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Performance of WEEPING LOVEGRASS *Under Different Management Practices*

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Weeping lovegrass, *Eragrostis curvula* (Schrad.) Nees, is a rather recent introduction from central Africa into Oklahoma agriculture. It has several excellent qualities including prolific seed production, great seedling vigor, and ease of establishment. It has the ability to grow and produce on relatively poor soils, yet responds well to high nitrogen levels. On the other hand, the advanced growth of weeping lovegrass tends to be coarse and fibrous and low in palatability.

It became evident shortly after the grass was introduced that its utilization and the value derived from it would largely depend upon management practices employed. Therefore, research was initiated in 1948 at the Perkins Agronomy Farm of the Oklahoma Agricultural Experiment Station to determine the effects of various clippings and fertilizer treatments upon the forage yield, persistence, and chemical composition of this species.[2] The effect of fertilization upon seed yields was investigated at locations elsewhere.

REVIEW OF LITERATURE

The literature relative to management of weeping lovegrass has not been extensively reviewed previously, therefore a rather complete review is presented herewith. Adequate botanical descriptions of this species may be found elsewhere (3,10).[3]

Weeping lovegrass, a long-lived, warm-season perennial bunch grass was introduced into the United States in 1927 from Tanganyika in

[1] Respectively: Assistant Professor (Grasses), Department of Agronomy; Assistant Professor (Weed Control), Department of Agronomy; and Professor and Emeritus Head of Department, Department of Agricultural Chemistry Research.

[2] Recommendations for the establishment and management of weeping lovegrass in Oklahoma based in part on research results reported here, are given in this station's Forage Crops Leaflet No. FCL-16, "Weeping Lovegrass."

[3] Numbers in parentheses refer to the Literature Cited section, page 11.

central Africa (3), and proved to be well adapted to the southwestern United States and to Oklahoma (3,10). Cummings (4) found that weeping lovegrass was superior to 21 grasses and legumes in establishing cover on exposed sites of infertile, strongly acid subsoil in southeastern Tennessee. Staten and Elwell (10) report that weeping lovegrass provided a protective cover quicker than any of the native grasses tested on badly eroded, abandoned lands in central Oklahoma.

Soil Preference

Weeping lovegrass is well adapted to many different soil types. It has been observed growing on soils varying in texture from coarse sand to heavy silts and clays, differing in pH from strongly alkaline to highly acid, and ranging in fertility from very poor to fertile (3). Weeping lovegrass has been grown in Oklahoma on practically all sites and situations including deep sands, eroded and leached clays, and rocky outcroppings.

Climatic Requirements

Weeping lovegrass is a sun-loving species that grows best in open areas, but it is able to associate with shrub and tree growth when such growth is not dense.

This grass has survived winter temperatures of —20° F. near Deansboro, N. Y., but winter killed at temperatures of 0° F. and —5° F. at Woodward, Oklahoma (3). Temperature alone is not the most important factor in winter survival; a combination of factors such as soil type, soil moisture, humidity, and snow cover are also involved.

Weeping lovegrass requires at least 15 inches of rainfall to become permanently established (3). Bridges (2) reports the failure of this grass when planted in 28 separate plots near Las Cruces, New Mexico, because of the limited rainfall there which averages about nine inches per season. Savage (8) found that weeping lovegrass at Woodward emerged promptly, showed strong seedling vigor, rapid and vigorous growth, and was resistant to heat and drought.

Ecology

In central Africa where it is native, weeping lovegrass is an intermediate plant in the succession from depleted farm and range land to good and excellent native ranges. Bewes (1) states that many species of *Eragrostis* are important pioneers in the early stages of the plant succession in the South African grass-veld and that *Eragrostis curvula* is especially important there. The *Eragrostis* species in general belong to the early stages of the plant succession and are rare in the climax grasslands in Africa. When the climax grasses have been destroyed by such artificial agencies as burning, overuse and soil erosion, weeping lovegrass often becomes a sub-climax species (3). After weeping lovegrass invades such areas, the organic matter in the soil is gradually built up. The lovegrass then tends to give way to the climax species.

Forage and Seed Production

Forage and seed yield tests were conducted on eroded, terraced upland at Guthrie, Oklahoma, over a five-year period from 1939 to 1943 (10). Seedings were made by the broadcast method and at two row widths. The row widths consisted of 21- and 42-inch middles with the plots being cultivated. The broadcast seedings produced an average of 5,483 pounds of oven-dry forage per acre. The 21-inch rows produced 4,620 pounds and the 42-inch rows 4,320. Seed yields were reversed: the 42-inch row plots produced 100 pounds of seed per acre, the 21-inch rows produced 82 pounds, and the broadcast plots averaged only 62 pounds of seed per acre.

