REPORT OF GRASS AND LEGUME INVESTIGATIONS

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HAY YIELDS FROM GRASS AND GRASS-ALFALFA MIXTURE PLOTS

Intermediate and pubescent wheatgrass plots: The stands in both the 1954 and the 1958 seedings of intermediate wheatgrass and pubescent wheatgrass were so poor in 1962 that the plots were not harvested for yield. The data in Table 1 show the average yields of the varieties included in the 1954 seeding for the period of 1955-1961, while average yields for the 1958 seeding are given for the period 1959-1961. These data are presented as a summary of the performance of the intermediate and pubescent wheatgrass varieties in these two different trials.

Hay yields of the varieties seeded in 1954 were quite high for the period 1955-1959, after which the stands began to show serious deterioration and by 1961 the plots of most varieties had less than a 35 per cent stand left. The average yield for all varieties in this trial was over 3/4 ton of hay per acre for the 7-year period, 1955-1961, despite the loss of stand in the last years of the trial. The stands actually were productive for 6 years. As shown in Table 1, the range in average yields for the different varieties was rather narrow, being only from 1845 pounds per acre for Ree wheatgrass, the highest producer, to 1531 pounds per acre for A-12496, the lowest producer.

Yields from the 1958 seeding were considerably less than from the earlier seeding, and serious stand deterioration occurred following only 2 years of harvest. In 1961, the last year that yields were taken from these plots, most of the plots had less than a 50 per cent stand on them, and there was no stand improvement in the 1962 season. The average yield of all varieties in this trial for the 3-year period, 1959-1961, was only 1097 pounds per acre, almost 500 pounds per acre less than the 7-year average yield for the plots seeded in 1954. The range in average yield was from a high of 1262 pounds per acre for South Dakota 20 to 983 pounds per acre for the lowest producer, Amur.

The principal value of intermediate wheatgrass in this area would seem to be in a relatively short-time rotation on well-drained soils which have a better-than-average moisture supply. Under such conditions relatively good yields of hay could be expected for periods of from 3 to 5 years. The grass has been especially productive on such sites when grown in mixture with alfalfa.

Table 1. Average Hay Yields of Intermediate Wheatgrass and Pubescent Wheatgrass in Two Different Trials at the Dickinson Station.

Variety	7-Year Avg. Yield-Lbs. Per Acre (1955-1961)	3-Year Avg. Yield-Lbs. Per Acre (1959-1961)
Ree Wheatgrass	1845	1055

M2-10820	1758	---
N. Dak. Pubescent	1693	---
Nebraska 50	1682	1090
N. Dak. Intermediate	1665	1087
Pubescent Wheatgrass	1647	---
A-12496	1531	1026
South Dakota 20	---	1262
Idaho #3	---	1242
Idaho #4	---	1106
Greenar	---	1024
Amur	---	983
Average	1689	1097

Uniform bromegrass trial: The hay yields for 1962 for the 14 strains of bromegrass included in the uniform bromegrass trial are given in Table 2. The 8-year average yields for the brome varieties are given in Table 3. These plots were seeded in 1953, and some of the plots show appreciable stand damage. Nonetheless the 1962 average yield for all varieties of 1582 pounds per acre was the highest average yield of any of the 8 years that the trial has been harvested. The yields of nearly all varieties in the 1962 season were higher than any of the yields made by the varieties in the previous years of the trial.

The data of Table 2 show that for the most part the southern types still show somewhat better yields than the northern types. The range in yields for the 1962 season was from a high of 1771 pounds per acre for Achenbach to a low of 1387 pounds per acre for Canadian commercial. Achenbach, Fischer, Bin 12, Elsberry, Kuhl, and Lincoln all produced about 1600 pounds per acre or more. On the basis of the 8-year averages, Lincoln, Fischer, and Achenbach (southern types) have been the best producers, each averaging slightly over 1200 pounds of hay per acre. The lowest producers have been, Homesteader, Manchar, Mandan 404, and Canadian commercial, all northern types.

Table 2. Composition of Hay Yields From Bromegrass plots Seeded in 1953

Variety	Dry-Wt. Yield - Lbs./Acre			Total Yield- Lbs. Per Acre
	Grass	Other Grass	Weeds	
Achenbach	1771	---	---	1771

Fischer	1714	---	26	1740
Bin 12	1650	---	---	1650
Elsberry	1628	---	---	1628
Kuhl	1609	---	17	1626
Martin	1584	---	12	1596
Lincoln	1576	---	20	1596
Oklahoma synthetic	1577	---	2	1579
Homesteader	1560	---	---	1560
Mandan 404	1524	---	---	1524
Lyon	1476	---	48	1524
Lancaster	1504	---	12	1516
Manchar	1451	---	---	1451
Canadian common	1299	---	88	1387
Average	1566	---	16	1582

