Effect of Herbicide Treatments on the Weed Population at the Different Dates of Count

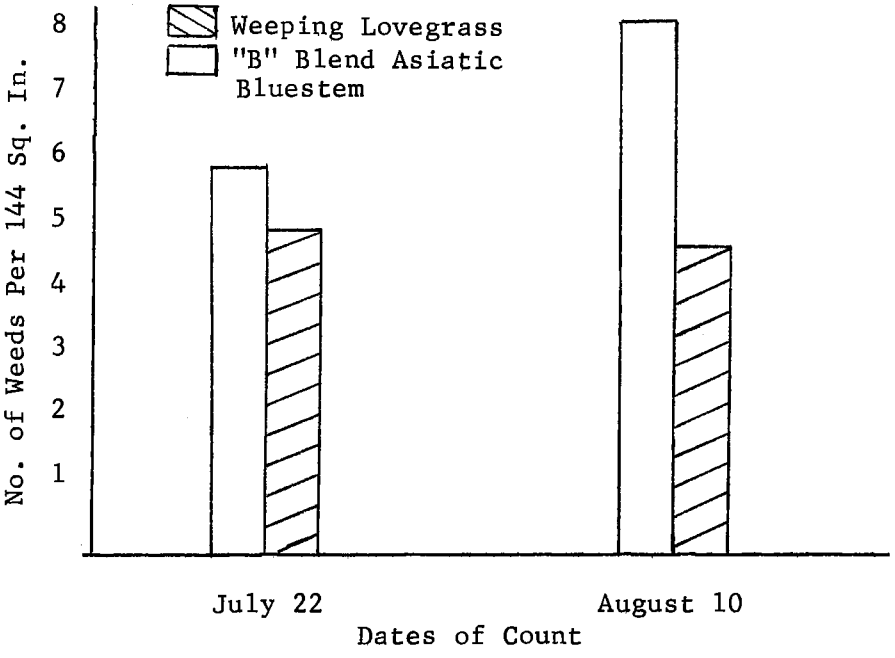

Figure 17. The Effect of Grass Stands on the Weed Population at the Different Dates of Count

10, the weed population in the weeping lovegrass plots had decreased from 4.8 to 4.5 plants per 144 square inches, but the "B" blend Asiatic bluestem plots had increased from 5.4 to 7.9 plants per 144 square inches. Evidently weeping lovegrass is more adept at competing with weeds than "B" blend Asiatic bluestem when seeded at these rates. When the weed population for each planting method was studied by each date counted, it was found that the weed population increased by the second date for every planting method. Although no significant difference was found, the Nisbet grass seeder had the fewest number of weeds per 144 square inches on August 10 as is shown in Figure 18. The John Deere drill had the fewest number of weeds on July 22.

The effect of the herbicide treatment and the kind of grass on the weed population at different dates is shown in Figure 19. The data showed that the weed population in the untreated "B" blend Asiatic bluestem plots remained rather constant with 18.3 weeds per 144 square inches on July 22 and 18.1 weeds per 144 square inches on August 10. The weeping lovegrass plots that received no herbicide had 12.5 weeds per 144 square inches on July 22 and 10.8 weeds per 144 square inches on August 10. In contrast, the bluestem plots treated with propazine had 1.1 weeds per 144 square inches on August 10. The propazine treated plots stayed about the same with 1.5 weeds per 144 square inches on July 22 and 1.6 weeds per 144 square inches on August 10.

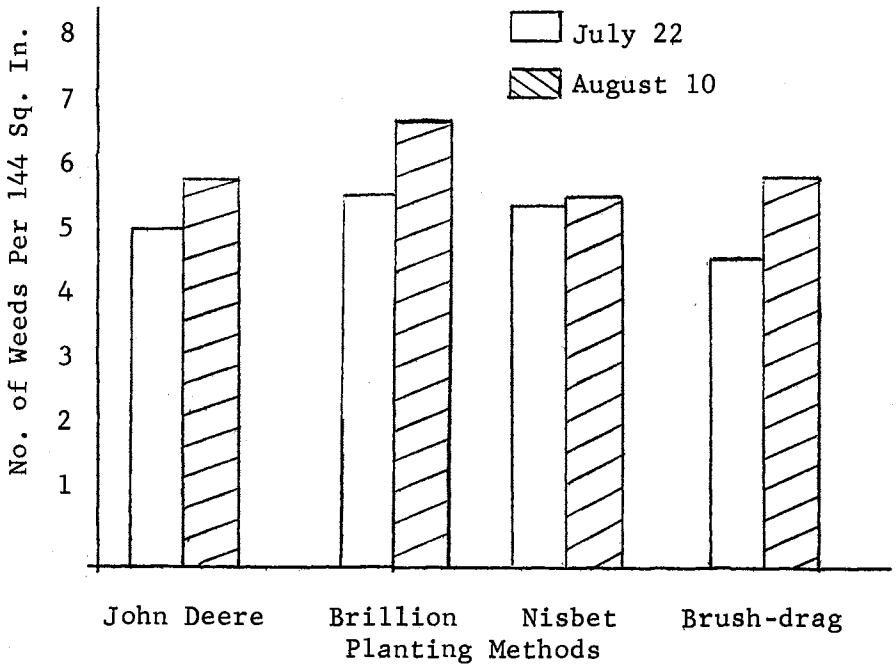

Figure 18. The Effect of the Different Planting Methods on the Weed Population at the Different Dates of Count

