A Comparison of Different Grains for Feed Production in North Dakota

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THERE is need for a heavy production of food and feed for man and beast in 1944. The question of what grains and varieties to grow is of more than usual interest. When planning how to increase the production of feed per acre the farmer may wonder whether to stress oats or barley, or whether some variety of wheat may exceed these grains in feed value per acre. Some may wonder whether corn will equal these small grains in total feed production per acre. Some comparison of crops and yields obtained when grown under similar conditions will give indication of their relative values for the production of feed.

In Western North Dakota

Varietal tests have been conducted at the Dickinson Substation in which replicated field plots are grown each year with about 25 varieties of hard spring wheat and approximately 15 varieties each of oats, barley, and corn, also with varieties of lower yielding grains such as rye, winter wheat, sorghum, proso and flax[3]. These have usually been sown in fields where the soil and soil preparation was the same.

In Table 1 are presented the average acre yields of grain and straw at the Dickinson substation for the highest yielding varieties of spring wheat, oats, marley and corn for the period, 1922 to 1943, inclusive, also the calculated average acre yields of digestible protein and total digestible nutrients for these grains based on fgures given in the twentieth edition of "Feeds and Feeding" by F. B. Morrison. The high-yielding varieties used in this long-time average were Ceres and Pilot wheat, Gopher oats, Steigum and Trebi barley and Falconer corn.

These results indicate that in average digestible protein per acre there is very little difference between the four grains, when both the grain and straw (or stover) are considered. However, when only the grain is taken into consideration the small grains, wheat, oats and barley, produced more protein per acre than did corn. In total digestible nutrients per acre shelled corn averaged higher than the best varieties of wheat, oats, and barley, and the total feed value per acre for corn and stover was greater than that from the grain and straw of any of the small grains. In total digestible nutrients the four grains ranked as follows: Corn 2100, barley 1552, oats 1506 and spring wheat 1451, a distinct advantage for corn.

The table also gives the average results from grain yields for Stark County, which also show but little difference in average digestible protein per acre and like the Substation results mentioned above, the total digestible nutrients per acre from corn grain was greater than from any of the other 3 grains. Further proof of the superiority of corn in feed production is seen in the fact that average yields of the rotation plots at the Dickinson substation, conducted by the Division of Dry

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land Agriculture for the period, 1907 to 1943, show that corn has ranked highest, and that spring wheat, oats and barley have differed but slightly in the 37-year average production of digestible nutrients per acre.

Table 1—Average yields, calculated digestible protein and total digestible nutrients of four major crops, Dickinson Substation, and a similar comparison based on estimated grain yields for Stark County.

	Average yield per acre—pounds		
	Yield	Digestible protein	Total digestible nutrients
	Comparisons, Dickinson Substation, 1922-1943[a]		
Wheat—grain	967 (16.1 bu.)	112	812
straw	1790	14	639
total	....	126	1451
Oats —grain	1186 (37.1 bu.)	111	848
straw	1491	13	658
total	....	124	1506
Barley—grain	1123 (23.4 bu.)	104	883
straw	1503	14	669
total	....	118	1552
Corn —grain	1168 (20.9 bu.)	83[c]	941[c]
stover	2291	50	1159
total	....	133	2100
	Farm comparisons, Stark County, 1919-1942[b]		
Wheat—grain	564 (9.4 bu.)	65	474
Oats —grain	595 (18.6 bu.)	56	425
Barley—grain	753 (15.7 bu.)	70	593
Corn —grain	918 (16.4 bu.)	65[c]	740[c]

[a]Using highest yielding variety from trial plots.
[b]Estimates, U.S.D.A. Agric. Marketing Service.
[c]Calculations based on No. 2 corn.

In Eastern North Dakota

Table 2 presents the average acre production of wheat, oats, barley and corn obtained from a series of comparable rotation and soil treatment plots at the Agricultural Experiment Station, Fargo, for the period 1916 to 1942, inclusive. In these plot comparisons there were 18 one-tenth acre plots of wheat, 9 of these following corn and 9 following potatoes; 9 plots each of oats and barley following clover and 9 plots of corn following the oats. Crop varieties used were those recognized as standard at the time, or promising new varieties. An exception to this might be the use of a strain of Manchuria barley thruout the period in place of the higher yielding Trebi or Wis. 38.