Table 3. Hay Yields From Bromegrass Plots Seeded in 1953

Variety	Dry - Weight Yield - Lbs./Acre								8-Yr. Average Yield lbs./acre
	1954	1955	1957	1958	1959	1960	1961	1962	
Lincoln	1606	1498	1459	1260	906	1115	432	1596	1234
Fischer	1637	1414	1408	1239	849	1111	461	1740	1232
Achenbach	1702	1463	1318	1159	734	1247	389	1771	1223
Oklahoma synthetic	1363	1426	1614	1190	789	1135	461	1579	1195
Elsbery	1190	1548	1537	1184	952	1010	438	1628	1186
Bin 12	1289	1326	1380	1206	1007	1071	416	1650	1168
Lancaster	1275	1476	1397	1142	864	1095	405	1516	1146
Lyon	1380	1511	1417	1140	707	1042	394	1524	1139

Kuhl	1334	1352	1486	1107	704	1088	401	1626	1137
Martin	1247	1335	1160	1179	951	986	384	1596	1105
Homesteader	1214	1433	1319	1099	677	1000	402	1560	1088
Manchar	1241	1478	1132	1126	746	1057	448	1451	1085
Mandan 404	1261	1359	1226	1069	865	991	385	1524	1085
Canadian com.	1122	1287	1095	920	774	990	327	1387	988
Average	1371	1421	1353	1144	823	1067	410	1582	1143

Crested wheatgrass trial: Yields of hay (oven-dry weight) from the crested wheatgrass varieties in the trial seeded in 1958 are given in Table 4. The 1962 average yield for the 9 varieties in the trial was 1790 pounds per acre, with common crested producing 2080 pounds per acre, the highest yield of any variety, and Turkish Fairway, the lowest producing variety, yielding 1338 pounds per acre. The highest producers this year and over the 4-year period of the trial have been derivatives from the standard type. These varieties include common standard crested, Summit, and Nordan. The Fairway selections (true crested wheatgrass) have been slightly lower in hay production than the standard derivatives.

The data of Table 3 show that Achenbach brome, the highest yielding brome variety in the 1962 season produced 1771 pounds per acre. This production was topped by four of the crested wheatgrass varieties as shown in Table 4.

The crested wheatgrass stands in this trial are in excellent condition, and contain very few weeds and practically no invading grasses. Turkish Fairway seems not to be well-adapted in this area, and there is some stand deterioration taking place in the plots of this variety. Except for this latter variety, all of the crested strains produced more than 3/4-ton of hay per acre this year, and over the 4-year period of the trial have averaged over ½-ton per acre.

Table 4. Hay Yields from Crested Wheatgrass Varieties Seeded in 1958

Variety	Dry Weight Yield - Lbs./Acre				4-Year Average Yield - Pounds Per Acre
	1959	1960	1961	1962	
Commercial Crested	1452	1815	824	2080	1543
Summit Crested	1328	1614	856	2023	1455
Nordan Crested	1427	1461	806	2006	1425
Nebraska 10	1137	1791	864	1890	1421

Commercial Fairway	1425	1619	873	1759	1419
Nebraska 3576 Fairway	1371	1605	905	1680	1390
Mandan 2359	1157	1687	833	1768	1361
South Dakota 15	1164	1546	770	1566	1262
Turkish Fairway	753	930	562	1338	896
Average	1246	1563	810	1790	1352

Station grass and mixture trial: Tables 5, 6, and 7 summarize the yields of the mixtures and straight grass seedings in the Station trial seeded in the spring of 1958. Table 5 gives the 1962 yields from the grass-alfalfa mixtures, and Table 6 gives the average yields from the mixtures over the 4-year period of the trial, 1959-1962. The average yields of the straight grass plots in the trial are given in Table 7.

Yields from the mixtures and straight grass seedings were very good this season, although not the highest obtained thus far during the 4-year period of the trial. The mixtures produced appreciably better than the straight grass seedings this year, the average yield for all mixtures being 2532 pounds per acre as contrasted to 1991 pounds per acre for the straight grass seedings. Alfalfa was especially important in the yields from the green stipa-alfalfa plots. Alfalfa made up over 50 per cent of the yield in each of the three top-producing mixtures in the 1962 season. These mixtures were green stipa-Ladak alfalfa, Nordan crested-Teton alfalfa, and Lincoln brome-Ladak alfalfa.

As shown in Table 6 the Nordan crested-Teton alfalfa has yielded somewhat better than the other mixtures over the 4-year period of the trial. On the basis of the 4-year average production five of the mixtures have produced over a ton of hay per acre. These mixtures are Nordan crested-Ladak, Intermediate wheatgrass-Teton alfalfa, Lincoln brome-Nordan-Ladak alfalfa, Lincoln brome-Ladak, and Lincoln brome-Teton.

The green stipa-alfalfa mixtures did not come into substantial production until the last two years of the trial, and alfalfa makes up a high proportion of the yield in these mixtures.

