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WHEAT VARIETIES on the HIGH PLAINS OF OKLAHOMA

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ABSTRACT

The experiments with wheat varieties conducted at the Panhandle Agricultural Experiment Station, Goodwell, Oklahoma, represent the soil and climatic conditions existing over a large area of the southwestern High Plains country in which wheat has been adopted as the principal crop. During the period 1924-30 yields at the station have varied from zero to 55 bushels per acre. Until the time of this report no new varieties have been discovered which excelled the common varieties of the Turkey group and Blackhull in average yield. Minhardi, Burbank and Fultz varieties produced the lower average yields. The differences recorded in yield in the upper group were not great enough to be of much significance.

Examples of variety adaptation to favorable and unfavorable methods of preparation were noted. All the varieties were grown each year on both summer fallowed and stubble land. Minturki produced 114 pounds net grain per acre more in continuous grain culture than in alternate wheat and fallow culture. Malakof on the other hand made a net gain of 55 pounds per acre over continuous culture by summer fallowing.

The average protein content of all varieties of wheat was 14.15% when grown on stubble land compared with 15.54% on summer fallowed land. Cultural and seasonal conditions affected protein content more than variety differences. There was apparently some tendency for the high protein samples to appear among varieties producing the smaller yields with lower test weights per bushel in a given group. However, this relation did not hold when comparing one year's results with another or different methods of preparation with each other on the same year.

Blackhull wheat was consistent in producing a higher proportion of grain to straw than any of the other varieties tested either on stubble land or on summer fallowed land. All varieties consistently produced higher proportions of grain to straw on stubble land.

The dockage of recleaned samples varied considerably among varieties but was influenced most by seasonal and preparatory conditions. Varieties like Minturki and Malakof, showing preferences for stubble and fallow preparations, respectively, also produced samples suffering the least market dockage where their highest yields were made.

There appeared to be some correlation between the thickness of stands produced by uniform rates of seeding and the relative winter hardiness of different varieties

Regarding the time required for maturity the varieties fell into three general groups. The earlier maturing included the Blackhull and Superhard Blackhull. About two days later came Kanred, Turkey, and similar varieties. Three or four days later Minturki and Minhardi matured. There was no consistent relation between time of maturity and yield.

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INTRODUCTION

Since wheat can be more economically produced on the heavy soils of the Panhandle of Oklahoma and adjacent regions than any other adapted crop, the development of new lands during the last 10 years has greatly increased the total wheat acreage and the proportion of tillable land devoted to this crop. The predominance of wheat growing has made information regarding relative merits of different varieties and methods of culture of great interest. Although none of the experiments reported herein are completed the demand for information makes a progress report necessary.

THE SOIL REPRESENTED BY THESE EXPERIMENTS

The tests reported in this bulletin were all conducted on the typical heavy wheat soil of the High Plains. According to the Bureau of Soils Reconnaissance Surveys of the Panhandle of Texas and of Western Kansas made in 1910, this type was designated as Amarillo silty clay loam and Richfield silty clay loam. A more recent survey, however, classifies this type as a heavy silt loam and describes the soil of the Panhandle Agricultural Experiment Station as typical of the upland soils found north of the Canadian breaks in the Panhandle of Texas; in Texas and Cimarron counties, Oklahoma, and parts of Beaver and Ellis counties, Oklahoma; Southwestern Kansas and in Southeastern Colorado. Because of the marked differences in the moisture utilization by different types of soil some care should be exercised in interpreting the results of these experiments on soil other than those mentioned, tho they are generally applicable in the area described where the heavier types of soils predominate.

PLAN OF EXPERIMENTS

Tests of wheat varieties were begun immediately upon the establishment of the station in 1923 and new varieties or selections have been added from time to time. The variety series have been seeded each year on summer fallowed land and also on stubble land.

The principal data obtained consist of yields of grain and straw, weight of grain per bushel and its protein content. The size of plots has varied from 1-10 acre to 1-20 acre and Kanred wheat has been used as a check variety being seeded in every third or fourth plot of each series. Stand counts have been kept to determine winter killing and the relative amounts of tillering of the different varieties under different conditions. Time of maturity was also noted. Dockage of the sample has been determined during the latter part of the experiment, and protein analyses made on some of the varieties each year.

THE WHEAT SEASON OF 1923-24

During the summer and fall of 1923 an abnormally large rainfall was received, particularly in the months of June, September, October, November and December. The months of July and August were favorable to the preparation of a good seed bed and the control of weeds. The variety tests were planted on September 24. Seeding was done with an eight-inch disk drill and chain cover on land which had been recently disked and harrowed. Top soil and subsoil moisture were ample to give the crop a good start and the rains which followed in October and November along with relatively high temperatures induced a rank fall growth in all plots. After December the rainfall was slightly below normal but sufficient to make satisfactory

progress in the spring growing of wheat until June. The excessive tillering brought about by the favorable fall growing conditions and the lack of any loss of stand due to winter killing brought the crop to a moisture crisis during June at about the time when the grain was beginning to fill. The rainfall for June 1924 was .41 inches or nearly two inches less than the normal, 19-year average. The result of this crop was that stubble land sowings yielded from 830 to 1090 pounds of grain per acre and fallow land sowings from 1250 to 1810 pounds per acre.

THE WHEAT SEASON OF 1924-25

The summer and fall of 1924 were such that volunteer wheat had not all germinated until late in September. The stubble land block consequently had to be disked immediately before sowing on September 29 under conditions of limited top soil moisture. Seeding was made with an eight-inch disk drill and chain cover but a uniform stand was not noted until October 13 after a shower of .37 inches on the 7th. Subsoil moisture was also deficient at the beginning of the fall growing period. Less than the normal precipitation fell during the period September, 1924, to March, 1925, inclusive. Although the month of April, 1925, gave 1.43 inches of rain, which was approximately normal, all the stubble land sowings had died out due to drouth and only partial stands remained on the summer fallowed sowing on April 24. Those plots which retained a partial stand were allowed to remain but received no additional effective rainfall and were abandoned May 15. The total rainfall received after seeding the crop until final abandonment was 3.24 inches compared with a normal for the same calendar period of 7.15 inches.

THE WHEAT SEASON OF 1925-26

Wheat was sown on fallow land September 28 in 1925 with top soil moisture conditions favorable to immediate germination. Since no wheat stubble land was available due to the 1925 failure a series of variety plots were seeded October 31 on unprepared sorghum stubble immediately after the crop had been removed. November rainfall was somewhat above normal and satisfactory stands were obtained on all plots though the fall growth generally was quite small. The spring growing season of 1926 opened with excessive rainfall which continued through harvest. The total rainfall for the period of four months, March to June, inclusive, 1926, was 12.91 inches compared with a normal for this period of 7.28 inches. The yields obtained from sorghum stubble ranged from 1811 to 2193 pounds per acre while those from fallow land gave 1712 to 3303 pounds per acre. The ample, well distributed rainfall in the spring rescued this crop from the effects of a very unpromising start and resulted in the production of some of the highest yields recorded at the station.

THE WHEAT SEASON OF 1926-27

As a result of the excessive rains which produced high yields in 1926 the summer fallowed land contained large amounts of available subsoil moisture at seeding time but the stubble land had no opportunity to accumulate soil moisture during the dry months of summer which followed harvest. Top soil moisture was deficient in both cases.

Seeding in moist soil was impossible until November 8. Both summer fallowed and stubble seedings were made on this date. Fortunately growing temperatures prevailed during November and the first week of December so that the crop became sufficiently established to stand through the winter. The rainfall during February, March and April was slightly below normal but sufficient to make fair progress particularly on those plots which began the season with ample stores of subsoil moisture. However, atmospheric conditions, low humidity, high winds and high temperature

were disastrous to the crop. The stubble land sowing was abandoned May 11 due to loss of stand from drouth killing. These severe conditions came to a climax on May 8 when the relative humidity dropped to seven percent with the temperature at 88°F. and a south wind averaging 21.6 miles per hour for the 24-hour period produced a most destructive dust storm. The loss of leaves from wheat in the storm was so great that plots which still retained available subsoil moisture were finally abandoned.

