Effect of Fertilization and Date of Planting on Establishment of Perennial Summer Grasses in South Central Oklahoma

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Establishment of perennial grasses on abandoned fields of the Southern Great Plains is one of the most difficult tasks, and yet probably the major need, of the agriculture of that area. The low seedling vigor of some of the adapted grasses, the high temperature, eroding wind, and erratic rainfall of the area, coupled with low soil fertility of the usual seeding sites make establishment very difficult and uncertain.

The problem soils occupy areas that were cultivated one to three decades and then abandoned when soil erosion, depleted fertility, and economic conditions made further cropping unprofitable. The application of fertilizer as an aid to establishment of grass seedings has not received wide attention in this area. Investigations and demonstrations in the Southern Great Plains have shown that fertilizer additions to established stands of native grasses have usually given slight to nonsignificant increases in herbage production (Aldous, 1935; Frolik, 1941; Harper, 1957). Topdressings of phosphorous have usually been reported as increasing the phosphorous content of herbage but not the yield. Duncan and Ohlrogge (1958) showed that corn roots treated with a nitrogen-phosphorous fertilizer produced root proliferation and herbage yields that were not produced when only one fertilizer element was added. Walker, *et al* (1958), working in the Texas Panhandle, did not obtain a significant fertilizer response from band seeded native range grasses.

This investigation was made to evaluate band applications of fertilizer on initial growth and establishment of certain grasses. Adapted species, once established, are not difficult to maintain if proper grazing management is followed.

Procedure

Renfrow sandy clay loam was taken from the eroded surface of a field at the Noble Foundation's Lone Grove Farm and placed in a greenhouse bench. This field, used later for field experiments, had been out of cultivation for a decade or more. The experimental soil contained 1.4 percent organic matter, 140 pounds per acre of exchangeable K_2O, "very low" available phosphorous, and had a pH of 6.1.

King Ranch bluestem *(Adropogon ischaemum)*, weeping lovegrass *(Eragrostis curvula)*, Caddo switchgrass *(Panicum virgatum)*, and blue panicgrass *(Panicum antidotale)*, were seeded in the soil in a greenhouse bench experiment. Quantities of fertilizer equivalent to 100 pounds per acre were banded with the seed in rows 14 inches apart. The rates of N, P_2O_5 and K_2O applied are given in Table 1. A split plot design with two replications were employed. The grass was planted in late winter 1955, permitted to grow seven weeks, and harvested at soil level.

In the spring of 1955, 1956, and 1957 band seedings of grasses were made in the field. Fertilizer treatments and species planted varied from year to year. The 1955 planting was made in early June with a hand-pushed belt planter. The fertilizer and seed were mixed and planted in the same row. A 14-inch row width was used. This planting was irrigated once in mid-July. The 1955 planting was replicated five times. The 1956 and 1957 plantings were made in triplicate with a Servis Planter which placed the fertilizer two inches below the seed. These rows were 18 inches apart. Plantings were made on March 28, May 8, and June 11 in 1956; and on March 13, April 17, and June 8 in 1957 in prepared seedbeds. Yields were measured by harvesting the herbage at the end of the growing season.

Results

Weeping lovegrass was always the first to emerge. King Ranch bluestem was the slowest but continued to emerge over a period of several weeks.

Data from the greenhouse planting, summarized in Table 1, show that nitrogen alone was of no value. Phosphorous gave a

Table 1. Herbage yield dry weight of grasses grown in a greenhouse and harvested 45 days after seeding.

Pounds/acre N-P_2O_5-K_2O	Weeping lovegrass	Caddo switchgrass	Blue panicgrass	King Ranch bluestem
	(Grams per 2-foot-row length)			
0-0-0	.21	.18	.25	.20
5-0-0	.45	.26	.26	.13
10-0-0	.33	.27	.29	.13
20-0-0	.35	.25	.27	.15
0-10-0	1.25	.94	1.33	.34
5-10-0	3.51	1.28	2.88	1.98
10-10-0	5.28	1.37	2.96	1.03
20-10-0	5.76	1.02	3.87	.81
10-10-10	3.93	1.35	3.38	1.10

moderate yield increase, but nitrogen-phosphorous combinations gave markedly increased yields. Five- to ten-pound-per-acre applications of nitrogen were sufficient to obtain maximum response when phosphorous was also applied. These same trends were secured from the field trials.