The straight grass seedings have yielded unusually well in this trial. The 4-year average yield for the varieties which have produced over the 4-year period has been 1979 pounds per acre. The top-producing variety has been Summit crested wheatgrass, followed by Nebraska 50 Intermediate wheatgrass. Nordan crested has yielded about the same as the Intermediate, and Lincoln brome and Southland have produced just slightly less than the Intermediate plots. All of these varieties have produced over a ton of hay per acre on the average. The green stipa varieties have just come into production in the last two years of the trial. Improved green stipa in the 1962 season produced 2441 pounds of hay per acre, the highest yield of any if the straight grass varieties.

Table 5. Composition of 1962 Hay Yields from Station Grass-Alfalfa Mixture Trial Seeded in 1958

Mixtures	Dry Weight Yields - Lbs./Acre				
	Grass	Alfalfa	Other Grass	Weeds	Total Yield
Green stipa (New) - Ladak Alfalfa	301	2612	---	93	3006
Nordan crested - Teton alfalfa	1978	992	---	---	2970
Lincoln brome - Ladak alfalfa	1880	944	---	---	2824
Lincoln brome - Teton alfalfa	2034	648	---	---	2682
Green stipa - Teton alfalfa	708	1857	42	77	2684
Lincoln brome - Nordan crested- Ladak alfalfa	2131	532	---	---	2663
Intermediate whtgr. - Teton alfalfa	1773	621	---	27	2421
Green stipa - Ladak alfalfa	1231	1035	16	62	2344
Manchar brome - Ladak alfalfa	1702	535	---	---	2237
Russian wildrye (2355) - Ladak alfalfa	1889	312	---	---	2201
Russian wildrye (2355) - Teton alfalfa	1234	591	---	---	1825
Average	1533	971	5	24	2533

Table 6. Average Hay Yields From Station Grass-Alfalfa Mixture Trial Seeded in 1958

Mixtures	Dry Weight Yields - Lbs./Acre				
	1959	1960	1961	1962	4-Year Avg. Yield
Nordan crested-Teton alfalfa	2536	3396	1360	2970	2566
Intermediate whtgr.-Teton alfalfa	3144	3381	647	2421	2398
Lincoln brome-Nordan Crested-Ladak alfalfa	2447	3204	1195	2663	2377
Lincoln brome-Ladak alfalfa	2171	3272	903	2824	2293
Lincoln brome-Teton alfalfa	2329	2765	943	2682	2180
Manchar brome-Ladak alfalfa	2127	2764	692	2237	1955
Russian wildrye (2355)-Teton alfalfa	1449	2307	786	1825	1592
Russian wildrye (2355)-Ladak alfalfa	1653	1716	711	2201	1570

Intermediate whtgr.-Ladak alfalfa	2818	3258	755	---*	---
Green stipa (New)-Ladak alfalfa	---	---	---	3006	---
Green stipa-Teton alfalfa	---	---	642	2684	---
Green stipa-Ladak alfalfa	---	---	1035	2344	---
Average	2297	2896	879	2532	2116
*Only 1 plot producing in 1962.					

Table 7. Four-Year Average Hay Yields From Station Grass Trial Seeded in 1958.

Grass Varieties	Dry Weight Yield - Lbs./Acre				4-Year Avg. Yield
	1959	1960	1961	1962	
Summit crested	2653	3310	1272	2317	2388
Intermediate whtgr. (N-50)	2865	3440	743	1855	2226
Nordan crested	2364	3203	1259	2032	2215
Lincoln brome	2559	3107	971	2185	2206
Southland brome	2344	3293	750	2141	2132
Northern brome	2324	2876	540	1818	1890
Manchar brome	2332	2560	707	1937	1884
Russian wildrye (2355)	1368	2086	686	1727	1467
Russian wildrye (Com.)	1404	1913	756	1530	1401
Slender whtgr.	1937	2601	No Stand		---
Green stipa (New)	---	---	755	2441	---
Green stipa (Com.)	---	---	608	1916	---
Average	2215	2839	822	1991	1979

Dryland Alfalfa Plots: Hay yields from the alfalfa plots seeded in the 1960 season are given in Tables 8 and 9. Table 8 gives the yields for the varieties in the 1962 season and Table 9 gives the yields for the two years of the trial. Two cuttings were made on all plots in the 1962 season, and excellent yields were obtained. The highest yield in the 1962 season was from Rambler, with a production of 5947 pounds per acre, and the lowest yield was from Ranger with a production of 4842 pounds per acre.

Yields of all varieties from the first cutting averaged 3773 pounds per acre, and from the second cutting 1667 pounds per acre. Thus on the average about 70 per cent of the yield was produced from the first cutting. All varieties except two, Teton and Ranger, produced over 5,000 pounds dry-weight of hay this year. On the basis of the 2-year average yields Rambler, Ladak, DuPuits, Rhizoma, Narragansett, and Vernal have been the best hay producers, all yielding over 3300 pounds per acre.

Table 8. Hay Yields for the 1962 Season from Dryland Alfalfa Plots Seeded in 1960.

