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BLACKHULL WHEAT IN KANSAS

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WHAT ABOUT BLACKHULL?

BLACKHULL WHEAT, which was originated by Mr. Earl G. Clark, of Sedgwick, Kan., and first distributed by him in 1917, is grown on about four million acres in Kansas. This variety possesses some very desirable characters such as a stiff straw, a high test weight, a tendency to ripen early, and the ability to produce high yields. On the other hand, it is definitely known to be less winter hardy than the Turkey types of wheat; the grain is softer in texture; the gluten or protein, although equal in quantity, is not so strong, and, hence, is not so satisfactory in commercial bakeries as the Turkey types of wheat.

While Blackhull is probably the most satisfactory variety for limited areas of the state where stiff straw and earliness are more important than ability to survive cold winters, it cannot be regarded as a satisfactory variety for the hard-wheat belt as a whole.

Kansas enjoys a premium for her wheat in the world's markets, because of the splendid reputation which has been established. It would be very unfortunate for all citizens of the state if this reputation should be lost by the widespread use of a variety unsuited to the trade requirements of a large part of the milling industry. It would, therefore, seem to be the part of wisdom for a majority of Kansas farmers in the hard-wheat belt to grow varieties of the Turkey type.

BLACKHULL WHEAT IN KANSAS[1]

S. C. SALMON, C. O. SWANSON AND H. H. LAUDE

INTRODUCTION

No other variety of wheat distributed in Kansas in recent years has attracted so much attention as has the variety known as Blackhull, originated by Mr. Earl G. Clark, of Sedgwick, Kan., and first distributed by him in 1917. It has increased until probably about four million acres of this variety are now grown in Kansas. This fact in itself is convincing proof that it possesses substantial qualities which appeal to the grower. Some millers, when it was first introduced, expressed doubt as to its milling and baking value, and the Kansas Agricultural Experiment Station has called attention to its softer kernel texture and probable lack of winter hardiness. Since it has been grown for several years without serious loss from winterkilling, this latter danger has been disregarded by farmers rather generally.

Some millers, it may be remembered, objected to the quality of Turkey wheat when it was first introduced and likewise to Kharkof wheat when it was brought from Russia by the United States Department of Agriculture in 1898. They also strenously objected to the quality of Kanred wheat when it was distributed by the Agricultural Experiment Station in 1916. Since none of these objections were well founded, as is now admitted, there is a decided tendency among farmers to discount the complaints that are now made regarding Blackhull.

Recently these complaints have become more numerous and insistent, supported in several cases by refusals to buy wheat in Blackhull territory. In recent years the Agricultural Experiment Station has accumulated considerable information relating not only to the milling and baking qualities of this variety, but also to its winter hardiness and yield, which indicate that it may be even less desirable for Kansas to produce a large amount of Blackhull wheat than was at first supposed.

To arrive at an accurate conclusion as to the value of Blackhull is an unusually difficult matter. It undoubtedly excels in some respects while it is certainly inferior in others. Thus its defects offset to such an extent its good qualities that it is difficult to determine

1. Contribution No. 168 from the Department of Agronomy and No. 33 from the Department of Milling Industry.

which predominate. Nevertheless, that is exactly what the farmer must do when he chooses between Blackhull on the one hand and Turkey or Kanred on the other It seems reasonable that a more reliable conclusion can be reached if one who is confronted with this question has all the facts before him. In the following pages an attempt is therefore made to set forth as clearly and concisely as possible both the strong and the weak points of Blackhull, with the hope that the information may be of value to the farmers of the state.

CHARACTERISTICS OF BLACKHULL WHEAT

The principal points in which Blackhull is claimed to excel are: Resistance to lodging, early maturity, high test weight, resistance to rust and Hessian fly, value for pasture, and high yield. On the other hand, as previously mentioned, its winter hardiness and its quality have been questioned. Some have also expressed doubts as to its protein content. It seems desirable to discuss each of these points in some detail.

RESISTANCE TO LODGING

One of the outstanding advantages of Blackhull is its stiff straw or resistance to lodging on rich soils and in wet seasons. This property also is of value in relation to cutting with the combine, since the stiffer the straw the longer a variety may be expected to wait for harvest without loss from lodging.