These comparisons, like those at Dickinson, show that when grain yields alone are considered, the average digestible protein per acre for wheat, oats and barley was higher than for corn. This difference in favor of the small grains was also true when both the grain and straw (or stover) yields were considered, but the difference then barley and corn is not appreciable.

In total digestible nutrients per acre, and considering only the grain, corn produced 1395 pounds, oats 1382 pounds, wheat 1376 pounds and

barley 1322 pounds per acre. When both the grain and the straw (or stover) are considered corn produced on the average 2578 pounds, wheat 2423 pounds, oats 2392 pounds and barley 2212 pounds per acre. This lower relative total yield for barley in this comparison is due in part to a relatively lower straw yield, but may also be due to the variety, Manchuria, used thruout the period, the barley yields not keeping pace with the variety improvement in the other crops, especially wheat and oats. A further indication of this can perhaps be seen in the estimated yields and calculated feed values of these crops for Cass County for the period 1919 to 1942. Here barley exceeds oats and equals wheat in the yield of digestible protein, and exceeds both oats and wheat in the yield of total digestible nutrients. Wis. 38 has been the most extensively grown barley on farms in Cass County for the last several years and previous to that Trebi, for a few years after its introduction, was grown extensively. Both these varieties usually outyield Manchuria.

Table 2—Comparing the average yields, calculated digestible protein and total digestible nutrients of four crops in a 4-year rotation, Agricultural Experiment Station, Fargo, and similar comparison based on estimated yields for Cass County.

	Average yield per acre—pounds		
	Yield	Digestible protein	Total digestible nutrients
	Experiment Station Crop Rotation plots, 1916-1942[a]		
Wheat—grain	1638 (27.3 bu.)	190	1376
straw	2932	23	1047
total	....	213	2423
Oats —grain	1933 (60.4 bu.)	182	1382
straw	2290	21	1010
total	....	203	2392
Barley—grain	1680 (35.0 bu.)	156	1322
straw	2001	18	890
total	....	174	2212
Corn —grain	1731 (30.9 bu.)	122[c]	1395[c]
stover	2266	50	1183
total	....	172	2578
	Farm comparisons, Cass County, 1919-1942[b]		
Wheat—grain	774 (12.9 bu.)	90	650
Oats —grain	826 (25.7 bu.)	78	590
Barley—grain	994 (20.7 bu.)	92	782
Corn —grain	1226 (21.9 bu.)	87[c]	988[c]

[a]Corn yields not available for 1917, 1918, 1926 and omitted from average. Barley, oats and wheat damaged by hail in 1918 and yields omitted from average.
[b]Estimates, U.S.D.A. Agric. Marketing Service.
[c]Calculations based on No. 2 corn.

The yields at Fargo and Dickinson are not directly comparable with each other. At Dickinson yield averages include the years of crop failure. At Fargo 3 years are omitted in the average for corn when no comparable yields of mature corn were obtained. The omission of these corn years, however, or the inclusion of the 3 years for the other crops would not change materially the average yields or the relative comparisons.

Comparison of the small grains

In table 3 is a direct comparison of red durum, barley, and two varieties each of oats and emmer, commonly called "speltz" when sown at Fargo. These crops were sown at the same time and under strictly comparable conditions. Corn was not included in this test. This yield comparison shows that for these 4 years in both the early and late seedings, there were no great differences in these grains in the amounts of digestible protein produced. Manchuria barley when sown early exceeded the other grains in total digestible nutrients per acre, averaging 1661 pounds compared with 1596 pounds for Yaroslav emmer, 1475 pounds for Gopher oats and 1450 pounds for red durum. Manchuria barley also exceeded the other grain in total digestible nutrients produced when sown late. All yields were reduced when grown late, emmer, ("speltz") suffering as much from late seeding as any of the other crops and barley apparently suffering the least.

Comparison of corn with the small grains during unfavorable years

While it is important to know what crops will give the highest average yields over a period of years, it is perhaps just as important to know what crops are the most dependable in producing the best yields in the dry years. Such years are certain to return again and then feed will be scarce and high in price. Table 4 was prepared by selecting those years when the yields at Dickinson were severely reduced by unfavorable conditions. Rust and grasshoppers reduced the yields in 1938. The stinkbug in 1940 and a severe hailstorm in 1941 greatly reduced yields of the small grains without serious injury to the corn crop. In the other 7 years drouth, together with some injury from grasshoppers and cutworms, was the main factor in reducing yields.