Variety	Dry-Weight Yield - Lbs./Acre		Total Yield - Lbs/Acre
	1st Clipping	2nd Clipping	
Rambler	4203	1744	5947
Rhizoma	4099	1824	5923
Ladak	4132	1719	5851
DuPuits	3849	1940	5789
Narragansett	3857	1801	5658
Vernal	3945	1600	5545
Grimm	3597	1757	5354
Scandia	3613	1699	5312
Pfister	3410	1683	5093
S. Dak H 2157	3590	1418	5008
Teton	3542	1418	4960
Ranger	3443	1399	4842
Average	3773	1667	5440

Table 9. Two-Year Average Hay Yields From Dryland Alfalfa Plots Seeded in 1960.

Variety	Dry Weight Yield - Lbs./Acre		Average Yield Lbs./Acre
	1961	1962	
Rambler	1124	5947	3535
Ladak	963	5851	3407
Du Puits	974	5789	3381

Rhizoma	827	5923	3375
Narragansett	1023	5658	3340
Vernal	1099	5545	3322
Grimm	1059	5354	3207
Scandia	907	5312	3109
Pfister - FD - 180	904	5093	2998
S. Dak. H-2157	900	5008	2954
Teton	841	4960	2900
Ranger	869	4842	2855
Average	989	5440	3199

NITROGEN FERTILIZER ON CRESTED WHEATGRASS

1. Plots fertilized every year: Dry weight yields from old crested wheatgrass plots fertilized every year with ammonium nitrate (33-0-3) are given in Table 12. This trial was begun in 1955 and 8-year's data are available. Fertilizer applications on these plots have all been made in early spring, with the 1962 applications being made on April 2. The treatments include check (0 nitrogen), 25 pounds nitrogen, 50 pounds nitrogen, and 100 pounds nitrogen per acre.

Yield responses to fertilizer application were excellent in the 1962 season, although as in past years, there was little advantage in applications of more than 25 pounds per acre. The check plots yielded 2519 pounds dry-weight of hay per acre as against an average check yield of 1242 pounds per acre. The plots receiving 25 pounds of nitrogen per acre produced 4130 pounds per acre in contrast to an average yield of these plots of 1861 pounds per acre. The yield of the plots receiving 50 pounds of nitrogen was 4200 pounds per acre, and from the 100 pounds N plots, 4326 pounds of hay per acre. Both these yields represent only negligible increases over the yields from the 25-pound-per-acre treatment.

For the 8-year period as a whole the 25-pound-per-acre treatment has produced a profitable increase in hay yield over that of the check. Even in favorable moisture years, such as the 1962 season, there seems little justification for using nitrogen in excess of 25 pounds per acre to increase production from old crested wheatgrass stands on dryland sites.

2. Plots fertilized every other year: The hay yields from the plots fertilized every other year with ammonium nitrate are given in Table 11. These plots are fertilized in the spring of alternate years at the same rates as the plots fertilized annually. Fertilizer applications have been made in the spring in 1957, 1959, and 1961. The data show that there is some carry-over effect from all rates of fertilization, although this effect may be small in some years.

There was appreciable carry-over effect in the 1962 season from the fertilizer applications made in the relatively dry 1961 season. Thus the check yield was 2,298 pounds per acre, while the 25-pound-per-acre alternate-year treatment produced 3,049 pounds per acre. The 50 pound-per-acre treatment produced 3,625 pounds of hay per acre, and the 100-pound treatment, 3792 pounds of hay per acre.

On the basis of the use of equal amounts of nitrogen over a 2-year period, the increases in yield obtained by fertilizing every-other-year with 50 pounds of nitrogen have not been quite as good as the increases obtained by fertilizing annually with 25 pounds of nitrogen per acre. Fertilizing with 100 pounds of nitrogen every-other-year has produced yields slightly better than the yields obtained every year with 50 pounds of nitrogen. The increased yields from 50 pounds of nitrogen every year or 100 pounds of nitrogen every other year are not large enough to justify the use of either of these treatments as compared to the 25-pound-per-acre annual rate or the 50-pound alternate-year rate.

Table 10. Forage Production From Old Crested Wheatgrass Plots Fertilized Annually at Three Rates Of Nitrogen (33-0-0)

Year	Dry-Weight Yield - Lbs./Acre				Percentage Increase Over Check		
	Check	25 lbs. N	50 lbs. N	100 lbs. N	25 lbs. N	50 lbs. N	100 lbs. N
1955	1276	2096	2121	2494	64.3	66.2	95.4
1956	612	751	763	670	22.7	24.7	9.5
1957	1356	2117	2064	2174	56.1	52.2	60.3
1958	1224	1679	1839	1993	37.0	50.2	62.8
1959	1116	1451	1284	1206	30.0	51.1	8.1
1960	1279	2003	1954	2160	56.6	52.6	68.9
1961	550	661	693	706	20.2	26.0	28.4
1962	2519	4130	4200	4326	64.0	66.7	71.7
8-Year Avg.	1242	1861	1865	1966	49.8	50.1	58.3

Table 11. Forage Production From Old Crested Wheatgrass Plots Fertilized Alternate Years* At Three Rates of Nitrogen (33-0-0)