THE WHEAT SEASON OF 1927-28

Following the failure of 1927 excessive rain fell in July and August. The September rainfall, which came mostly in the first half of the month, was below normal and the remainder of the year produced no effective showers. Summer fallowed land which was seeded to a variety test September 12 produced good stands and made a small fall growth. For lack of grain stubble on which to seed a duplicate series an attempt was again made to utilize sorghum stubble but a sowing on October 18 failed to make a stand.

A good rain February 6 gave the wheat an excellent start in the spring. A normal rainfall for March and April with an excess in May favored wheat which was well established in the fall. A considerable amount of late sown and stubble seeding in the neighboring territory failed to germinate until spring this year and produced yields ranging from nothing to 500 or 600 pounds per acre. The varieties planted on fallowed land gave yields ranging from 914 to 1333 pounds per acre.

THE WHEAT SEASON OF 1928-29

Although subsoil moisture supplies were good on summer fallowed land in the fall of 1928, the September rainfall, .36 inch, was so low that early sowing would have necessitated seeding in the dust. Excessive rains fell, however, during October and permitted the seeding of both fallow and stubble land series in excellent top soil moisture conditions. The variety test was seeded October 19, 1928. Unusually heavy late fall rains continued through November and into December. The spring growing season of 1929 began with excessive moisture in March which tided the crops over the dry month of April permitting the normal amounts of moisture during May and June to produce average yields. Stubble land plantings made, in 1929, from 646 to 1272 pounds of grain per acre while fallow land plantings made from 1429 to 2270 pounds per acre.

THE WHEAT SEASON OF 1929-30

Summer fallowed land during the summer of 1929 accumulated a moderate margin of stored water over that obtained by stubble land in preparation for the fall sowing of 1929. Another dry September similar to that of 1928 delayed the seeding of the crop in order to avoid drilling in the dust. Several showers during the early part of October permitted a successful seeding to be made on October 21. Good stands were obtained and a small fall growth was made. Cold weather began early in November 1929 and prevented any further development of the crop until spring. Soil in the field was frozen to a depth of 19 inches during January when the temperature reached -17°F. The condition of the crop with reference to soil moisture was very similar at the opening of the spring growing season of 1930 to what it was in 1927. The rainfall for February, March, April and May was also very similar to that received in 1927 but a significant difference in atmospheric conditions prevailed. During the time preceding June when the crop was being retarded most by drouth, the atmospheric conditions were much more favorable. Approximately one-fourth the days of this dry period were cloudy whereas in 1927 only one-sixth of the days were cloudy. The humidity averaged considerably higher and the wind velocity

Table 1—Monthly and Annual Rainfall at Goodwell, Oklahoma, 1923-30

(Inches of Rainfall)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1923	.00	.61	.78	1.57	1.34	4.47	1.54	1.75	5.02	4.21	1.53	1.30	24.12
1924	.30	.20	1.70	1.85	2.00	.41	1.15	2.65	1.05	.62	.06	.13	12.12
1925	.20	.25	.04	1.43	.76	2.03	4.52	1.88	3.23	.45	1.07	.07	15.93
1926	.11	.15	1.47	2.32	4.09	5.03	.47	.99	1.81	.04	.23	.58	17.29
1927	t	.41	.25	1.52	t	1.86	5.19	5.04	1.73	.34	t	t	16.34
1928	t	1.21	.86	1.41	6.48	2.92	3.57	1.85	.36	3.04	1.90	.70	24.30
1929	.30	.22	2.02	.24	2.22	2.28	4.62	2.64	.84	1.14	1.77	.01	18.30
1930	.32	.03	.25	.63	.57	2.59	4.24	1.75	3.15	4.39	.33	.28	18.53
Means	.15	.39	.92	1.37	2.18	2.70	3.16	2.32	2.15	1.78	.86	.38	18.36

Table 2—Loss or Gain by Years for Summer Fallowing

Year	Yield Pounds Grain Per Acre		Loss or Gain for Fallowing	
	Stubble	Fallow	Yield	Seed
		(All Varieties)		
1924	975.0	730.8	−245.0	+15.0
1925	0.0	0.0	0.0	+15.0
1926	2057.5	1380.2	−677.3	+15.0
1927	0.0	0.0	0.0	+15.0
1928	0.0	583.5	+583.5	+15.0
1929	962.3	892.0	− 70.3	+15.0
1930	325.1	451.3	+126.2	+15.0
Annual Average	617.2	576.8	− 40.4	+15.0
(Net Loss by Fallowing All Varieties 25.4 Pounds per Acre Annually)				
		(Minturki)		
1924	1090.0	667.5	−422.5	+15.0
1925	0.0	0.0	0.0	+15.0
1926	1944.0	1252.0	−692.0	+15.0
1927	0.0	0.0	0.0	+15.0
1928	0.0	591.0	+591.0	+15.0
1929	1126.0	760.0	−366.0	+15.0
1930	517.0	500.0	− 17.0	+15.0
Annual Average	668.1	538.6	−129.5	+15.0
(Net Loss by Fallowing Minturki 114.5 Pounds per Acre Annually)				
		(Malakof)		
1924	1000.0	905.0	− 95.0	+15.0
1925	0.0	0.0	0.0	+15.0
1926	2193.0	1651.5	−542.0	+15.0
1927	0.0	0.0	0.0	+15.0
1928	0.0	602.0	+602.0	+15.0
1929	782.0	866.5	+ 84.5	+15.0
1930	235.0	464.0	+229.0	+15.0
Annual Average	601.4	641.3	+ 39.9	+15.0
(Net Gain by Fallowing Malakof 54.9 Pounds per Acre Annually)				

was less. Although the 1930 crop suffered severely from drouth, small to fair yields of grain were matured on all plots both in stubble and fallow land series. The stubble land seedings were injured considerably by cut worms which destroyed the stand in spots early in the spring growing season but enough of all varieties remained unharmed to secure data of yields by cutting down the size of plot harvested. The 1930 yields on stubble land ranged from 110 to 704 pounds per acre. On summer fallowed land the yields fell between 648 and 1280 pounds per acre.

SUMMARY OF SEASONAL CONDITIONS

Reference to Table 2 will show that during the seven-year period, 1924-27, four crops have been harvested out of seven sowings on stubble land. Two of the failures experienced were concurrent with failures on summer fallowed land, 1925 and 1927, but the third failure, that of 1928, took place under conditions with which the earlier sown summer fallowed wheat made a profitable yield. The use of sorghum stubble instead of wheat stubble for the 1927-28 crop may have been unfair to the stubble preparation plan because the failure in this instance was due principally to the delayed seeding. Plots in other experiments which were seeded on land which had failed in wheat the previous year produced small yields. A consideration of the results of continuous culture wheat with various systems of summer fallowing and rotation should give a more reliable comparison between the merits of summer fallowing and continuous cropping.

Two complete failures have resulted during the seven-year period from summer fallow seedings. The first, 1925, may be traced to lack of initial moisture as well as unfavorable growing conditions during the spring season but in 1927 soil moisture was ample on fallowed plots and the failure must be blamed entirely upon the unfavorable weather conditions. The seven-year average yield of all varieties sown on stubble land was 613.7 pounds or 10.22 bushels per acre. This yield was obtained from the four harvests made out of the seven sowings on the basis of a seven-year average yield. The average production of the same groups of varieties on summer fallowed land was 1143.3 pounds or 19.05 bushels per acre. If the yield is computed to a basis of acreage devoted to wheat including both land in wheat and in summer fallow each season the yield per acre is cut in half or 9.52 bushels per acre. This average includes two years of complete failure out of the seven-year period.