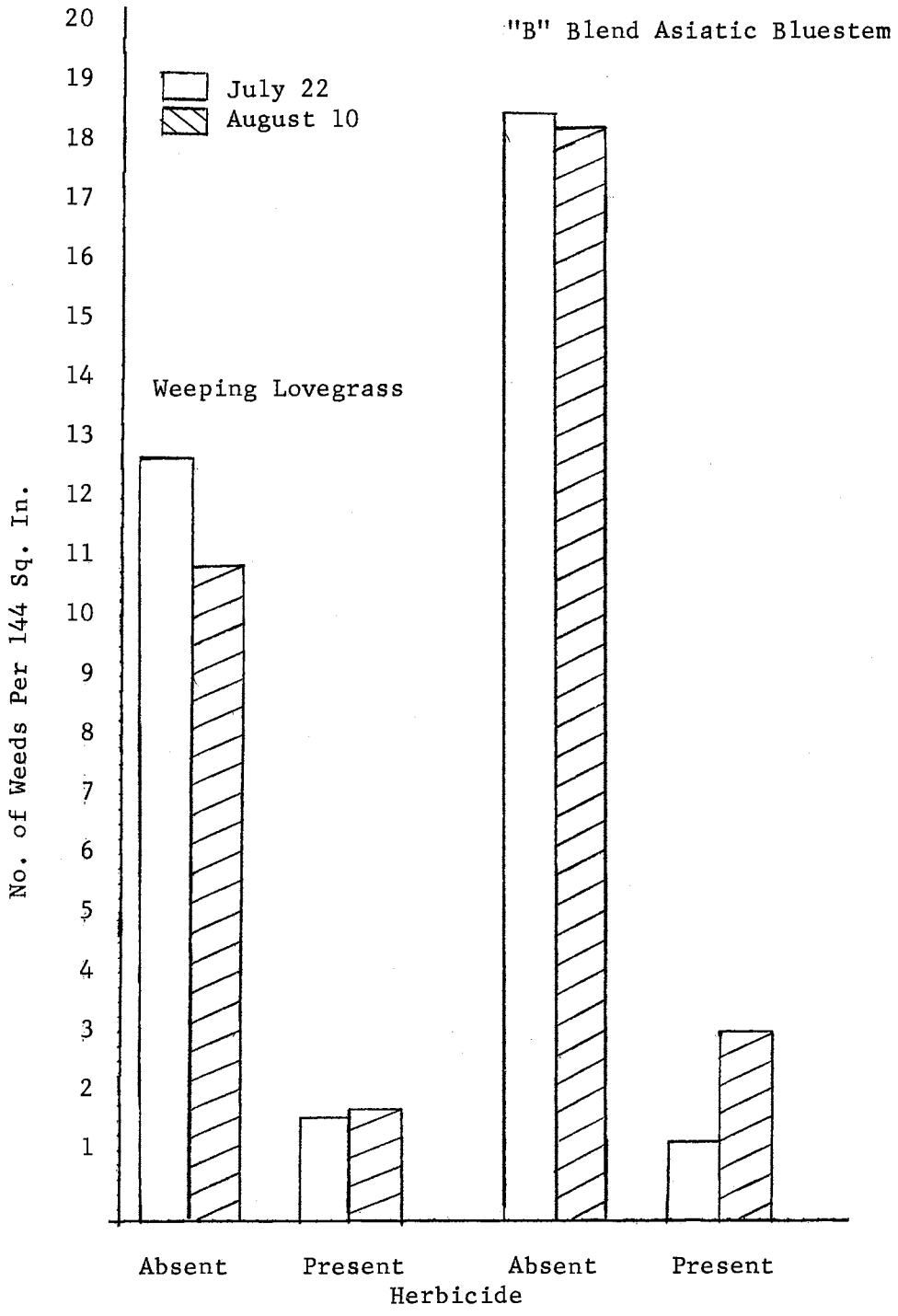

Figure 19. The Effect of the Herbicide Treatments and Stands of Grass on the Weed Population at the Different Dates of Count

CHAPTER V

SUMMARY AND CONCLUSIONS

In June of 1970, an investigation for the evaluation of planting methods, herbicide effects, fungicide benefits, and kinds of grasses on stand establishment for soil erosion control was initiated. Treatments consisted of all possible combinations of four planting methods, two herbicide levels, two fungicide levels, and two kinds of grasses.