Year	Dry-Weight Yield				Percentage Increase Over Check		
	Check	25 lbs. N	50 lbs. N	100 lbs. N	25 lbs. N	50 lbs. N	100 lbs. N
1957	1239	1714	2013	2001	38.3	62.5	61.5

1958	1003	1016	1114	1250	1.3	11.1	24.6
1959	1094	1230	1266	1659	12.4	15.7	51.6
1960	1306	1813	1801	2187	38.8	37.9	67.5
1961	554	608	658	624	9.7	18.8	12.6
1962	2298	3049	3265	3792	32.7	42.1	65.0
	1234	1572	1686	1919	27.4	36.6	55.5
*Fertilizer applied in spring of 1957, 1959, and 1961.							

NEW FERTILIZER TRIAL

1. Hay yields from new fertilizer trial: In this trial, which was seeded in the spring of 1956, Nordan crested wheatgrass, Lincoln brome, Intermediate wheatgrass, and Russian wildrye were grown alone, mixed with Ladak alfalfa, and in plots fertilized with 33 pounds, 67 pounds, and 100 pounds nitrogen per acre. Fertilizer applications were made in the fall of 1957 and 1958, but for all other seasons the fertilizer was applied in the spring. Serious stand deterioration appeared in the intermediate wheatgrass and Lincoln brome plots in 1959, and the plots of these two grasses have not been harvested for yield since the 1960 season.

The hay yields for each of the treatments for the period 1958-1962 are given in Table 12. Yields of Nordan crested and Russian wildrye only are given for the 1961 and 1962 seasons. Check yields of Nordan crested wheatgrass and Russian wildrye in the 1962 season were 1859 pounds of hay per acre and 1338 pounds per acre, respectively. Yield increase with alfalfa was small for Nordan crested and negligible for Russian wildrye. Actually very little alfalfa remains in these plots and what effect on yield there is from this association is largely residual.

However, very substantial increases were obtained from the fertilizer applications. The production of Nordan crested with 33 pounds of nitrogen was 3171 pounds per acre, 1312 pounds more than the check-an increase of over 70 per cent.

The production of Russian wildrye with 33 pounds of nitrogen was 2041 pounds per acre, 703 pounds per acre more than the check. This was an increase of slightly over 50 per cent. Both of these increases would have been profitable on the basis of costs of nitrogen and returns from the additional hay produced. While further increases were obtained with the 67-and 100-pound rates, the returns would not have been economical.

The 5-year average yields for Nordan crested wheatgrass and Russian wildrye are given in Table 13. These data show that for the 5-year period 1858-1962 Nordan crested fertilized with 33 pounds nitrogen per acre produced 594 pounds more hay per acre than did the check. This would be a profitable increase in yield with hay values based at 1 cent per pound and nitrogen costs placed at 10 cents per pound. Uses of higher rates of nitrogen would not be justified on the basis if nitrogen costs and increased yields. The yield increase from Russian

wildrye with 33 pounds of nitrogen, averaging as it does only 357 pounds of hay per acre, would not be enough to more than just barely pay for the fertilizer.

The results of the trial to date confirm the conclusion that there is little or no justification for using more than 25 to 30 pounds of nitrogen per acre in annual applications on grasses for hay production. With Russian wildrye even this relatively light application was not justified on the basis of increased hay yields. However, the use of nitrogen on grass used for pasture is an entirely different situation that needs further investigation. The indications are that in this area nitrogen fertilizer may be used more profitably on pasture land than on hayland.

Table 12. Hay Yields From Grasses in Pure Stands, in Mixtures with Alfalfa, and in Pure Stands Fertilized At Three Different Rates 1958-1962

Grasses	Year	Dry-Weight Yield - Lbs./Acre				
		Grass Alone	With Alfalfa	33 lbs. N	67 lbs. N	100 lbs. N
Nordan crested	1958	1809	1647	1832	2491	2724
Intermediate whtgr.	1958	1729	1706	1992	2466	2714
Lincoln brome	1958	1461	1818	2205	2459	2342
Russian wildrye	1958	941	1111	1224	1613	1984
Nordan crested	1959	1416	1827	2120	1737	2011
Intermediate whtgr.	1959	1033	1372	1244	1468	1325
Lincoln brome	1959	936	1465	1630	1421	1279
Russian wildrye	1959	778	841	975	971	1086
Nordan crested	1960	2134	2485	2910	2713	2714
Intermediate whtgr.	1960	1395	1980	1877	2259	1998
Lincoln brome	1960	1265	1610	2151	2283	2203
Russian wildrye	1960	1287	1312	1710	1823	1997
Nordan crested	1961	1036	1012	1187	1120	1108
Intermediate whtgr.	1961	No yield - stand largely gone				
Lincoln brome	1961	No yield - stand largely gone				

Russian wildrye	1961	643	616	821	761	777
Nordan crested	1962	1859	2136	3171	3242	3573
Intermediate whtgr.	1962	No yield - stand largely gone				
Lincoln brome	1962	No yield - stand largely gone				
Russian wildrye	1962	1338	1395	2041	2077	2746