No exact data as to lodging have been secured in field trials, but the general experience of farmers and certain observations in experimental trials leave little doubt as to the superiority of Blackhull in this respect. During the past year the strength of the straw of Blackhull as compared with other varieties was determined by a special instrument which recorded the weight necessary to break a number of straws when supported at two points about three inches apart. The average of a number of determinations for several varieties, expressed as the breaking strength of a single straw, is shown in Table I.

TABLE I.—Relative breaking strength of straw of Blackhull, Turkey, Kanred, and other varieties.

(Grown at Manhattan, Kan., 1926.)

VARIETY.	Number of pounds necessary to break a single straw.
Harvest Queen	1.25
Currell	1.10
Fulcaster	1.03
Zimmerman	.96
Blackhull	.92
Superhard Blackhull	.86
Kharkof	.84
Turkey	.75
Kanred	.73

It will be seen that Blackhull is intermediate with respect to strength of straw, being considerably stronger than Turkey and Kanred, but not so strong as certain varieties of soft wheat, particularly Harvest Queen.

TEST WEIGHT

Blackhull wheat almost invariably weighs from one to three pounds more per bushel than Turkey or Kanred. This fact is shown in Table II, which gives the average test weight of Blackhull, Turkey, and Kanred grown in comparative trials in different part, of the state. It will be seen that Blackhull averaged 60.4 pounds per bushel as compared with 58.2 for Turkey and 57.1 for Kanred. Ordinarily a higher test weight means a higher grade and a higher price. Millers usually are willing to pay more for a high-test than for a low-test wheat because more flour can be milled from it, other things being equal. It has been found, however, that this relation between test weight and flour yield is not the same when Blackhull is compared with Turkey and Kanred. Blackhull has a thicker bran and, as will be shown later, it usually produces no more flour per bushel of wheat than does Turkey or Kanred. In other words the higher test weight of Blackhull is of little advantage to the miller and consequently there is no inducement for him to buy high-test wheat if in doing so he gets Blackhull. The higher test weight, of course, may be a temporary benefit to the farmers growing Blackhull in Turkey and Kanred territory.

TABLE II.—Relative test weight of Blackhull, Turkey, and Kanred grown at the Agricultural Experiment Station and in 234 fields in different parts of Kansas.

YEAR.	Number of trials.	Test weight, pounds per bushel.		
		Blackhull.	Turkey.	Karned
Agricultural Experiment, Station, Manhattan, Kan.				
Average, eight years, 1919 to 1926.		60.4	57.8	57.2
Cooperative Tests with Farmers				
1922.	27	60.0	57.5	55.9
1923.	57	58.1	56.5	54.5
1924.	56	60.7	58.2	58.2
1925.	49	61.1	58.7	57.7
1926	45	62.1	60.0	59.4
Average of 242 trials.		60.4	58.2	57.1

BLACKHULL FOR PASTURE

Farmers have observed that Blackhull frequently furnishes more pasture than Turkey or Kanred. This may be due to a larger, more erect growth habit or perhaps to a more vigorous growth. In this respect, as in many others, Blackhull resembles soft winter wheat.

TIME OF HEADING AND RIPENING

Blackhull tends to ripen on the average nearly a day earlier than Kanred and about two days earlier than Turkey. Average dates of heading and ripening at the Agricultural Experiment Station, Manhattan, Kan., are shown in Table III. The fruiting period, that is, the number of days from heading to ripening, is considerably longer for Blackhull than for other hard red winter varieties. This means that there is a longer period for the developing and maturing of the kernel in Blackhull than in Kanred or Turkey. This may account for the higher test weight and may also be related to the higher yields of Blackhull secured under certain conditions.

TABLE III.-Average dates of heading, ripening, and the fruiting period of Blackhull, Turkey, and Kanred.

VARIETY.	Average date of ripening.	Average date of ripening.	Fruiting period *i. e.*, days from heading to ripening.
Blackhull.	May 23	June 20	28
Turkey.	May 27	June 22	26
Kanred.	May 26	June 21	26

RUST RESISTANCE

It has been claimed that Blackhull is resistant to rust. Carefully controlled experiments have failed to verify this claim. It should be pointed out, however, that the tendency of Blackhull to head and ripen early sometimes enables it to escape rust damage when other varieties are injured. This, of course, is an advantage in favor of Blackhull in those seasons when rust appears early enough to damage other varieties but not early enough to injure Blackhull.