A comparison of the crops harvested from summer fallowed land and from cropped land shows that no consistent relationship exists. In 1924 the fallowed yield per pair of acres was 1461.6 pounds or 730.8 pounds per acre. Wheat on stubble land with a yield of 975.8 pounds showed a gain over fallow of 245 pounds. (See Table 2). In 1925 there was no crop and consequently no advantage in either method excepting the use of land had been lost for one year on stubble sowings whereas it was lost for two years in the case of fallowing. In 1926 the favorable seasonal condition much overshadowed the effect of previous crop and preparation giving the stubble sowings a gain of 677 pounds per acre over the net yield per acre on fallowed land. The year 1927 gave a repetition of the results of 1925, no crop being harvested by either method. In 1928 the stubble land sowings failed but wheat planted on summer fallowed ground made an average of 1167 pounds per acre or a net acre gain over the stubble sowings of 583 pounds. In 1929 there was a small difference of 70 pounds per acre in the net results favoring stubble land sowings. In 1930 summer fallowing made a net gain of 115 pounds per acre over stubble sowings. There has undoubtedly been some operative advantage in favor of summer fallowing when the size of yields harvested are considered. Although there were two failures out of seven years planting on summer fallowed land the five harvests made were all well worth cutting, the lowest average yield being obtained in 1930 which was 13.8 bushels per acre. The sowings made on cropped land produced four yields out of the seven years but one of these, 1930, made an average for all varieties of only 5.0 bushels per acre. Two of the other yields averaged slightly more than 16 bushels while only one could be considered highly profitable, that of 1926, which averaged over 34 bushels.

The average rate of yield per harvest of wheat seeded on cropped land was 1076 pounds or nearly 18 bushels per acre. The average yield per harvest on summer fallowed land was 1600 pounds or 26.5 bushels per acre.

When the extra seed is subtracted from the acre yield of continuously cropped wheat there is very little difference in the net grain received per acre between the two methods. Wheat growers who are in a position to utilize an advantage in protein content or who can take advantage of a better distribution of labor may justify the practice of summer fallowing regularly. However, it should be pointed out that occasionally a season may be experienced in which the cost of weed control during the spring growing season fully equals or exceeds the cost of combine harvesting. The year 1926 is such an example.

RELATION OF VARIETY TO SUMMER FALLOWING

Although a net loss of 25.4 pounds per acre annually has been observed for fallowing as an average of all varieties, individual varieties show markedly different adaptations to this practice. In the latter part of Table 2 will be found the result of two contrasting varieties, Minturki and Malakof. Loss in net yield has been experienced four out of eight years in summer fallowing for Minturki, the average being −114.5 pounds per acre. Loss from summer fallowing for Malakof has occurred only twice in eight years and the average shows a gain of 54.9 pounds per acre for summer fallowing. This tendency, for a variety to show an adaptation to certain average growing conditions, is noticeable though less well marked in several of the other varieties used in these experiments. Although Minturki is an average low yielder it has proved to be a relatively high producer under conditions of stubble land seeding. Malakof on the other hand has shown a special aptitude to produce well under most favorable conditions. Reference to Table 9 will bear out this point. An entirely different ranking of varieties is observed for the two methods of preparation.

COMPARISON OF VARIETIES

Tables 3, 4, 5 and 6 give the actual yields recorded for each variety, the years it was grown along with the standard deviation and coefficient of variability for a group of Kanred plots planted at intervals through the variety series. The variability as expected runs higher on stubble than on summer fallowed plots in the same year and also higher generally on years of low production. The variability of check plots has been excessive one year, 1930, and higher than might be considered desirable in 1928. At other times plot variation has not exceeded eight per cent. The difference in yield which might be considered significant averaged 143.6 pounds per acre for the seven series of observations recorded.

When all the other varieties are compared directly with Kanred by the adjustment of grain yields to fit the field curve as determined by the check series of Kanred plots, the Tables 7 and 8 are the result.

There are some displacements of rank observed when this adjustment is made, for example, Blackhull on summer fallowed land ranks fourth when compared to the average of all varieties but ranks second when compared to adjacent plots of Kanred. The difference between actual and calculated yields which brings about this shift in rank of varieties is about one-fourth of the standard deviation for the check series, so that it is apparent there is no significant difference in yields observed among several of the leading varieties.

Tables 5 and 6 report the straw yields of the wheat varieties in the same manner as grain yields are given in Tables 3 and 4. It is generally noticeable that straw yields from summer fallowed seedings average from two to three times those of stubble seedings. The correlation between grain and straw yield fluctuations, caused by variation in seasonal conditions, is very close but the proportion of grain to straw varies considerably among the varieties when grown under similar conditions. See Table 10 in which the

Table 3—Grain Yields on Stubble Seedings of Wheat in Variety Test at Goodwell, Oklahoma, Average All Plots, Actual Yields in Pounds Per Acre

Variety	1924	1925	1926	1927	1928	1929	1930	7 Yr. Ave.	5 Yr. Ave.	2 Yr. Ave.
Kanred	830	0	2161	0	0	929	379	614.1	693.8	654.0
Turkey	1005	0	2193	0	0	907	323	632.5	684.6	615.0
Blackhull	1075	0	----	0	0	1001	507	----	----	754.0
Malakof	1000	0	2193	0	0	782	235	601.4	642.0	508.5
Minturki	1090	0	1944	0	0	1126	517	668.1	717 4	821.5
Minhardi	855	0	1811	0	0	896	415	568.1	624.4	655.5
Turkey 101			2043	0	0	865	359		653.4	612.0
Turkey 102			2085	0	0	1053	235		674.6	644.0
Kharkov				0	0	1272	212		----	742.0
Eagle Chief			2043	0	0	1074	234		670.2	654.0
Burbank Super					0	646	110			378.0
Fultz					0	876	249			562.5
Superh. Blkh.						1084	322			703.0
Ridit							296			
Crimean 50							503			
Nebr. 60							296			
Nebr. 6							392			
Sibley's NG							268			
Averages	975.8		2057.5			962.3	325.1	616.8	670.0	638.7
Kanred Ave. Yield			2160.6			929.8	379.5			
Standard Deviation			−133.4			− 66.8	−183.6			
C. V.			6.17			7.18	48.3			20.55

Table 4—Grain Yields on Summer Fallow Seedings of Wheat in Variety Test at Goodwell, Oklahoma, Average All Plots, Actual Yields in Pounds Per Acre

Variety	1924	1925	1926	1927	1928	1929	1930	7 Yr. Ave.	5 Yr. Ave.	3 Yr. Ave.
Kanred	1520	0	3040	0	1132	1874	970	1219.4	1403.2	1325.3
Turkey	1505	0	3098	0	1290	1804	1142	1262.7	1466.8	1412.0
Blackhull	1350	0	2703	0	1075	2143	1095	1195.1	1403.2	1437.6
Malakof	1810	0	3303	0	1204	1733	928	1282.5	1433.6	1288.3
Minturki	1335	0	2504	0	1182	1520	1000	1077.2	1241.2	1234.0
Minhardi	1250	0	1712	0	967	1429	691	864.1	959.8	1029.0
Turkey 101			----	0	1279	1905	1040		----	1408.0
Turkey 102			----	0	1333	1722	857		----	1304.0
Kharkov			1981	0	1311	2087	722		1220.2	1373.3
Eagle Chief			2906	0	1280	1910	836		1386.4	1342.0
Burbank Super					1150	1550	649			1116.3
Fultz					914	1246	714			958.0
Superh. Blkh.					1010	2270	813			1364.3
Ridit							729			
Crimean 50							1129			
Nebr. 60							998			
Nebr. 6							1089			
Sibley's NG							847			
Averages	1461.6		2760.5		1167.0	1748.0	902.7	983.5	1189.3	1276.3
Kanred Ave. Yield			3040.0		1132.3	1873.7	970.3			
Standard Deviation			−124.0		−212.0	−139.2	−146.3			
C. V.			4.07		18.72	7.42	15.07			