Table 13. Five-Year (1958-1962) Average Hay Yields of Nordan Crested Wheatgrass and Russian Wildrye In Pure Stands, In Mixture With Alfalfa, and In Pure Stands Fertilized With Nitrogen At Three Different Rates

Grasses	Dry Weight Yields - Lbs./Acre				
	Grass Alone	With Alfalfa	33 Lbs. N	67 Lbs. N	100 Lbs. N
Nordan Crested	1651	1821	2245	2261	2430
Russian Wildrye	997	1055	1354	1449	1718

FERTILIZER ON NATIVE GRASS

A small plot fertilizer trial on native grass was started in the 1962 season. Plots were established on two sites, one of which was on a terrace above the creek in the livestock farm pasture and the other was on a west-facing slope in the same pasture. The terrace site was somewhat more favorable than the slope site. Individual plots were 10 x 40 feet in a randomized block with four replications. The treatments included check (no nitrogen), 33 pounds nitrogen, 67 pounds, and 100 pounds nitrogen per acre.

Yield data and components of the yield are summarized for both sites in Table 14. Table 15 gives the percentage composition of the yields in three groups of plants, mid-grasses, short grasses, and forbs. The data of Table 14 show that the total yields from both sites for the same treatment were quite comparable, but that the yields had a considerably different composition on each site. The most striking feature of yield from the slope site is the much higher proportion of forbs that it contained as contrasted to the yield from the terrace site.

Grass production on the terrace site was increased from 753 pounds per acre to 1085 pounds per acre with the addition of 33 pounds of nitrogen. With 67 pounds of nitrogen the grass production was further increased to 1752 pounds per acre. Less than 100 pounds of additional grass was obtained from the 100-pound-per-acre treatment.

Most of the actual increases in yield came from increases in production of the short grass component, although, percentage-wise, mid-grass yield increases were as great as short grass increases. Increased yields of forbs on the terrace site did contribute to increase total yield from the fertilizer applications, but these contributions were not of major importance. The most economical increase, considering grass production, forb production, and total yield was obtained with the 67-pound rate of nitrogen on this site.

Grass production on the slope-site was increased from 585 pounds per acre to 847 pounds with 33 pounds of nitrogen, while 67 pounds of nitrogen produced 994 pounds of grass, and 100 pounds of nitrogen produced 1145 pounds of grass. Again most of the actual increase in grass yield came from increased production of short grasses. The data of Table 14 show that an appreciable portion of the increase in total yield on this site came from increased production of both perennial and annual forbs. On the basis of increase in grass yield the use of fertilizer on this site would have been uneconomical.

The percentage composition data given in Table 15 show that on each site the actual composition of the yields from the unfertilized plots was not much different from the percentage composition of the yields from the check plots. This indicates that in general the mid-grass, short grass, and forb components responded in about equal degree to the applied fertilizer and that no major shifts in plant population occurred as the result of the treatments.

There is some indication that the 100-pound rates did stimulate mid-grass production slightly more than they stimulated the other components. The much greater forb population on the upland site than on the terrace site is reflected in the much higher production of forbs on the upland site.

Much of the increased forb production was due to the stimulation of pasture sage (Artemisia frigida).

Table 14. Forage Production on Two Native Grass Sites Fertilized at Three Rates of Nitrogen, 1962 Season

Site	Treatment	Dry-Weight Yields - Lbs./Acre						Total Yield - Lbs./Acre
		Mid Grasses	Short Grasses	Total Grasses	Perennial Forbs	Annual Forbs	Total Forbs	
Terrace above creek	Check	152	601	753	65	222	287	1040
	33 lbs. N	177	908	1085	28	405	433	1518
	67 lbs. N	309	1443	1752	100	341	441	2193
	100 lbs. N	438	1439	1877	76	481	557	2434
Upland Slope	Check	73	512	585	280	198	478	1063
	33 lbs. N	115	732	847	613	214	827	1674
	67 lbs. N	97	897	994	727	310	1037	2031
	100 lbs. N	318	827	1145	484	516	1000	2145

Table 15. Percentage Composition of Yields from Two Native Grass Sites Fertilized at Three Rates of Nitrogen, 1962 Season				
Site	**Treatment**	**Percent Composition of Yield**		
		Mid Grasses	**Short Grasses**	**Forbs**
Terrace above creek	Check	14.6	57.8	27.6
	33 lbs. N	11.7	59.8	28.5
	67 lbs. N	14.1	65.8	20.1
	100 lbs. N	18.0	59.1	22.9
Upland slope	Check	6.9	48.1	45.0
	33 lbs. N	6.9	43.7	49.4
	67 lbs. N	4.8	44.2	51.0
	100 lbs. N	14.8	38.6	46.6

SPRING GRAZING TRIAL

The pastures that have been used for the spring grazing trial were grazed for the eighth season in 1962. The grazing period was quite long this year extending from May 3 to July 9, a period of 67 days. The crested wheatgrass pasture fertilized with 50 pounds of nitrogen per acre was stocked with 8 yearling steers, while the other crested wheatgrass pasture (pasture #3) was stocked with 6 steers. Crested-alfalfa pasture #2 was stocked with 6 steers, and crested-alfalfa pasture #4 was stocked with 8 steers. These stocking rates were based on relative productivity of the pastures.