Crider (3) reports seed yield trials at three locations. In the summer of 1944 at Beltsville, Maryland, yields of 113 pounds of seed per acre were obtained on plots that were mowed and fertilized with 200 pounds of ammonium sulphate per acre. At Woodward, yields of plantings under irrigation ranged from 320 pounds to 450 pounds per acre, and those without irrigation from 60 to 140 pounds. Yields on river bottom land at Tuscon, Arizona, reached as high as 580 pounds per acre under irrigation. Yields of more than 1000 pounds per acre from three seed harvests per season have been obtained at that location.

Grazing Value

McMillen and Williams (7) found that weeping lovegrass compared favorably with the native grasses for early spring grazing in the Panhandle region of Oklahoma. In August and September, however, it was inferior in protein content to such native species as blue grama, *Bouteloua gracilis* (H.B.K.) Lag., and buffalo grass, *Buchloe dactyloides* (Nutt.) Engelm. Weeping lovegrass outyielded the native grasses in that area in a two-year grazing trial. It produced 169 pounds of beef per acre per grazing season as compared to 38 pounds of beef per acre per year from the native grasses.

Mules readily ate mature weeping lovegrass during the winter months at Stillwater, Oklahoma (10). Savage (8) states that the plant growth of weeping lovegrass is rather coarse and fibrous but is readily eaten by livestock. In South Africa it is considered a useful pasture grass, and cattle are fond of it when it is in the early stages of growth (3).

Chemical Composition

Staten and Elwell (10) show that the mature forage of this species compares favorably with the mature forage of native grass species in central Oklahoma. Analyses showed mature weeping lovegrass to contain 0.357 percent calcium, 0.065 percent phosphorus, and 9.38 percent protein. Native grasses from the same area in the same stage of growth averaged 0.442 percent calcium, 0.074 percent phosphorus, and 6.88 percent protein.

Savage and Heller (9) made extensive chemical analyses of weeping lovegrass forage grown at Woodward. They report calcium content of 0.708 percent in April, 0.307 percent in July, 0.381 percent in November, and 0.259 percent in March. The phosphorus content was 0.303 percent in April, 0.149 percent in July, 0.118 percent in November, and 0.076 percent in March. The protein content was 20.83 percent in April, 5.92 percent in July, 3.47 percent in November, and 4.28 percent in March. Chemical determinations were made throughout the year and the averages were 0.386 percent for calcium, 0.154 percent for phosphorus, and 7.42 percent for protein.

The same workers found that the carotene content was very high in April with 684.5 ppm. (parts per million), but decreased rapidly to 128.9 ppm. by July and to only 6.5 ppm. in March.

Fudge and Fraps (5) analyzed several grass species from the High Plains of Texas. They found that young plants of weeping lovegrass averaged 13.24 percent protein, with a low of 9.20 percent and a high of 16.75 percent. The average calcium content was 0.72 percent, ranging from 0.38 to 0.91 percent. Phosphorus averaged 0.38 percent, and ranged from 0.34 to 0.44 percent.

In general, the protein in the native grasses had very little relation to total nitrogen in the soil in that area of Texas. Protein in 54 samples of native grasses from soils which contained less than 0.061 percent nitrogen was as high as in those produced on soils which contained more than 0.180 percent nitrogen. The average phosphorus content of the grasses increased when the quantity of active phosphoric acid in the soil increased. At the young stage of growth, phosphoric acid in grass samples from soils which contained less than 31 ppm. active phosphoric acid averaged 0.35 percent compared with an average of

0.48 percent in samples from soils containing 201 to 400 ppm. active phosphoric acid.

Henrici (6)[4] analyzed the leaves of mature weeping lovegrass grown in South Africa and reported 6.56 percent protein, 0.29 percent phosphorus, and 0.46 calcium.

MATERIALS AND METHODS

Weeping lovegrass plots were established in the spring of 1948 on a Norge fine sandy loam soil at the Perkins Farm located nine miles south of Stillwater. The experiment was laid out in a randomized block design with four clipping treatments, two fertility levels, and three replications. The individual plots were 5 x 20 feet.

