NATIVE GRASSLAND FERTILIZATION

A native grassland fertilization trial was begun on the Dickinson Experiment Station in the spring of 1970. The initial trial was modified in 1971 to include more and different combinations of treatments in order to more fully evaluate fertilizer effects upon the native vegetation. The experimental site is located approximately three miles northwest of the Main Station on gently rolling topography consisting mainly of a sandy loam soil type. The vegetation is predominantly western wheatgrass (Agropyron smithii), plains reedgrass (Calamagrostis montanensis), needle-and-thread (Stipa comata), and fringed sage (Artemisia frigida).

The study presently includes 11 different treatments of various combinations of nitrogen, phosphorus, and potassium, nitrogen and phosphorus alone, heavy one-time nitrogen applications, and alternate year nitrogen applications. Plots receiving no nitrogen (check plots) are included in the study as a basis for comparison of treatment effects. The alternate year application includes only the 67-pound-nitrogen rate this season, but the 100-pound-nitrogen rate will be included in the 1972 season. Water availability and use efficiency, protein content, and soil nitrogen availability data are taken at weekly or bi-weekly intervals throughout the growing season. These data will be correlated with production (yield) data taken at the end of the growing season. The total yields from all treatments are hand-clipped, separated into components consisting of midgrasses, shortgrasses, perennial forbs and annual forbs, oven-dried and reported as pounds per acre. Fertilizer rates are expressed as actual pounds of elemental fertilizer per acre.

The data in Table 1 show that the highest total production (3289 lbs. / acre) from all treatments in 1971 was realized from the plots fertilized with a combination of 67 lbs. N plus 50 lbs. P per acre. The greatest response was by the midgrasses in the individual component categories with a yield of 1973 pounds per acre. The shortgrass component yielded approximately one-half as much as the midgrasses (1032 lbs. / acre), although this yield was also nearly as great as that shown by the same category under different fertilizer treatment rates. The 2-year average data show essentially the same results (Table 2.) Addition of 200 lbs. K to the 67 lbs. N + 50 lbs. P treatment did not increase the total yield and perhaps caused a decrease (3192 vs. 3289 lbs. / A) as indicated by the data in Table 1. Total forb production (509 lbs. / acre) however, was greatest at the 67 N + 50 P + 200 lbs. K / acre rate (Table 1).

The application of phosphorus or potassium alone showed only a slight increase in yields over that observed from check plots in 1971. The data show that the shortgrass component seems to be favored over all others by both of these treatments. Yields were slightly greater with the 200 K treatment than was observed with the 50 lbs. P treatment when compared with the check plots. In general, however, these yields do not appear to be significant with respect to practical application.

Plots receiving only 67 lbs. N fertilizer per acre in 1971 showed yields nearly as great as those obtained with the nitrogen + phosphorus application (Table 1). Again, the midgrasses were the highest yielding and were nearly double that of the shortgrasses. The 2-year average yields of all treatments applied annually showed the 67 lb. N treatment as being only somewhat lower yielding than the 67 lb. N + 50 lb. P treatment (Table 2). The 100 lb. N treatment showed a lower total yield than was observed from the 67-pound nitrogen rate of application (Tables 1 and 2).

Table 1. Forage Production from a Native Grassland Fertilized with Nitrogen, Phosphorus, and Potassium at Different Rates - 1971 Season

	Dry Weight Yield – Pounds per Acre						
Treatments lb. / Fertilizer	**Mid Grasses**	**Short Grasses**	**Perennial Forbs**	**Annual Forbs**	**Total Grasses**	**Total Forbs**	**Total Yield**
67 N every year	1759	905	362	87	2664	449	3113
67 N every other year[2/]	749	1079	292	14	1828	306	2134
100 N every year	1311	745	146	6	2056	152	2208
200 N[1/]	1701	847	265	4	2548	269	2817
300 N[1/]	1808	868	272	25	2676	297	2973
400 N[1/]	1654	1191	299	54	2845	353	3198
67 N – 50 P every year	1973	1032	269	15	3005	284	3289
67 N – 50 P – 200 K every year	1778	905	485	24	2683	509	3192
50 P every year	605	941	216	57	1546	273	1819
200 K every year	762	1069	167	27	1831	194	2025
Check No fertilizer	883	832	84	11	1715	95	1810

1/ One-time application, spring, 1970.

2/ Fertilizer applied spring, 1971.

Nitrogen rates of 200, 300, and 400 lbs. N / acre were applied in the spring of 1970. These plots have not received additional treatment or fertilizer applications since that time. The 1971 data showed the total yields of the treatments in increasing order to be 2817, 2973, and 3198 pounds per acre, respectively (Table 1). The actual differences in total yield were relatively small and showed no substantial advantage between rates of application. No appreciable differences in yield were observed between treatments or within the different components in either the 1971 or 1970-71 growing seasons (compare Tables 1 and 2). A decrease in yield of shortgrasses in 1971 was observed at all of the heavy rates of application. The yields of the midgrass species remained essentially the same in both the 1970 and 1971 seasons. It is becoming evident that a change in the plant community is occurring with an increase in midgrasses followed by a corresponding decrease in the shortgrasses. The forb component has increased appreciably during the study period at all rates of fertilization when compared with the check plot data (Tables 1 and 2).

The percentage composition of yields for the 1971 season is given in Table 3. In general, the plots fertilized with nitrogen alone or in combination with either phosphorus or potassium, show a definite increase in midgrasses with a corresponding decrease in shortgrasses. The 2-year average data also show similar results (Table 4).