Table 5—Straw Yields on Stubble Seedings of Wheat in Variety Test at Goodwell, Oklahoma, Average All Plots, Actual Yields in Pounds Per Acre

Variety	1924	1925	1926	1927	1928	1929	1930	7 Yr. Ave.	5 Yr. Ave.	2 Yr. Ave.
Kanred	1280	0	2810	0	0	1214	518	831.7	908.4	866.0
Turkey	1935	0	2844	0	0	1095	572	920.8	902.2	833.5
Blackhull	1775	0	----	0	0	730	785			757.5
Malakof	1740	0	2731	0	0	1158	428	865.2	863.4	793.0
Minturki	2160	0	3376	0	0	1085	953	1082.0	1082.8	1019.0
Minhardi	1955	0	3651	0	0	1147	508	1037.2	1061.2	827.5
Turkey 101			3022	0	0	1179	857		1011.6	1018.0
Turkey 102			2867	0	0	1366	360		918.6	863.0
Kharkov			----	0	0	1398	369			883.5
Eagle Chief			3079	0	0	1095	351		905.0	723.0
Burbank Super					0	1064				
Fultz					0	1377	470			923.5
Superh. Blkh.						1043	381			712.0
Ridit							550			
Crimean 50							1291			
Nebr. 60							539			
Nebr. 6							655			
Sibley's NG							558			
Average	1807.5		3047.5			1150.0	596.7	947.3	956.6	851.6

Table 6—Straw Yields on Summer Fallow Seedings of Wheat in Variety Test at Goodwell, Oklahoma, Average All Plots, Actual Yields in Pounds Per Acre

Variety	1924	1925	1926	1927	1928	1929	1930	7 Yr. Ave.	5 Yr. Ave.	3 Yr. Ave.
Kanred	3330	0	4678	0	3305	3199	1318	2261.4	2500.0	2607.3
Turkey	2985	0	5023	0	3259	3121	1570	2276.8	2594.6	2650.0
Blackhull	3370	0	4485	0	2970	3330	1435	2227.1	2440.0	2578.3
Malakof	3500	0	5498	0	3290	3213	1356	2408.1	2671.4	2619.6
Minturki	3255	0	4344	0	3503	3375	1553	2290.0	2555.0	2810.3
Minhardi	3140	0	3014	0	3350	3081	1031	1945.1	2095.2	2487.3
Turkey 101			----	0	3213	3689	1325		----	2742.3
Turkey 102			----	0	2772	3142	1162			2358.6
Kharkov			3198	0	3244	3750	1112		2260.8	2702.0
Eagle Chief			4876	0	3150	3360	1183		2513.8	2564.3
Burbank Super					2756	2590	968			2104.6
Fultz					2437	2523	1066			2008.6
Superh. Blkh.					2756	3243	1087			2362.0
Ridit							1153			
Crimean 50							1754			
Nebr. 60							1724			
Nebr. 6							1633			
Sibley's NG							1795			
Average	3263.3	0	4389.5	0	3077.3	3201.2	1345.8	2234.7	2453.8	2507.3

Table 7—Grain Yields on Stubble Seedings of Wheat in Variety Test at Goodwell, Oklahoma, Adjusted to Kanred Field Curves, Pounds Per Acre

Variety	1924	1925	1926	1927	1928	1929	1930	7 Yr. Ave.	5 Yr. Ave.	2 Yr. Ave.
Kanred	830	0	2161	0	0	929	379	614.1	693.8	654.0
Turkey	1005	0	2118	0	0	972	230	617.8	664.0	601.0
Blackhull	1075	0	----	0	0	1003	499	----	----	751.0
Malakof	1000	0	2204	0	0	822	222	606.8	649.6	522.0
Minturki	1090	0	1817	0	0	1135	453	642.1	681.0	794.0
Minhardi	855	0	1739	0	0	878	399	553.0	603.2	638.5
Turkey 101			2187	0	0	893	376		691.2	634.5
Turkey 102			2089	0	0	1062	315		693.2	688.5
Kharkov			----	0	0	1268	276		----	772.0
Eagle Chief			2018	0	0	1076	275		673.8	675.5
Burbank Super					0	595	136			365.5
Fultz					0	830	157			493.5
Superh. Blkh.						1081	362			721.5
Ridit							172			
Crimean 50							318			
Nebr. 60							187			
Nebr. 6							299			
Sibley's NG							352			
Averages	975.8	0	2041.6	0	0	964.9	300.3	606.7	668.7	639.3

Table 8—Grain Yields on Summer Fallowed Seedings of Wheat in Variety Test at Woodwell, Oklahoma, Adjusted to Kanred Field Curves, Pounds Per Acre

Variety	1924	1925	1926	1927	1928	1929	1930	7 Yr. Ave.	5 Yr. Ave.	2 Yr. Ave.
Kanred	1520	0	3040	0	1132	1874	970	1219.4	1403.2	1325.3
Turkey	1505	0	3040	0	1156	1804	948	1207.5	1389.6	1302.6
Blackhull	1350	0	2605	0	1361	2149	1151	1230.8	1453.2	1553.6
Malakof	1810	0	3578	0	1216	1711	792	1301.0	1459.4	1239.6
Minturki	1335	0	2702	0	1333	1505	1126	1143.0	1333.2	1321.3
Minhardi	1250	0	1872	0	1034	1396	785	905.2	1017.4	1071.6
Turkey 101			----	0	1378	1801	893		-----	1357.3
Turkey 102			----	0	1266	1608	743		----	1205.6
Kharkov			2046	0	1515	2078	667		1261.2	1420.0
Eagle Chief			3040	0	1146	1842	722		1350.0	1236.6
Burbank Super					1112	1510	691			1104.3
Fultz					927	1214	565			902.0
Superh. Blkh.					1205	2307	799			1437.0
Ridit							564			
Crimean 50							903			
Nebr. 60							843			
Nebr. 6							977			
Sibley's NG							810			
Averages	1461.0	0	2740.3	0	1213.9	1753.7	830.5	1167.8	1333.4	1267.4

Table 9—Rank in Grain Yield of Winter Wheat Varieties in Various Periods for Which Data are Available at Goodwell, Oklahoma

Rank	7 Year Average		5 Year Average		3 Year Average	
	Stubble	Fallow	Stubble	Fallow	Stubble	Fallow
1	Minturki	Malakof	Kanred	Malakof	Minturki	Blackhull
2	Turkey	Blackhull	Turkey 101	Blackhull	Kharkov	Superh. Blkh.
3	Kanred	Kanred	Turkey 102	Kanred	Blackhull	Kharkov
4	Malakof	Turkey	Minturki	Turkey	Superh. Blkh.	Turkey 101
5	Minhardi	Minturki	Eagle Chief	Eagle Chief	Turkey 102	Kanred
6		Minhardi	Turkey	Minturki	Eagle Chief	Minturki
7			Malakof	Kharkov	Kanred	Turkey
8			Minhardi	Minhardi	Minhardi	Malakof
9					Turkey 101	Eagle Chief
10					Turkey	Turkey 102
11					Malakof	Burbank Super
12					Fultz	Minhardi
13					Burbank Super	Fultz

Table 10—The Proportions of Grain and Straw Produced by Different Varieties of Wheat at Goodwell, Oklahoma, Two Year Average 1929-30

Variety	Straw Expressed in Percentage of Grain Yield	
	Stubble	Fallow
Blackhull	100	179
Superhard Blackhull	101	173
Eagle Chief	110	191
Kharkov	119	196
Minturki	124	227
Minhardy	126	241
Kanred	132	196
Turkey 102	134	181
Turkey	135	187
Malakof	156	203
Fultz	164	209
Turkey 101	166	194

proportions are worked out for all the varieties. The grain yield is used as a basis of comparison.

There exists a definite negative correlation between the rank in grain yield and the amount of straw per unit weight of grain as indicated by a correlation of $-.7413 \pm .05$ between grain yield and straw per hundred pounds of grain, where the varieties were grown on stubble land. The correlation is less definite among these same varieties grown on fallow land as shown by a coefficient of $-.4342 \pm .10$.