Experiments elsewhere tested the effect of fertilization upon seed production.

Clipping Treatments

The clipping intervals consisted of plots clipped every two, three, four, and six weeks. The two-week clipping interval simulated a heavily grazed pasture, the first clippings being made when the plants were only six inches high. The three-week interval simulated medium grazing, with the plants first clipped when they were 12 inches high. The four-week interval was comparable to light use with hay production, the plants being first clipped when in the pre-bloom stage. The six-week clipping interval simulated very light use with hay production, and the plants were first clipped when in the post-bloom stage.

Fertilizer Treatments

The two fertility levels were (a) an application of 300 pounds of ammonium nitrate (33 percent nitrogen) and (b) a check in which no fertilizer was added. The fertilized plots were treated once each year in early March.

Green weights were determined for each plot at every cutting. Samples were then taken for dry weight determinations, from which total forage yields per acre were computed.

A composite sample of each treatment was taken at each cutting date for chemical analysis. The percentages of moisture, ash, protein, fat, fiber, nitrogen free extract, calcium, phosphorus, and parts per

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[4] All analyses reported by these four groups of workers are on a dry matter basis.

million of carotene were determined. All analyses were according to the official and tentative methods of analyses of the Association of Official Agricultural Chemists.

Seed Production

Separate studies were conducted at seven locations in Oklahoma to determine the effect of fertilizer upon seed yields of weeping lovegrass. Treatments included check plots receiving no fertilizer and plots receiving nitrogen only, phosphate only, and a combination of nitrogen and phosphorus.

RESULTS AND DISCUSSION

Clipping

The two-week clipping interval (heavy pasture usage) was too severe; the plots were greatly reduced in stand as well as in vigor. Infestation of annual weeds in these plots became increasingly greater from the first to the third year of clipping.

Clipping at three-week intervals left unfertilized plots in only fair condition, but fertilized plots were in good condition. This treatment, usually unfertilized, is comparable to fairly heavy grazing with good pasture management. Such treatment should keep the forage fairly well grazed down and actively growing. It has been found that weeping lovegrass is readily eaten by livestock only when in the tender growing stage so this type of treatment might prove ideal when the sward is to be used for pasture.

The four- and six-week clipping intervals left all the plots in good to excellent condition at the end of three years. This indicates that if the sward is to be used for hay production only, the stand may be retained indefinitely with proper management.

Fertilization

The addition of nitrogen fertilizer increased forage yields at the different clipping intensities from 76 to 105 percent over similar plots receiving no fertilizer (Table 1). The percentage of protein was increased from 6 to 24 percent, and the total protein was increased from 111 to 142 percent.

The moisture and carotene contents were higher in forage from the fertilized plots. The phosphorus percentage was decreased on the fertilized plots, but the total phosphorus was increased because of the increased forage yields. The percentages of ash, fiber, fat, and calcium were affected only slightly.

The greatest forage yields containing the higher protein, moisture, and carotene percentages were obtained in the spring and early summer (Figures 1 and 2 and Tables I, II, and III). By mid-summer, the added nitrogen had been depleted and the available moisture was very limited in the fertilized and unfertilized plots alike. When the late August and early September rains came, both the forage yields and protein percentages increased, but there was no difference in performance on the fertilized and unfertilized plots. This indicates that the fertilizer applications should have been divided into two treatments, one in early spring and one in mid-summer. Heavier applications of nitrogen may have given greater returns than were obtained from the treatment discussed.

Seed Production

The results of the seed yield studies are presented in Table IV. The application of 90 pounds of nitrogen and 45 pounds of phosphate produced the maximum seed yields of 238 pounds per acre. Average yields with no fertilizer were 45 pounds. Phosphate was of minor value when little nitrogen was applied but became of increasing importance as the nitrogen was increased.

Summary of Results

Nitrogen fertilization of weeping lovegrass increased the forage yields and the protein, carotene, and moisture content of the forage, but slightly reduced the percentage of phosphorus. Such constituents as ash, calcium, fiber, fat, and nitrogen free extract were scarcely affected.

Heavy use without nitrogen fertilization resulted in rapid deterioration of the stand and loss of production. Heavy use with high nitrogen levels, however, produced as much forage as light use without fertilization and twice as much protein per acre. If the grass is to be used for summer pasture it should be heavily grazed for best results.

Seed yields were increased by the addition of nitrogen and phosphate fertilizers.