Table 2. Average Forage Production from a Native Grassland Fertilized with Nitrogen, Phosphorus, and Potassium at Different Rates - 1970-1971 Seasons

	Dry Weight Yield - Pounds per Acre						
Treatments lbs. / Fertilizer	**Mid Grasses**	**Short Grasses**	**Perennial Forbs**	**Annual Forbs**	**Total Grasses**	**Total Forbs**	**Total Yield**
67 N every year	1366	1218	430	49	2584	479	3063
67 N every other year 1/	749	1079	292	14	1828	306	2134
100 N every year	1441	1022	324	7	2463	331	2794
200 N 2/	1668	1017	347	4	2685	351	3036
300 N 2/	1902	1166	465	15	3068	480	3548
400 N 2/	1678	1277	378	30	2955	408	3363
67 N – 50 P every year	1404	1308	455	17	2712	472	3184
67 N – 50 P – 200 K every year 1/	1778	905	485	24	2683	509	3192
50 P every year	653	1042	229	47	1695	276	1971
200 K every year 1/	762	1069	167	27	1831	194	2025
Check No fertilizer	894	955	128	22	1849	150	1999

1/ 1971 data only.

2/ One-time application, spring, 1970.

Table 3. Percentage Composition of Yields from a Native Grassland Site Fertilized with Nitrogen, Phosphorus, and Potassium at Different Rates and Combinations – 1971 Season

	Composition of Yields - Percent						
Treatments lbs. / Fertilizer	**Mid Grasses**	**Short Grasses**	**Perennial Forbs**	**Annual Forbs**	**Total Grasses**	**Total Forbs**	**Total Yield**
67 N every year	56.5	29.1	11.6	2.8	85.6	14.4	3113
67 N every other year[2/]	35.1	50.6	13.7	0.7	85.7	14.3	2134
100 N every year	59.3	33.7	6.6	0.2	93.1	6.9	2208
200 N[1/]	60.3	30.1	9.4	0.1	90.5	9.5	2817
300 N[1/]	60.8	29.2	9.1	0.8	90.0	10.0	2973
400 N[1/]	51.7	37.2	9.3	16.9	89.0	11.0	3198
67 N – 50 P every year	60.0	31.3	8.1	0.4	91.4	8.6	3289
67 N – 50 P – 200 K every year	55.7	28.3	15.1	0.8	84.1	15.9	3192
50 P every year	33.2	51.7	11.9	3.1	85.0	15.0	1819
200 K every year	37.6	52.8	8.2	1.3	90.4	9.6	2025
Check No fertilizer	48.8	46.0	4.6	0.6	94.8	5.2	1810

1/ One-time application, spring 1970.

2/ Fertilizer applied spring, 1971.

Table 4. Average Percentage Composition of Yields from a Native Grassland Site Fertilized with Nitrogen, Phosphorus, and Potassium at Different Rates and Combinations – 1970-1971 Seasons

	Composition of Yields – Percent						
Treatments lbs. / Fertilizer	**Mid Grasses**	**Short Grasses**	**Perennial Forbs**	**Annual Forbs**	**Total Grasses**	**Total Forbs**	**Total Yield lbs. / acre**
67 N every year	44.6	39.8	9.8	1.6	84.4	15.6	3063
67 N every other year[1/]	35.1	50.6	13.7	0.7	85.7	14.3	2134
100 N every year	51.6	36.6	11.6	0.2	88.1	11.9	2794
200 N[2/]	54.9	33.4	11.4	0.1	88.4	11.6	3036
300 N[2/]	53.6	32.9	13.1	0.4	86.5	13.5	3548
400 N[2/]	49.9	38.0	11.2	0.9	87.9	12.1	3363
67 N – 50 P every year	44.0	41.0	14.2	0.5	85.2	14.8	3184
67 N – 50 P – 200 K every year[1/]	55.7	28.3	15.1	0.8	84.1	15.9	3192
50 P every year	33.1	52.9	11.6	2.3	86.0	14.0	1971
200 K every year[1/]	37.6	52.8	8.2	1.3	90.4	9.6	2025
Check No Fertilizer	44.7	47.8	6.4	1.1	92.5	7.5	1999

1/ 1971 date only.

2/ One-time application, spring 1970.

Heavy continuous grazing over a long period of time has caused much of the grassland in western North Dakota to change from a high-producing midgrass to a lower producing shortgrass type. In order to achieve a reasonable balance of both the mid- and shortgrass components, intensive range management becomes necessary. A return to a natural balance would require complete rest or very light grazing of these pastures for many years. To shorten this period of bringing the midgrasses back at the expense of the shortgrasses, the application of nitrogen and other fertilizers has been attempted. The results thus far indicate that the application annually of nitrogen at either moderate rates (67 lbs. N) or one-time heavy applications may serve to change the plant community from shortgrass to midgrasses in a relatively short period. The advantage in application of heavy rates may be that it is a one-time operation with the added benefit of carry-over nitrogen in the soil which has a lasting effect for several years. Additional nitrogen applications may be of a relatively small magnitude to satisfy the nitrogen needs of the existing plants and at the same time maintain proper balance and high productivity of all species. The annual application of a moderate amount of nitrogen, and perhaps nitrogen and phosphorus in combination, may change the community more slowly but allow the farmer or rancher to maintain a delicate balance of species more effectively than would be possible with heavy applications.

Continued study of the effects on plant communities of varying amounts of fertilizer and its management implications is necessary. Correlations of data from soil water usage, the soil nitrogen cycle, protein and nutrient contents in forage species and their behavior, species changes, and yield characteristics, must be made before reasonably accurate recommendations for management can be established. Appreciable increases in quantity and quality of forage appears certain in most of the grasslands of western North Dakota by the use of nitrogen fertilizers.