The analyses of the data indicate that the grass population is greatly affected by the presence or absence of the pre-emergence herbicide, propazine, and by the kind of grass planted. Weeping lovegrass when seeded at five pounds pure live seed per acre produced 27.6 plants per 144 square inches. "B" blend Asiatic bluestem when seeded at two pounds pure live seed per acre produced 2.4 plants per 144 square inches. Although not statistically different, the overall performance of the John Deere drill with propazine and Tersan with either weeping lovegrass or "B" blend Asiatic bluestem produced the best stands of grass. In this investigation, the addition of the fungicide, Tersan, reduced the grass seedling population in those cases where the John Deere drill or Nisbet grass seeder were used. These results cannot be explained but are probably just the result of chance, yet they should be studied further.

The analyses of data on the weed population counts indicate that the pre-emergence application of propazine significantly reduces the

number of weeds. The stands produced by the kind of grass seeded also affect the weed population. "B" blend Asiatic bluestem seeded plots that were not treated with propazine averaged just over 18 weeds per 144 square inches. Weeping lovegrass, also in plots not treated with propazine, had about 12.5 weeds per 144 square inches.

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APPENDIX

TABLE III

THE ANALYSES OF VARIANCE OF THE EFFECT OF SEEDING METHODS, HERBICIDE AND FUNGICIDE TREATMENTS, AND GRASS SPECIES ON STAND ESTABLISHMENT

Source of Variance	d.f.	M.S.
Total (corrected)	287	0.4102
Replications	2	0.4455
Methods	3	0.4938
Herbicide	1	5.1784**
Varieties	1	61.3842**
Fungicide	1	0.1077
Meth. x Herb.	3	0.5263
Meth. x Vrty.	3	0.1048
Meth. x Fung.	3	1.4270*
Herb. x Vrty.	1	0.9240
Herb. x Fung.	1	0.6853
Vrty. x Fung.	1	0.1068
Meth. x Herb. x Vrty.	3	0.1181
Meth. x Herb. x Fung.	3	0.2413
Meth. x Vrty. x Fung.	3	0.6906
Herb. x Vrty. x Fung.	1	0.1297
Meth. x Herb. x Vrty. x Fung.	3	0.4592
Quadrate Samples in Plots	192	0.0684
Experimental Error	62	0.3712
General Mean		0.9942
C.V.		61.3 %

*Indicates significance at the 5 percent level of probability.

**Indicates significance at the 1 percent level of probability.

TABLE IV

THE ANALYSES OF VARIANCE OF THE EFFECT OF SEEDING METHODS, HERBICIDE AND FUNGICIDE TREATMENTS, AND GRASS SPECIES ON THE WEED POPULATION ON TWO COMBINED AND SEPARATE DATES OF COUNT

Source of Variance	d.f.	M.S.
Total (Corrected)	575	142.5233
Replications	2	1.2517*
Methods	3	0.1020
Herbicide	1	82.2788**
Variety	1	2.0777*
Fungicide	1	0.1323
Meth. x Herb.	3	0.2032
Meth. x Vrty.	3	0.0946
Meth. x Fung.	3	0.2433
Herb. x Vrty.	1	0.5671
Herb. x Fung.	1	0.0572
Vrty. x Fung.	1	0.0691
Meth. x Herb. x Vrty.	3	0.5114
Meth. x Herb. x Fung.	3	0.2686
Meth. x Vrty. x Fung.	3	0.2337
Herb. x Vrty. x Fung.	1	0.8644
Meth. x Herb. x Vrty. x Fung.	3	0.0621
Pooled Error A	62	0.3553
Reading Dates	1	0.4773*
Meth. x Dates	3	0.0544
Herb. x Dates	1	1.1753**
Vrty. x Dates	1	0.9526**
Fung. x Dates	1	0.0228
Meth. x Herb. x Dates	3	0.0769
Meth. x Vrty. x Dates	3	0.1666
Meth. x Fung. x Dates	3	0.0672
Herb. x Vrty. x Dates	1	0.4048*
Herb. x Fung. x Dates	1	0.0976
Vrty. x Fung. x Dates	1	0.1096
Meth. x Herb. x Vrty. x Dates	3	0.0391
Meth. x Herb. x Fung. x Dates	3	0.1438
Meth. x Vrty. x Fung. x Dates	3	0.1794
Herb. x Vrty. x Fung. x Dates	1	0.2013
Meth. x Herb. x Vrty. x Fung. x Dates	3	0.2075
Pooled Error B	64	0.0949
Quadrate Samples in Plots in Dates	384	0.0374
General Mean		0.8143
C.V. (Main Plot)		73.2 %
C.V. (Sub Plot)		37.8 %

*Indicates significance at the 5 percent level of probability.

**Indicates significance at the 1 percent level of probability.

VITA

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Master of Science

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