As a result of these tests it is possible to select a group of high yielding varieties consisting of Turkey, Turkey related varieties and Blackhull. The tests, so far, have not progressed to a point permitting the selection of an outstanding variety or strain from this group. There are, also, a number of varieties definitely shown to be inferior in their adaptation to conditions of the Panhandle of Oklahoma, namely: Fultz, Burbank and Minhardi.

QUALITY OF GRAIN

Neidig and Snider (6) of Idaho found the protein content of wheat to be increased under similar systems of culture both by summer fallowing and manuring. The application of manure widened the nitrogen carbon ratio in the soil while summer fallowing and tilled crops decreased the total amount of both nitrogen and organic matter under dry land farming conditions in the Palouse country where the average rainfall received was about 22 inches annually.

Downs and others at Michigan (2) found a correlation between the botanical subgroups of Awnless white, Awnless black and Bearded red varieties of winter wheat and average protein content.

Salmon and associates (8) reporting the performance of Blackhull wheat in Kansas indicated that, although the test weight and crude protein content might be the same in different varieties, these varieties could show a wide variation in milling and baking qualities. They found Blackhull averaging high yields excepting in the Northwestern part of Kansas and producing a higher average test weight than Turkey and Kanred. Protein content averaged about the same. Bread produced from Blackhull compared favorably with that of Kanred and Turkey when the dough was mixed gently but was deficient in absorption, loaf volume and texture when the dough was mixed severely.

Table II—Relation of Seasonal and Varietal Factors in Wheat Grown on Stubble Land 1924-30, Goodwell, Oklahoma, Average of All Plots of Each Variety

	1924			1926			1928			1929			1930		
Variety	Yield Grain	Wt. Per Bu.	% Protein	Yield Grain	Wt. Per Bu.	% Protein	Yield Grain	Wt. Per Bu.	% Protein	Yield Grain	Wt. Per Bu.	% Protein	Yield Grain	Wt. Per Bu.	% Protein
Turkey	1005	61.0	11.6	2043	61.7	15.5	0000	----	----	935	57.1	13.1	306	57.5	15.8
Kanred	830	62.0	----	----	----	----	0000	----	----	901	56.6	13.9	393	57.9	16.4
Blackhull	1075	62.0	13.1	----	----	----	0000	----	----	1001	58.9	12.6	507	58.4	14.9
Malakof	1000	59.0	13.0	----	----	----	0000	----	----	782	56.7	11.9	234	57.2	16.8
Minturki	1090	59.0	----	----	----	----	0000	----	----	1126	58.1	14.8	517	56.0	16.2
Minhardi	855	59.0	11.8	----	----	----	0000	----	----	896	56.5	14.1	415	55.1	15.9
Kharkov	----	----	----	----	----	----	0000	----	----	1272	58.5	14.5	211	56.3	16.3
Superh. Blk.	----	----	----	----	----	----	0000	----	----	1084	59.4	10.9	322	58.6	14.9
Fultz	----	----	----	----	----	----	0000	----	----	876	55.8	14.5	248	54.8	17.3
Burbank	----	----	----	----	----	----	0000	----	----	646	55.5	14.7	110	----	13.9
Eagle Chief	----	----	----	----	----	----	0000	----	----	1074	58.1	13.2	234	57.4	16.5
Average	983.7	60.2	12.3	2043	61.7	15.5	0000	----	----	963	57.4	13.4	317.9	56.9	15.9

Table 12—Relation of Seasonal and Varietal Factors in Wheat Grown on Stuble Land 1924-30, Goodwell, Oklahoma
Average of All Plots of Each Variety

Variety	1924			1926			1928			1929			1930		
	Yield Grain	Wt. Per Bu.	% Protein	Yield Grain	Wt. Per Bu.	% Protein	Yield Grain	Wt. Per Bu.	% Protein	Yield Grain	Wt. Per Bu.	% Protein	Yield Grain	Wt. Per Bu.	% Protein
Turkey	1505	61.0	____	3098	61.0	15.4	1873	58.6	13.5	1859	54.4	18.8	1052	59.9	16.5
Kanred	1520	60.0	____	3155	60.0	16.3	1085	59.3	13.7	1861	54.9	16.8	1117	59.9	15.9
Blackhull	1350	60.0	____	2702	61.5	16.5	1075	60.0	14.3	2143	56.2	17.5	1095	60.5	15.6
Malakof	1810	60.0	____	____	____	____	1204	59.4	13.7	1733	54.3	18.8	927	59.4	16.2
Minturki	1335	57.0	13.4	____	____	____	1182	56.8	13.5	1520	53.2	19.2	999	57.8	16.5
Minhardi	1250	58.0	13.9	1505	59.0	17.9*	967	58.2	14.9	1429	53.5	18.7	691	56.7	15.7
Kharkov	____	____	____	1981	62.0	15.6	1311	60.0	13.5	2087	55.5	18.0	721	59.3	16.8
Superh. Blk.	____	____	____	____	____	____	1010	59.2	13.9	2270	57.4	16.0	812	61.4	16.1
Fultz	____	____	____	____	____	____	913	59.0	15.0	1246	51.2	18.3	714	57.6	16.2
Burbank	____	____	____	____	____	____	1150	57.7	13.3	1550	51.8	18.5	648	56.2	____
Eagle Chief	____	____	____	____	____	____	____	____	____	1910	54.9	17.8	836	59.7	16.2
Average	1292.5	57.5	13.6	2488	60.7	16.3	1243	58.5	14.3	1782	54.3	18.0	873.8	58.9	16.1

*Grown on Cowpea land.

Table 13—Protein Content and Yield of Wheat Varieties Grown on Stubble and Fallow Land 1929 and 1930, Goodwell, Oklahoma

Variety	STUBBLE			FALLOW			AVERAGE ALL PLOTS		
	Percentage Protein			Percentage Protein			%	Test Wt.	Yield Grain
	1929	1930	Ave.	1929	1930	Ave.	Protein	Per Bu.	Lbs. per Acre
Turkey	13.1	15.8	14.4	18.8	16.5	17.6	16.05	57.2	1038
Kanred	13.9	16.4	15.1	16.8	15.9	16.3	15.75	57.3	1068
Blackhull	12.6	14.9	13.7	17.5	15.6	16.5	15.15	58.5	1186
Malakof	11.9	16.8	14.3	18.8	16.2	17.5	15.92	56.9	919
Minturki	14.8	16.2	15.5	19.2	16.5	17.8	16.67	56.3	1040
Minhardi	14.1	15.9	15.0	18.7	15.7	17.2	16.10	55.4	858
Kharkov	14.5	16.3	15.4	18.0	16.8	17.4	16.40	57.4	1073
Superh. Blk.	10.9	14.9	12.9	16.0	16.1	16.0	14.47	59.2	1122
Fultz	14.5	17.3	15.9	18.3	16.2	17.2	16.57	54.8	771
Eagle Chief	13.2	16.5	14.8	17.8	16.2	17.0	15.92	57.5	1013
Averages	13.35	16.10	14.70	17.99	16.17	17.05	15.90	57.05	1008.8

Studies of factors affecting the protein content of North Dakota wheat by Mangels (5) showed that the protein content of wheat had no relation to the crop produced from it. Differences between the crude protein content of varieties and their bread making qualities were pointed out. The effects of preceding cropping and culture were marked, wheat after wheat producing the lowest protein content while corn, summer fallow and sweet clover as crop preparations showed increasing amounts of protein in the order named. Data of four years showed no significant correlation between test weight per bushel and protein analyses.

Kiesselbach (4) observed a notable lack of correlation between percentage of crude protein in wheat grown in different years at the Nebraska station and the baking strength of the flour produced. Increased yields were obtained from applications of manure without affecting the milling qualities of flour one way or the other.