Table 16 summarizes pasture yields and forage utilization on the pastures in the 1962 season. Forage production was very high on the fertilized pasture this season, averaging 2882 pounds per acre dry weight. Utilization on this pasture was also high, 1805 pounds per acre, but even so the steers could not keep up with grass growth and at the end of the grazing period over 1,000 pounds per acre still remained on the ground. Forage production on the unfertilized crested wheatgrass pasture was 1291 pounds per acre of which 942 pounds were utilized during the grazing period.

Crested wheatgrass-alfalfa pasture #2, somewhat surprisingly, produced 1664 pounds of forage per acre, while pasture #4 produced only 1274 pounds per acre. There is not much alfalfa left in either of the pastures, but pasture 2 has somewhat more alfalfa in it than pasture 4, although it has not been quite as productive as pasture 4 over the period of the grazing trial.

Although more forage was consumed off pasture 2 than off pasture 4, the overall percentage utilization was heavier on pasture 4 than on

pasture 2.

Table 16. Forage Produced and Forage Utilized by Yearling Steers On Spring Grazed Pasture, 1962 Season

Pasture No.	Pasture Type	Forage produced- lbs./acre (dry weight)	Forage utilized- lbs./acre (dry weight)	Forage left on ground lbs./acre
1	Crested Wheatgrass*	2882	1805	1077
3	Crested Wheatgrass	1291	942	349
2	Crested-alfalfa	1664	1231	433
4	Crested-alfalfa	1274	989	285

*Pasture 1 fertilized with 50 pounds nitrogen per acre on April 4, 1962.

Table 17 gives the animal data obtained on the pastures in the 1962 season. The average seasonal and the daily gains per head were appreciably better than on the fertilized crested wheatgrass pasture than on any of the other pastures. The gain per acre on the fertilized crested wheatgrass pasture, 182.0 pounds, is the highest per acre gain that has been obtained on any of the pastures over the entire period of the study. The other crested wheatgrass pasture, stocked at a lighter rate, showed a per acre gain of 128.3 pounds. The lighter-stocked crested-alfalfa pasture (pasture 2) showed a 132.0 pound per acre gain, while the heavier-stocked crested-alfalfa pasture showed a per acre gain of 174.0 pounds.

Table 17. Performance of Yearling Steers on crested Wheatgrass and Crested-Alfalfa Pastures During Spring Grazing Period From May 3 to July 9, 1962. (Weights and gains in lbs.)

Pasture No.	Pasture Type	No. of Steers	Acres Per Pasture	Days on Pasture	Avg. Initial Wt. Per Steer	Avg. Final Wt. Per Steer	Avg. Seasonal Gain Per Head	Avg. Daily Gain Per Head	Gain Per Acre
1	Crested Whtgr.*	8	8	67	471	653	182	2.72	182.0
3	Crested Whtgr.	6	8	67	468	639	171	2.55	128.3

2	Crested-alfalfa	6	8	67	467	643	176	2.63	132.0
4	Crested-alfalfa	8	8	67	470	644	174	2.60	174.0

*Pasture No. 1 fertilized with 50 lbs. nitrogen per acre.

Table 18 contrasts forage production and gains per acre for the four years on straight crested wheatgrass, on crested-alfalfa, and on crested wheatgrass fertilized with 50 pounds of nitrogen per acre. It should be remembered that there is not much alfalfa left in the crested-alfalfa pastures and the productivity of these pastures is only slightly greater than the productivity of the straight crested wheatgrass pasture. The data of this table show that fertilized crested wheatgrass, for the 4-year period of the comparison, has produced about 57 per cent more forage than straight crested pastures, and 37 per cent more forage than the crested-alfalfa pastures.

Table 18. Forage Production and Gains Per Acre on Spring Grazed Pastures of Crested Wheatgrass, Crested-Alfalfa, and Crested Wheatgrass Plus 50 lbs. of Nitrogen

Pasture Type	Year	Forage Production-Lbs./Acre	Gain Per Acre-Lbs.
Crested Wheatgrass	1959	940	103.2
Crested Wheatgrass	1960	981	101.2
Crested Wheatgrass	1961	852	83.1
Crested Wheatgrass	1962	1291	128.3
4-year average		1016	104.0
Crested and alfalfa	1959	1110	112.5
Crested and alfalfa	1960	1200	137.0
Crested and alfalfa	1961	885	94.0
Crested and alfalfa	1962	1469	153.0
4-year average		1166	124.1
Crested + 50 lbs. N	1959	1153	133.0
Crested + 50 lbs. N	1960	1476	165.0
Crested + 50 lbs. N	1961	884	106.9

Crested + 50 lbs. N	1962	2882	182.0
4-year average		1599	146.7

Beef production per acre has averaged 41 per cent more on fertilized crested than on straight crested, and about 18 per cent more than on crested alfalfa. The actual increase in forage produced over the check yield would do little more than pay for the cost of the fertilizer, with forage figured at 1 cent per pound and fertilizer at 10 cents per pound. However, the extra beef produced, figured at 20 cents per pound, would be substantially profitable as between fertilized crested and straight crested pastures.