General Recommendations and Observations

Generally speaking, weeping lovegrass is not recommended by this experiment station for widespread range seeding; however, this grass is highly useful for special problem sites and areas. It may be used in many parts of the South and Southwest for planting on poor, leached, and eroded sites where it will be plowed up later to make way for better forage species after soil fertility has been built up enough to maintain the climax species. Such use would be similar to the place this grass occupies in Africa as a sub-climax grass, as described by Bewes (1) and Crider (3).

Weeping lovegrass is also of exceptional value for planting in small areas of intensive use such as feeding areas and traps adjacent to farm buildings.

It is drought enduring and persistent, thereby providing a valuable source of reserve roughage for emergency periods.

Although this grass becomes tough and fibrous as it nears maturity, it is not unique in that respect; most of the native summer-growing perennial grasses in central Oklahoma behave in a similar way. The principal difference is that weeping lovegrass reaches maturity very rapidly; therefore it must be kept in the active growing stage by heavy grazing or by mowing. If maintained in a succulent growing condition, it is readily eaten by most classes of livestock; but if it is allowed to reach maturity in the field, it is not relished by livestock during the summer months.

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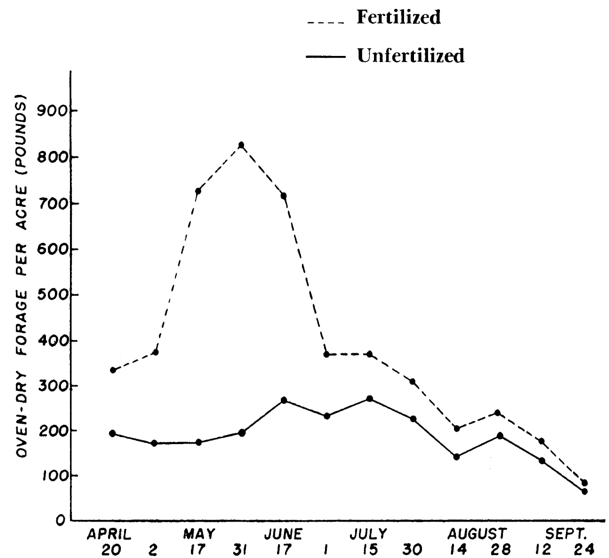

Fig. 1.—Seasonal trend in oven-dry forage yield of weeping lovegrass when clipped at 2-week intervals.

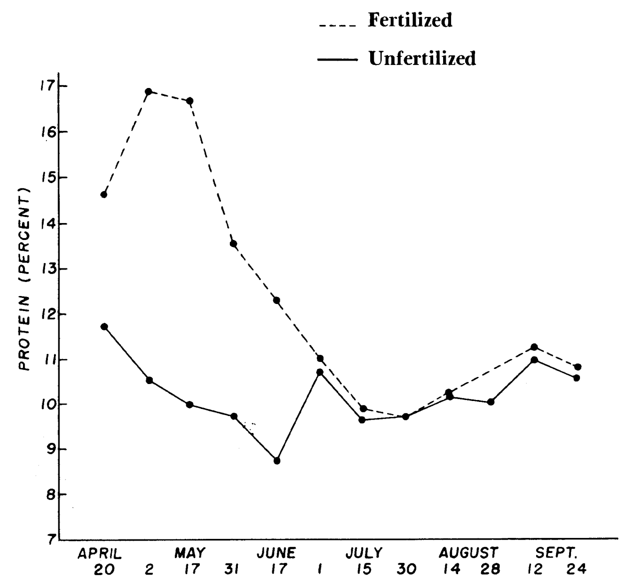

Fig. 2.—Seasonal trend in protein content of weeping lovegrass forage when clipped at 2-week intervals.

Table I.—The Effect of Clipping Intensities and Nitrogen Fertilization Upon the Dry Weight, Protein, and Phosphorus Content of Weeping Lovegrass; Average of Three Years, 1948-1950.