Burke's studies (1) in Montana emphasize the importance of available nitrogen accumulations as a fallow effect having a distinct bearing upon the yield and protein content of wheat. Excessive accumulations of nitrates under summer fallowing conditions were thought to be the cause of some loss into the lower subsoil by leaching.

The data of protein content is rather fragmentary for the early years of this Oklahoma experiment but certain of the varieties included in each group were analyzed each year so that it is possible to obtain yearly averages and also varietal averages. Tables 11 and 12 give the average results of analyses for each variety along with the yield and weight per bushel. In Table 13 these data are averaged by varieties for the two years 1929 and 1930 when the information was complete for those varieties named.

Such portions of the data are selected for Table 14 as will provide a comparison of the results of stubble and summer fallow preparations based on the same group of varieties. In 1924 and 1926 tests and analyses were available representing both methods of preparation from only one variety each. Since that time, however, complete information on 11 varieties is available and has been averaged in this table.

Slight differences are shown in average protein content of varieties grown under all conditions. When the percentages of protein produced by the same variety grown on stubble land and on summer fallowed land are correlated the coefficient of $.1980 \pm .11$ is obtained. When the protein content is reduced to the percentage of the yearly group average, however, as in Table 15, the tendency of variety to affect protein content is indicated by a correlation coefficient of $.3453 \pm .09$.

When the average of all observations of protein content made on a variety are compared with the average yield and average test weight per bushel there are rather distinct relationships exhibited. See Table 13.

The strictest correlation is between average yield and average weight per bushel, being $.8998 \pm .02$. The correlation between average weight per bushel and average protein content for 10 varieties was $-.8219 \pm .03$. Yield per acre and protein content are thereby associated to the extent represented by a correlation coefficient of $-.5783 \pm .09$ which is barely significant.

Protein content is undoubtedly affected more by the relation of the existing stand, regardless of how it was obtained, to the progressive moisture-fertility complex than to variety characteristics, within the limited selection of varieties used in this experiment.

Table 14—Yield, Test Weight and Protein Content of Wheat Grown on Stubble and Summer Fallowed Land, 1924-30, Goodwell, Oklahoma

	STUBBLE			FALLOWED			
Year	Yield Pounds Grain Per Acre	Test Weight	Percentage Protein	Yield Pounds Grain Per Acre	Test Weight	Percentage Protein	No. of Varieties Averaged
1924	855.0	59.0	11.8	1250.0	58.0	13.9	1
1925	0.0			0.0			0
1926	2043.0	61.7	15.5	3098.0	61.0	15.4	1
1927	0.0			0.0			0
1928	0.0			1243.0	58.5	14.3	11
1929	963.0	57.4	13.4	1782.0	54.3	18.0	11
1930	318.0	56.9	15.9	874.0	58.9	16.1	11
Averages	1044.7	58.7	14.15	1649.4	58.1	15.54	

Table 15—Protein Content Calculated to a Basis of Percentage of the Yearly Group Average

Variety	Stubble 1929	Fallow 1929	Stubble 1930	Fallow 1930
Turkey	98.1	104.5	98.1	102.0
Kanred	104.1	93.3	101.8	98.3
Blackhull	94.3	97.2	92.5	96.4
Malakof	89.1	104.5	104.3	100.1
Minturki	110.3	106.7	100.6	102.0
Minhardi	105.6	104.5	98.7	97.0
Kharkov	103.6	100.0	101.2	103.8
Superh. Blkh.	81.6	88.9	92.5	99.5
Fultz	108.6	101.7	107.4	100.2
Eagle Chief	98.8	98.9	102.4	100.2

COMMERCIAL DOCKAGE

Studies of the amount and character of dockage found in the re-cleaned samples of wheat produced by the different varieties in the experiment have been carried out since 1928. Samples were prepared for this study by first recleaning the thresher run grain with an ordinary Clipper fanning mill. The samples were then relatively uniform in regard to chaff, straw and dust, the principal differences remaining being in respect to the amount of shriveled and cracked kernels they contained. The test weight was accurately determined before and after dockage was separated. An electric driven Emerson Kicker dockage tester was used to make the separations.

The percentage of dockage and the weight per bushel gain as a result of docking expressed in percentage are shown in Table 16 along with the density of the dockage as calculated from this information. The density is indicated by the ratio of the cleaned and docked sample weight as 1.00 to the dockage weight. The dockage removed from wheat grown on summer fallowed land was consistently heavier and smaller in quantity than that taken from the wheat grown on stubble land. The gains in test weight as a result of separating the dockage were consequently greater for wheat grown under unfavorable conditions.

It will be noted by reference to Table 14 that the average test weight for all varieties for seven years has been about the same for wheat produced

on stubble land and on summer fallowed land. The heavier stand produced by increased tillering on summer fallowed land sometimes operates to exhaust a limited moisture supply during the period of maturity. This was particularly the case in 1924 and 1929. A correlation of 44 observations of the association of number of straws per square foot with the percentage of dockage gave a coefficient of $.3899 \pm .06$ on summer fallowed land and $-.0236 \pm .12$ on stubble land, indicating that crowding affected the amount of dockage more often on fallowed land than on stubble.

If the annual groups of varieties are separated according to stubble and fallow preparations for sowing, the amount and density of dockage corresponds fairly well with what is observed if the varieties are separated into groups according to thin and thick average stands they have produced. The stubble sowings, like the varieties which produce thin stands, have relatively large amounts of dockage of light weight showing probability of greater improvement in test weight by proper grading than the fallow and thick stand variety groups which have produced grain samples of less dockage of a heavier weight.

Increase of the amount of dockage in the case of thin stands induced either by restricted fertility conditions or winter killing of some varieties more than others is sometimes the result of the appearance of late shoots which produce uneven ripening.

An examination of the dockage records of Minturki, a variety shown by its yield to be especially adapted to stubble sowing, and Malakof, a variety especially responsive to summer fallowing, brings out a contrast between the relations of quality of grain to the conditions under which it was grown. The average stands of Minturki did not vary abnormally from the average of all varieties, nevertheless, dockage removed from Minturki wheat was actually less in amount on stubble land than it was on fallow. Averaging all conditions of growth, therefore, this variety produced a grade of grain with a very low amount of dockage of great density. The average gain in weight per bushel for the amount of dockage removed was less than for any other variety grown.

In the case of Malakof the dockage was greater on stubble land, as it was for most of the other common varieties.

HARDINESS AND STANDS

Quisenberry and Clark (7) reported on the relative winter hardiness of common varieties of winter wheat including data from 30 experiment stations in the United States and Canada, north of central Kansas. There appears to be some correlation between their rank of varieties as to winter hardiness and the average final stands secured at Goodwell.

In Table 17 will be found a record of the final stands resulting from uniform seedings in variety tests of 30 pounds of seed per acre. The same drill, a cup delivery eight inch disk style drill with chain cover, has been used throughout this experiment. The stands recorded were determined by taking four random hoop counts in each plot and calculating to the number of straws per square foot. It will be noted that the number of straws produced on stubble land seedings will average from one-half to three-fourths of the number produced by seeding on summer fallowed land. The failure of the stubble seedings in 1928 widens the average ratios as shown in the last columns of Table 16.

Counts of the stools on representative plots show that the difference in numbers of plants is rarely as wide as the straw count would indicate. Stubble land sown at the same time with summer fallowed land often produces 90% or more of the number of stools found on the fallowed land. The effect of accumulated soil resources which are usually found in summer fallowed soil is largely felt in the tillering of the young plants.