Even with the relatively low-producing crested-alfalfa pastures being grazed in this study, though, the extra beef produced with fertilizer would no more than pay for the cost of fertilizer when compared to the average gains per acre produced on crested-alfalfa pastures.

GENERAL PASTURE FERTILIZATION

The crested wheatgrass pastures used for general spring grazing on the livestock farm were fertilized with 25 pounds of nitrogen per acre (75 pounds 33-0-0) in early April of the 1962 season. A series of small check areas were left to determine the influence of the fertilizer on grass yield, and a total of 18 cages were used to determine production on the check and fertilized areas. The results of the cage clipping indicate that the average yield of the fertilized grass was 2867 pounds dry-weight per acre, while the average yield from the check areas was 2161 pounds per acre. The net result of the fertilizer was thus an increase of over 32 per cent in production of grass.

NEW PASTURE SEEDING

The alfalfa was overseeded in the new pasture trial on May 8 and 9. The Nordan crested wheatgrass was seeded on the trial in the late fall of 1961. The alfalfa seedlings made an excellent development during the early part of the season, but grass seedlings showed spotty distribution. Heavy weed growth interfered seriously with the overall establishment of the stands, and by the end of August it looked as though the stands would be too thin for use in a grazing trial in the 1963 season. The actual beginning of the grazing trial will be delayed until the 1964 season.

PERSONAL ACTIVITIES

Correspondence: Thirty-five letters were written in the conduct of business relating to the Dickinson Experiment Station.

Radio Programs and TV Shows:

Radio Programs and TV Shows	
Feb. 9, 1962	Pasture Fertilization (recording)

Feb. 28, 1962	Pasture Fertilization (recording)
March 10, 1962	Forage and Beef Yields from Pastures
May 31, 1962	Pasture Management
June 7, 1962	Early Season Grass Growth
July 12, 1962	Intermediate Wheatgrass
Sept. 27, 1962	Fertilizing Native Grass

TV Programs	
Feb. 26, 1962	TV Farm Short Course - (WDAY)
May 31, 1962	Bateman's Country Line - (WDAY)

Public Meetings:

Date	Meeting	Attendance	Participation
6/12/62	North Dakota Stockmen's Assoc., Bismarck, North Dakota	200	Talk on crested whtgr. pastures
6/13/62	Grassland Field Day, Mandan, North Dakota	3000	Attended
6/26/62	Lion's Club tour of Station	18	15-minute talk on micro-climate set-up
6/29/62	Farm Judging Tour with Soil Conservation Service	6	Judging conservation work on farms
7/10/62	Tour of microclimate project and grass work ARS personnel	4	Half-day tour
7/18/62	Station Crops Field Day	150	Half-day of tours
7/25/62	Dickinson State Teachers College Conservation Class	16	Grass work at Dickinson
9/22/62	Cub Scout Tour of tree plantings	20	2-hour tour of trees
11/20/62	Career Days, Fargo, Range Management and Conservation	62	Student conferences 2 hours
11/28/62	Rotary Club, Fargo	35	Discussion of Career Day program
12/5/62	Livestock Research Roundup	1200	Tour and 15 minutes on fertilizing grass
12/18/62	Seed Trade Short Course, Fargo	150	Attended and contri- buted to brochure

Scientific Conferences:

Date	Meeting	Attendance	Participation
1/22-26/62	American Society of Range Management, Corpus Christi, Texas	650	Attended and conducted Range Plant Contest
2/15-16/62	GP-6 Range Management Technical Committee, Denver, Colorado	17	Discussions on technical range projects
5/4-5/62	North Dakota Academy of Science, Fargo	85	Attended
7/12-13/62	American Society of Range Management, Northern Plains Section, Havre, Montana	75	Range tour
10/6/62	Northern Plains Section, ASRM, Mandan	25	Attended pasture tour
10/25/62	Soil and Water Conservation Research Needs Committee	29	Discussed plans for research

Publications:

1. Whitman, W. C., D. R. Petersen, and T. J. Conlon. 1962. Results of Clipping Trials with Grasses and Grass-Alfalfa Mixtures. North Dakota Farm Research 22: 4-13.

2. Chapt. 3, "Vegetation of North Dakota", in: Conservation of Natural Resources, Dietrich and Hove, editors. September, 1962 Webb Publ. Co., St. Paul.

3. Note in "Crop and Soils", Dec. 1962 issued: "Grass-alfalfa mix shows promise in study."