	Forage Yield (lbs. per acre; oven-dry)*	Protein		Phosphorus		Increased Yield per Acre due to fertilization (percent)			Condition of stand after three years
		Percent	Lbs. per Acre	Percent	Lbs. per acre	Forage	Protein	Phosphorus	
Unfertilized									
Clipped every two weeks	2,209	10.3	228	0.22	5	---	---	---	Very poor
Clipped every three weeks	3,235	8.4	272	0.18	6	---	---	---	Fair
Clipped every four weeks	3,335	7.5	250	0.18	6	---	---	---	Good
Clipped every six weeks	4,186	6.3	264	0.15	6	---	---	---	Excellent
Fertilized**									
Clipped every two weeks	4,537	12.2	554	0.20	9	105	142	80	Poor
Clipped every three weeks	5,692	10.0	569	0.17	10	76	109	66	Good
Clipped every four weeks	6,693	8.4	562	0.15	10	101	124	66	Excellent
Clipped every six weeks	8,199	7.1	582	0.14	12	96	120	100	Excellent

* Forage yield L.S.D.: .05=1,052 pounds of dry matter.
.01=1,460 pounds of dry matter.

** Fertilized with 100 pounds nitrogen.

Table II.—Summary of Chemical Analyses of Dry Forage Based on the Average of Three Seasons, 1948-1950.

Clipping interval (weeks)	Soil treatment	Monthly Averages (percent) April	May	June	July	Aug.	Sept.	Seasonal average (percent)
				Protein				
2	Fertilized*	15.72	15.05	10.73	9.82	10.44	10.05	11.96
	Not fertilized	11.25	9.85	10.00	9.73	10.44	10.62	10.32
3	Fertilized	12.35	12.76	10.67	8.38	8.74	9.44	10.39
	Not fertilized	8.36	7.96	7.82	8.80	8.51	8.46	8.32
4	Fertilized	12.01	8.17	7.66	6.73	6.90	9.02	8.42
	Not fertilized	8.48	6.94	7.02	7.44	6.75	8.86	7.58
6	Fertilized	-----	10.92	6.30	-----	4.90	6.30	7.10
	Not fertilized	-----	5.72	5.72	-----	5.98	7.77	6.30
				Calcium				
2	Fertilized	.435	.323	.290	.309	.310	.328	.332
	Not fertilized	.370	.354	.308	.316	.311	.325	.331
3	Fertilized	.312	.299	.325	.311	.336	.346	.322
	Not fertilized	.334	.291	.338	.302	.320	.338	.321
4	Fertilized	.340	.284	.313	.304	.271	.327	.307
	Not fertilized	.322	.301	.331	.334	.294	.334	.319
6	Fertilized	-----	.307	.406	------	.281	.321	.329
	Not fertilized	-----	.319	.364	------	.293	.325	.325
				Phosphorus				
2	Fertilized	.219	.198	.150	.206	.196	.211	.197
	Not fertilized	.192	.224	.206	.225	.230	.292	.220
3	Fertilized	.148	.145	.188	.161	.230	.203	.179
	Not fertilized	.166	.155	.206	.198	.180	.231	.189
4	Fertilized	.152	.136	.146	.159	.148	.171	.152
	Not fertilized	.168	.150	.167	.197	.172	.206	.177
6	Fertilized	-----	.145	.118	------	.162	.135	.140
	Not fertilized	-----	.140	.159	------	.152	.154	.151

* Fertilized with 100 pounds available nitrogen applied in early March each year.

Table II.—Continued.

Clipping interval (weeks)	Soil treatment	Monthly Averages (percent) April	May	June	July	Aug.	Sept.	Seasonal average (percent)
				Ash				
2	Fertilized	6.61	5.96	5.74	5.57	6.96	6.09	6.16
	Not fertilized	7.64	6.35	6.29	5.81	6.52	6.27	6.48
3	Fertilized	5.40	5.38	5.66	4.94	5.03	5.45	5.31
	Not fertilized	6.31	5.86	5.79	5.52	5.31	5.47	5.71
4	Fertilized	5.55	5.80	5.31	5.10	4.93	5.60	5.38
	Not fertilized	5.41	5.96	5.54	5.24	4.65	5.35	5.36
6	Fertilized	-----	5.98	5.96	-----	4.37	4.55	5.22
	Not fertilized	-----	5.86	5.49	-----	4.45	5.03	5.21
				Fat				
2	Fertilized	3.59	3.87	2.96	3.28	3.25	2.69	3.27
	Not fertilized	2.78	3.45	3.58	3.10	3.12	2.44	3.08
3	Fertilized	3.50	3.26	3.28	2.98	2.72	1.98	2.95
	Not fertilized	2.75	2.95	3.33	3.14	2.82	1.95	2.82
4	Fertilized	3.45	3.39	3.17	3.12	3.21	2.60	3.16
	Not fertilized	3.83	3.14	3.26	3.23	2.80	2.59	3.14
6	Fertilized	-----	3.09	2.50	-----	3.24	3.00	2.96
	Not fertilized	-----	2.66	2.57	-----	3.35	2.71	2.82
				Fiber				
2	Fertilized	27.00	27.10	31.96	30.19	32.66	30.79	29.95
	Not fertilized	28.11	31.02	32.75	30.51	31.28	31.56	30.87
3	Fertilized	30.19	31.96	33.82	31.89	32.04	30.44	31.72
	Not fertilized	28.23	32.25	33.01	34.52	33.63	32.79	32.41
4	Fertilized	31.50	32.96	38.15	32.52	31.83	32.90	33.31
	Not fertilized	32.20	32.79	38.01	34.12	33.62	33.11	33.98
6	Fertilized	-----	32.70	32.11	-----	34.59	32.05	32.86
	Not fertilized	-----	29.33	33.02	-----	32.98	33.25	32.15