Table 16—Amount and Density of Dockage Taken From Recleaned Samples of Wheat

Variety	1928 Fallow			1929 Stubble			1929 Fallow			1930 Stubble			1930 Fallow			3 Year Average		
Variety	Per cent Dockage	Per cent Gain in Wt. per Bu. after Docking	Ratio of Grain Wt. to Dockage Wt.	Per cent Dockage	Per cent Gain in Wt. per Bu. after Docking	Ratio of Grain Wt. to Dockage Wt.	Per cent Dockage	Per cent Gain in Wt. per Bu. after Docking	Ratio of Grain Wt. to Dockage Wt.	Per cent Dockage	Per cent Gain in Wt. per Bu. after Docking	Ratio of Grain Wt. to Dockage Wt.	Per cent Dockage	Per cent Grain in Wt. per Bu. after Docking	Per cent Grain Wt. to Dockage Wt.	Per cent Dockage	Per cent Grain in Wt. per Bu. after Docking	Ratio of Grain Wt. to Dockage Wt.
Kanred	1.7	.2	.85	2.9	1.8	.61	.9	.7	.56	1.7	.9	.65	.7	.3	.70	1.58	.78	.67
Turkey	1.4	.5	.73	3.1	1.8	.63	1.2	.6	.66	1.3	1.2	.52	.7	.0	1.00	1.54	.82	.71
Blackhull	.7	.3	.70	5.9	5.3	.52	.7	.5	.58	3.0	1.5	.66	.3	.2	.60	2.12	1.56	.61
Malakof	.8	.3	.72	2.8	1.8	.60	1.3	.6	.68	1.8	.9	.66	1.0	.3	.76	1.54	.78	.68
Minturki	2.3	.0	1.00	.8	.7	.53	1.7	.4	.80	.8	.5	.61	.7	.2	.77	1.26	.36	.74
Minhardi	3.2	.7	.83	9	.7	.56	1.9	.8	.70	1.0	.5	.66	1.3	1.4	.48	1.66	.82	.65
Turkey 101	2.2	.5	.81	3.1	1.8	.63	1.4	.9	.60	1.4	1.0	.58	.5	.2	.71	1.72	.88	.67
Turkey 102	3.8	.7	.84	1.8	1.2	.60	1.4	.6	.70	1.1	1.2	.47	.4	.2	.66	1.70	.78	.65
Kharkov	1.2	.3	.80	.9	.7	.56	1.5	1.1	.57	3.5	1.6	.68	.3	.3	.50	1.48	.80	.62
Eagle Chief	1.7	.5	.77	2.9	1.7	.62	1.5	1.5	.50	1.8	1.0	.64	.4	.3	.57	1.64	1.00	.62
Burbank Super	1.5	.7	.68	.5	.5	.50	.9	.2	.81				1.4	1.2	.53	---	---	---
Fultz	1.3	.5	.72	.5	.7	.41	.9	.6	.60	1.4	.7	.66	1.0	.7	.58	1.02	.64	.59
Superh. Blkh.	1.4	.3	.82	4.0	2.9	.57	.8	.2	.40	2.7	2.2	.55	.4	.2	.66	1.86	1.16	.60
Ridit										2.7	1.1	.71	.4	.2	.66			
Crimean 50										1.0	1.7	.37	.4	.2	.66			
Nebr. 60										.7	1.2	.36	.6	.7	.46			
Nebr. 6										.8	1.4	.36	1.0	.5	.66			
Sibley's NG										.2	.4	.33	.5	.2	.71			
Average	1.8	.4	.79	2.3	1.7	.56	1.2	.7	.63	1.6	1.1	.56	.7	.4	.65			

Table 17—Stands Resulting From Uniform Seedings of 30 Pounds per Acre on Stubble and Fallow Land

Variety	No. Straws Per Square Foot												Ratio of Stubble to Fallow Land	
	1926		1928		1929		1930		4 Yr. Ave.		3 Yr. Ave.		4 Yr.	3 Yr.
	Stub.	Fal.	Stub.	Fal.	Stub.	Fal.	Stub.	Fal.	Stub.	Fal.	Stub.	Fal.	Ave.	Ave.
Kanred	33.4	48.0	0	56.5	36.2	61.8	26.7	87.9	24.0	51.0	21.0	52.1	2.13	2.48
Turkey	41.8	49.2	0	48.8	33.2	65.8	27.2	40.3	25.6	51.0	20.1	51.6	1.99	2.57
Blackhull		38.7	0	39.4	24.3	49.8	20.2	29.5		39.4	14.8	39.6		2.68
Malakof	34.2	61.2	0	64.5	31.3	64.5	26.5	32.1	23.0	55.6	19.3	53.7	2.42	2.78
Minturki	33.8	39.0	0	58.9	31.0	60.6	19.4	47.0	21.1	51.4	16.8	55.5	2.44	3.30
Minhardi	30.4	41.2	0	41.0	42.0	60.0	22.7	43.0	23.8	46.3	21.6	48.0	1.95	2.22
Turkey 101			0	54.3	34.6	65.2	20.7	42.0			18.4	53.8		2.92
Turkey 102			0	65.7	33.6	60.9	20.5	33.0			18.0	53.2		2.96
Kharkov		42.0	0	46.4	38.7	65.4	14.5	36.3		47.5	17.7	49.4		2.79
Eagle Chief	24.1	39.6	0	49.7	25.0	67.1	27.6	38.5	19.2	48.7	17.5	51.8	2.54	2.96
Burbank S.			0	19.2	24.3	40.2	6.8	11.5			10.4	23.6		2.27
Fultz			0	15.7	21.2	53.6	15.1	40.3			12.2	36.5		2.99
Superh. Blk.			0	37.1	25.9	57.6	20.4	26.2			15.4	40.3		2.62
Ridit							19.6	25.9						
Crimean 50							23.5	41.9						
Nebr. 60							25.3	35.9						
Nebr. 6							27.6	30.5						
Sibley's NG							21.5	36.2						
Average	33.0	44.9	0	45.9	30.9	59.4	21.4	34.9	22.8	48.9	17.2	46.9	2.25	2.73

The data of Table 17 do not indicate whether final stands falling below the average are the result of weak tillering or actual losses of plants by winter killing. There is no relation between the stands resulting from different varieties and average yield. Most varieties of the Turkey group are among those averaging high straw counts and these are consistently high yielders. Minhardi has on the other hand made thick stands and low yields. The group averaging low stand counts contains generally low yielders with the notable exception of Blackhull. Under the conditions of this experiment it may be safely concluded that ability to effect a heavy ground cover is not necessarily responsible for the high yielding capacity of a variety.

TIME OF MATURITY

The time of maturity has been observed for all varieties in the group but the dates are reported in Table 18 only for those varieties having a five-year or longer record. June 24 has been the average date of maturity of all varieties and the variation from this average has not exceeded three days in either direction. There has been a slightly wider spread between the early and late maturing varieties when grown together on summer fallowed land than on stubble land. Blackhull is the earliest maturing variety included in this group while Minhardi and Minturki are the later maturing varieties. There are slight differences in the maturity of the others but they do not depart radically from the average.

Blackhull has been noted to reap the greatest advantage from its early maturity during seasons in which the effects of drouth became apparent late in the fruiting stage. The years 1924 and 1929 were examples of this situation. It will be noted that the differences in maturity date were greater on these occasions between Blackhull and competing varieties than were observed on other years when the wheat matured under favorable June conditions.

DISCUSSION OF VARIETIES

Kanred—This variety, originating at the Kansas Experiment Station, spread over the Panhandle of Oklahoma concurrently with its distribution in Southern and Western Kansas and became ultimately much confused and mixed with the older variety of common Turkey red wheat. Many persons using old lines of seed do not know definitely whether their wheat is Kanred or Turkey or a mixture of the two. Kanred does not respond in tillering as strongly as the average to favorable conditions, but produced thicker than average stands under both stubble and fallow conditions. The amount of dockage was about equal to the average of the group and the density was slightly less than average. Kanred wheat tended to develop higher than average protein content under unfavorable conditions and dropped considerably below the average when grown on summer fallowed land. The test weight was equal to the group average. Kanred was intermediate in proportions of grain to straw under both fallow and stubble conditions. It ranked well with the group of high grain yielders with no particular advantage under favorable or unfavorable conditions.