The 1955 field experiment was a 3 x 4 factorial with 0, 5, 10, and 20 pounds of N, and O, 10, and 20 pounds of P_2O_5. An increase in herbage production was secured during the establishment year from a N-P_2O_5 fertilizer as compared to straight superphosphate. However, this yield increase with nitrogen did not persist beyond the establishment year. Conversely, the application of only ten pounds of P_2O_5 with the seed in 1955 was still apparent in the 1957 yield (Table 2).

In 1956, weeping lovegrass, Caddo switchgrass, King Ranch bluestem, Indiangrass *(Sorghastrum nutans)*, and little bluestem *(Andropogon scoparius)*, were planted on the three dates given. The summer of 1956 was extremely dry and the only plots that became established were the March 28 plantings of lovegrass and switchgrass and the May 18 planting of lovegrass (Table 3). Only two fertilizer treatments, check and 100 pounds per acre of 16-20-0 were used in 1956.

The 1957 experimental design was similar to the one used in 1956, except that Caucasian bluestem *(Andropogon intermedius caucasius)*, was used in place of little bluestem, and 8-32-0 fertilizer was used instead of 16-20-0. The 1957 plantings were not harvested but were rated according to stand and growth (Table 4).

Table 2. Response of grasses to band seeding applications of phosphorus, 1955 seeding.

Lbs. P_2O_5	Weeping lovegrass			Caddo switchgrass				Blue panicgrass			King Ranch bluestem		
per acre	1955	1956	1957	1955	1956	1957	Ave.	1955	1956	1957	1955	1956	1957
	(Pounds of hay herbage per acre)												
None	801	1332	[1]	630	1031	1086	916	654	269	[1]	1239	1198	[2]
10	1942	2436	[1]	937	1491	1482	1303	1369	582	[1]	2007	1867	[2]
20	1974	2350	[1]	1096	2012	1623	1577	1600	678	[1]	2301	2005	[2]
Ave.	1570	2035		886	1511	1390		1208	510	[1]	1849	1693	1319

[1] Died during 1956 drought
[2] Plots could not be individually harvested

Discussion

Summer perennial grasses adapted to the Southern Great Plains may respond to band seeding applications of fertilizer, even though established stands of the same species do not. The effect of only 10 pounds of P_2O_5 per acre applied in the row with the seed was still apparent and measurable three years later.

Grasses having strong seedling vigor, such as weeping lovegrass, blue panicgrass, and Caddo switchgrass, will respond to fertilizer grades such as 5-20-0 and 10-20-0.

Perhaps the greatest obstacle to successful establishment of seedings has been competing weedy vegetation—primarily prairie three-awn *(Aristida oligantha)*. Quantity and grade of fertilizer used, planting date, and seedling vigor of the various species are interdependent on one another in establishing adapted

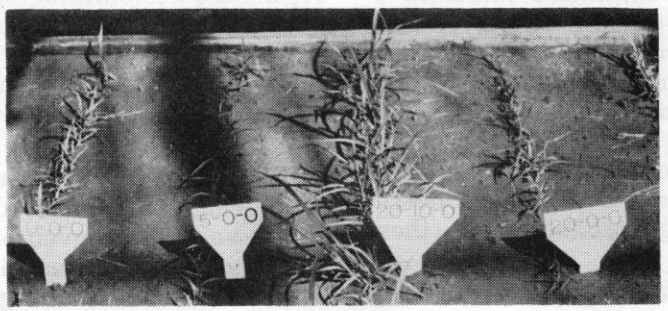

FIGURE 1. Growth response of King Ranch bluestem from a band of fertilizer applied with seed. Photographed four weeks after seeding in a greenhouse bench.

Table 3. Herbage produced by weeping lovegrass and Caddo switchgrass seeded and band fertilized on March 28 and May 18, 1956.

	March 28		May 18	
	Check	16-20-0	Check	16-20-0
	Pounds per acre			
Weeping lovegrass	532	1242	491	840
Caddo switchgrass	400	589		

Table 4. Relative establishment of five grasses planted at three dates in 1957.

Planting date	Weeping lovegrass	Caddo switchgrass	King Ranch bluestem	Indian-grass	Caucasian bluestem
March 13	3.2	2.7	0	0	1.0
April 17	4.7	4.0	1.2	0	1.8
June 8	0	0.3	0	0	0.3

0=complete failure; 5=satisfactory establishment

grasses. Unless the seed bed is known to be free of weed seeds, spring seeding should be delayed until weed seeds have germinated and the seedlings eradicated. If weed seeds are present, little or no fertilizer of any kind should be used.

April was the best time for establishment of most of the grasses tested. This was especially true for switchgrass and lovegrass. Late April or early May plantings were best for King Ranch bluestem.

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