Table II.—Continued.

Clipping interval (weeks)	Soil treatment	Monthly Averages (percent) April	May	June	July	Aug.	Sept.	Seasonal average (percent)
		Nitrogen Free Extract						
2	Fertilized	48.25	46.21	48.34	50.61	48.42	48.00	48.31
	Not fertilized	49.86	48.75	47.47	50.70	49.34	48.50	49.10
3	Fertilized	48.72	47.23	48.55	51.48	49.38	51.33	49.44
	Not fertilized	54.35	51.01	49.02	50.20	49.80	51.42	50.96
4	Fertilized	47.46	49.63	45.58	52.51	52.44	50.33	49.66
	Not fertilized	51.77	50.93	45.12	50.93	52.14	50.08	50.16
6	Fertilized	-----	47.29	53.11	-----	53.10	54.06	51.89
	Not fertilized	-----	56.42	53.16	-----	53.21	61.20	53.50
		Carotene *(Parts Per Million)*						
2	Fertilized	278	346	340	246	276	241	288
	Not fertilized	113	268	296	225	238	217	226
3	Fertilized	215	282	294	237	237	302	261
	Not fertilized	165	238	242	245	209	300	233
4	Fertilized	-----	361	315	234	287	178	275
	Not fertilized	-----	285	235	206	312	177	243
6	Fertilized	-----	234	219	-----	158	217	207
	Not fertilized	-----	208	129	-----	127	213	169
		Moisture *(Percent)* [Based on green sample]						
2	Fertilized	57	66	58	56	56	47	57
	Not fertilized	48	53	56	57	54	46	52
3	Fertilized	60	69	60	58	57	50	59
	Not fertilized	52	57	57	57	57	51	55
4	Fertilized	-----	68	62	57	53	49	58
	Not fertilized	-----	54	56	55	53	49	53
6	Fertilized	-----	66	53	-----	52	49	58
	Not fertilized	-----	55	53	-----	54	49	55

Table III.—Forage Yields by Months, and Seasonal Average, Fertilized and Unfertilized, for Four Clipping Intensities; Three-year Average, 1948-1950.

(Pounds, oven-dry)

Clipping interval (weeks)	Soil treatment	Monthly Averages (percent)						Seasonal average
		April	May	June	July	Aug.	Sept.	
2	Fertilized*	688	1477	1075	672	445	180	4537
	Not fertilized	347	355	503	492	347	165	2109
3	Fertilized	842	1703	1018	1348	442	339	5692
	Not fertilized	469	538	454	965	447	363	3235
4	Fertilized	---	2365	2600	894	614	220	6693
	Not fertilized	---	756	1219	608	552	200	3335
6	Fertilized	---	4167	1889	----	1421	722	8199
	Not fertilized	---	1189	1136	----	1159	702	4186

* Fertilized with 100 pounds available nitrogen applied in early March each year.

Table IV.—Effect of Various Rates of Fertilizer on Seed Production; Average of Seven Locations

Treatment		Avg. seed yield (lbs. per acre)	Advantage of N. over original seed yield	Advantage of P. over original seed yield + advantage of N.*
Nitrogen (lbs.)	Phosphate (lbs.)			
0	0	45**	---	--
0	45	45	---	0
45	0	131	86	--
45	45	147	86	16
67	0	142	97	--
67	45	186	97	44
90	0	159	114	--
90	45	238	114	79
135	0	155	110	--
135	45	236	110	81

* Assumed gain above nitrogen alone is due to phosphate.
** Original seed yield.