Turkey (Common)—This is a widely distributed and popular variety of wheat in this territory and is the oldest variety still in common use. The final stands resulting were very slightly thinner than Kanred but still well above the group average on both stubble and fallowed land. It did not tiller excessively under favorable conditions. The average amount of dockage from Turkey was very near the average for the group. The density of dockage was only slightly more than the average. Protein content showed a tendency to run less than the average on stubble land and more on fallowed land. The test weight was average, as were the proportions of grain to straw. This variety showed no special preference for continuous or fallow culture practices and ranked with Kanred in the high yielding group.

Table 18—Dates of Full Maturity for Varieties of Wheat at Goodwell, Oklahoma

Variety	1924	1926	1928	1929	1930	4 Yr. Average
			STUBBLE			
Kanred	June 26	June 28		June 20	June 20	June 23
Turkey	June 26	June 28		June 20	June 19	June 23
Blackhull	June 20			June 19	June 18	
Malakof	June 27	June 28		June 20	June 20	June 24
Minturki	June 27	July 4		June 23	June 22	June 26
Minhardi	June 27	July 3		June 23	June 22	June 26
Kharkov				June 20	June 20	
Eagle Chief		July 2		June 20	June 20	
			FALLOW			
Kanred	June 26	June 24	July 2	June 23	June 22	June 23
Turkey	June 26	June 24	July 2	June 23	June 22	June 23
Blackhull	June 20	June 25	July 1	June 20	June 21	June 21
Malakof	June 27	June 24	July 2	June 22	June 21	June 23
Minturki	June 27	June 29	July 3	June 28	June 25	June 27
Minhardi	June 27	June 30	July 3	June 27	June 24	June 27
Kharkov		June 29	July 3	June 23	June 23	
Eagle Chief		June 25	July 2	June 24	June 22	

Blackhull—Blackhull was introduced into the Panhandle of Oklahoma after Kanred and perhaps has not yet reached the full extent of its potential popularity judging by the current demands for seed. The stands resulting from uniform seedings of Blackhull and other varieties indicate it to be less winter hardy or less disposed to tiller than the average variety. However, the proportion of tillers produced on fallowed land compared with stubble is near the average which is indirect evidence that the thinner stands are due principally to winter losses. The average percent of dockage was higher for Blackhull than for any other variety and the material eliminated was relatively light in weight. The protein content was much lower than the group average under both systems of culture but the depression was greatest when the variety was grown on stubble land. The weight per bushel was high and the proportion of grain to straw averaged higher than any other variety grown. Yields of Blackhull were high with possibly a slight advantage for the variety on fallowed land.

Malakof—This variety has been known in experimental circles for many years but has not been commonly used in the Panhandle of Oklahoma. The average stands passing the winter were above the group average with considerable emphasis on excessive tillering under summer fallowed conditions. The amount and density of dockage were near the group average. The tendency toward higher protein under fallowed conditions was somewhat less marked than noticed in the case of Turkey. Weight per bushel of Malakof wheat was very slightly below the group average. The amount of straw produced per unit weight of grain was greater under both conditions of culture than usual. Malakof wheat ranked high in average yield and showed a particular adaptation to summer fallow culture.

Minturki—This variety has never been distributed in this locality and is being used only experimentally at this time. The stands secured were slightly below the group average on stubble land and are above it on summer fallowed land, showing a strong tendency toward excessive tillering under favorable conditions. Dockage of the Minturki grain sample was very low in amount and high in density. It was one of the three varieties which stood higher than the group average in protein content under both stubble and fallow culture. The test weight was .7 pounds per bushel lower than the average. The proportion of grain to straw was slightly greater than the average on stubble land but was among the lowest on summer fallow. Minturki was an outstanding yielder on stubble land but fell below several other varieties on summer fallowed land.

Turkey 101 and 102—These are pure line selections made at Panhandle A. and M. College by R. C. Shiflett about 1921 or 1922 and have been included in wheat variety tests while an effort was being made to secure data on their smut resistance. Neither strain has been distributed except for experimental purposes. In regard to hardiness both selections produced better than average stands and showed a disposition toward excessive tillering under summer fallowed conditions. Both were slightly higher than the group average in amount of dockage and approximately equal to it in density of dockage. The data of protein content and test weight were not reported since it was incomplete and not comparable with the other varieties, however, they were very similar to the common Turkey variety in both respects. Turkey 102 was slightly below the average in proportion of grain to straw and Turkey 101 was among the lowest. Both varieties have ranked well in yield, usually slightly above the common Turkey with Turkey 101 seeming to prefer fallow tillage and Turkey 102 continuous culture.

Kharkov—Kharkov wheat was at one time widely distributed in the Panhandle of Oklahoma but has recently given place to earlier maturing

varieties which occasionally show some advantage on years of unfavorable maturing period. Kharkov produced approximately average stands under both conditions of culture. Dockage of the Kharkov sample has averaged a little less than usual and has been relatively low in weight. Protein content has run higher than the average under all conditions of culture and the weight per bushel very slightly higher. It has produced more grain per unit weight of straw than the ordinary varieties of the Turkey group. While Kharkov remains in the upper half as to yield it has not been tested long enough to get a satisfactory comparison of performance with the other varieties.

Eagle Chief—This variety recently distributed by C. H. Hyde of Alva, Oklahoma, has so far only been used experimentally in the Panhandle section of the state. It is about equal to or slightly above the average in stand count with a tendency toward excessive tillering under favorable conditions. The dockage has been about average in quantity and light in weight. Protein content has averaged approximately the same as the group. The weight per bushel was slightly higher than the average. Eagle Chief was next to Blackhull in high proportion of grain to straw on stubble land and somewhat higher than the average of the group on fallow land. In yield it has shown no preference for either stubble or fallow culture and ranks in the Turkey group.

Minhardi—This variety has not been introduced into this part of Oklahoma except for experimental purposes. The stands resulting are near the group averages but it shows the least tendency of all varieties to strong tillering under specially favorable conditions. The amount of dockage is slightly more than the average but the weight of dockage was about equal to it. Protein content was higher than the stubble group normal but only slightly higher than the fallow group normal. Weight per bushel was very low being 1.6 pounds below the average. The proportion of grain to straw was near the group average on stubble land but the lowest observed on summer fallowed land. Minhardi was among the low producers in all groups.

OTHER VARIETIES

Varieties added to the experiment in 1928 were: Burbank Super, Fultz and Superhard Blackhull. Of these only Superhard Blackhull appears to be classified among the better adapted kinds. None of the more recent introductions have been tested long enough to warrant their discussion.

SUMMARY

1. This study of wheat variety reactions on heavy soils of the High Plains region of Oklahoma covers the period 1924-30 in which seasonal conditions varied sharply resulting in yields that ranged from 0.0 to 55.0 bushels per acre.

2. There appeared to be a tendency for some varieties to manifest particular adaptation to summer fallow practice and others to continuous culture. Minturki showed a seven-year average net loss by summer fallowing in yield of 114.5 pounds per acre annually while Malakof showed a net gain by fallowing of 54.9 pounds per acre annually. Other varieties ranged between these two extremes.

3. The differences in average yield under all conditions for the seven-year period were not great enough among the leading varieties to single out a particular outstanding variety. Turkey and Turkey related varieties along with Blackhull constituted the high yielding group. Minhardi, Burbank and Fultz were inferior under all conditions.

4. Protein content averaged 14.15% in wheat grown on stubble land compared to 15.54% on summer fallowed land.

5. Soil and seasonal conditions appeared to exert a greater influence on protein content than varietal characteristics within the group studied. However, variety has some bearing upon the quality with reference both to protein and dockage in the relation of its reaction through stand to the progressive moisture-fertility complex of the season.

6. Highest average dockage occurred among varieties producing thin stands and in groups subjected to continuous culture. Blackhull and certain selections of Turkey were included in this group. The least dockage was found in some of the least productive varieties.

7. The thinner average stands were produced by varieties which general experience further north indicate to be least winter hardy although winter killing in this locality is usually attributed to dryness rather than low temperature.

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