Table 3—Comparing yields, digestible protein, and total digestible nutrients in pounds per acre of leading varieties of small grain, when sown under directly comparable conditions at Fargo. Average 4 years, 1928-1931.

Crop variety	When sown early			When sown late			
	Grain yield	Digestible protein	Total digestible nutrients	Grain yield	Digestible protein	Total digestible nutrients	Percent decline when sown late (grain)
Red durum (D-5).....	1726	200	1450	1445	168	1213	16
Oats—Gopher.....	2063	194	1475	1832	172	1310	11
Victory.....	1963	185	1403	1517	143	1085	23
Barley—Manchuria...	2110	196	1661	1824	170	1435	14
Emmer ("speltz")							
Yaroslav.....	2136	205	1596	1677	161	1253	21
Kaphli.....	1708	164	1276	....	...	....	..

During the 10 most unfavorable years at Dickinson, as shown in Table 4, Falconer corn yielded about twice as much in digestible nutrients per acre as the best spring wheat and more than twice as much as the highest yielding oats and barley. The only complete failure with corn was in 1936 when the drouth, grasshoppers and jackrabbits left no corn above ground by the end of summer. The ear corn was a failure in 1934 but the fodder yield was of more feed value than the crop of wheat, oats or barley. The importance of the corn crop during these unfavorable years is emphasized by the fact that at such times feed is scarce and high in price and must be shipped in from other areas.

It requires somewhat more labor to produce an acre of corn than an

acre of small grain. This extra labor is being partially overcome by the use of improved corn machinery and also by pasturing off the corn crop with livestock. The extra labor is also partly offset by having a better seedbed and better yields from the crop following corn than would have been possible if small grain had preceded it. Average yields for a 35-year period from rotation plots at Dickinson, conducted by the Division of Dry Land Agriculture, show that spring wheat on disked corn stubble has averaged 12 percent more in bushels per acre than when grown on spring plowed grain stubble.

The results presented indicate that corn is injured less by diseases, insects, hail and drouth than are the small grains in this district and that in areas where corn can be grown it is the most dependable source of feed for all kinds of livestock.

Table 4—Comparative feed production per acre during 10 years when drouth or other adverse conditions caused serious reductions in yields at the Dickinson Substation.[1]

	ACRE YIELDS							
	CORN		BARLEY		OATS		SPRING WHEAT	
	Shelled bu.	Stover lbs.	Grain bu.	Straw lbs.	Grain bu.	Straw lbs.	Grain bu.	Straw lbs.
1926.....	2.3	872	9.7	1083	14.0	887	7.4	863
1929.....	17.7	1924	9.6	1016	24.1	786	10.0	1447
1931.....	20.0	2268	5.3	745	13.2	423	6.3	803
1933.....	5.4	1588	6.9	605	13.7	786	11.4	1051
1934.....	0	812	4.7	374	8.6	400	2.4	547
1936.....	0	0	0	tr	0.5	tr	0.3	tr
1937.....	23.5	2745	4.7	884	7.0	814	7.2	1339
1938.....	12.2	2040	15.1	930	18.1	1668	8.5	2290
1940.....	30.8	3238	18.3	952	25.9	770	5.5	1512
1941.....	24.7	2322	4.2	1313	11.5	1937	7.4	2203
Av. pounds per acre.....	765	1781	377	790	437	847	398	1206
Av. total digestible nutr. per acre—lbs.....	617	901	297	352	312	374	334	431
Av. total digestible nutr. (grain plus straw) lbs....	1518		649		686		765	

[1]Yields were reduced by rust and grasshoppers in 1938, by the stinkbug in 1940 and a severe hailstorm in 1941. During the other 7 years drought during part of the growing season was the chief factor affecting yields.

A careful selection of the crop and variety to grow for the kind of feeding intended, will insure the highest yield and feed value per acre. Two or more crops for use as feed will insure a more stable feed supply and result in a better feeding program.