RESISTANCE TO STINKING SMUT

Some farmers believe that Blackhull is more susceptible to smut than are other varieties. Experiments so far conducted have failed to demonstrate any differences of importance. Blackhull will become infected with stinking smut as readily as Turkey or Kanred but no more readily so far as known.

RESISTANCE TO HESSIAN FLY

The claim has been made that Blackhull is resistant to Hessian fly. In controlled experiments in which Blackhull, Turkey, Kanred, and other hard red winter varieties have been subjected to equal chances of infestation fewer flies as a rule have been found on Blackhull than on the other varieties. However, the same has been true of most soft winter varieties when grown in the same way. When soft wheats are grown exclusively, as in the eastern states, they are severely damaged. In other words it appears that the Hessian fly prefers hard wheats, but that the soft wheats have no real ability to resist the attacks of the fly when grown exclusively in a locality. The same appears to be true of Blackhull.

THE QUALITY OF BLACKHULL WHEAT

One of the most important questions regarding Blackhull, as well as perhaps the most difficult one to answer, relates to its quality. Does it resemble soft wheat as many millers have claimed? Is it deficient in protein? Does it produce as good flour as Turkey or Kanred? Quality has several, meanings, and hence it will be necessary to consider first just what is meant by this term.

What is Good-quality Wheat?

The best grades of Kansas hard red winter wheat bring a premium on the market because of their "strength." Thus a small quantity of the "strong" flour, if mixed with a "weak flour" from soft red winter or soft white wheat enables the baker to produce better bread than would otherwise be possible.

Usually a "strong flour" is from hard wheat with a high protein content. This is the reason for the premiums that are often paid for Kansas wheat. But this does not tell the whole story, for there are some varieties of wheat that contain more protein even than the best Kansas hard wheat and yet do not make good bread. The protein in such cases is of poor quality.

But "strength" and "quality" of protein are not the only factors to be considered. The way in which the dough is mixed and baked also has a marked influence on the quality of the bread. The general practice in large bakeries using strong flour is to mix several hundred pounds of dough at one time in large mechanical mixers. operated by powerful motors. This usually gives the dough a very severe treatment — much more severe than it receives from the housewife who kneads it by hand. A strong flour made from a high-quality protein wheat is required to withstand this treatment. A dough from weak flour soon becomes soft and sticky and the bread baked from it is unsatisfactory. If, on the other hand, a weak flour is mixed less severely as by hand, very good bread may be made from it. Also a strong flour absorbs a larger quantity of water which means more bread per bushel of wheat, and also a better quality of bread. This fact, is of considerable importance to the baker.

Milling and Baking Tests With Blackhull

Extensive milling and baking tests with Blackhull grown in the same fields with Turkey and Kanred have been conducted by the Agricultural Experiment Station since 1919. These fields were located in various parts of the state. It was found that Blackhull has many of the milling characteristics of a soft wheat, producing a thicker, larger flaked bran and a softer, whiter flour than Turkey or Kanred.

Until 1924 the dough was mixed more or less as the housewife would mix it, or perhaps as it would be mixed in slow-speed machines such as are frequently found in small bakeries. In 1925 and 1926 another method was used which treated the dough more severely. The mixing was about like that of the bakeries where high-speed mixers are used. Table IV gives the results of these milling and baking tests. Extensive tests were made previous to 1923, but the results were essentially the same as those in 1923 and 1924 as given in the table. The table includes data on test, weight, per cent of flour, protein content of the wheat, per cent of absorption, loaf volume, and texture of bread, which are the most important points

to consider. The loaf volume is expressed in cubic centimeters. Since an equal amount of flour was used in each case the greater the loaf volume the better the flour. The texture is scored on the basis of 100 per cent; that is, a loaf that is perfect in this respect would have a texture score of 100 per cent.

TABLE IV.—Milling and baking tests of Blackhull, Turkey, and Kanred wheat.

Year.	Variety.	Number of samples tested.	Average protein content.	Yield of flour.	Absorption.	Average loaf volume.	Average texture score.
Dough Mixed Gently							
			Per cent.	*Per cent.*	*Per cent.*	*c. c.*	*Per cent.*
1923	Blackhull	40	11.7	71.5	61	1,894	91
	Turkey	40	11.4	71.8	61	1,893	90
	Kanred	40	11.9	72.3	61	1,874	90
1924	Blackhull	49	11.3	71.5	53	1,699	90
	Turkey	49	10.9	69.2	54	1,705	91
	Kanred	49	10.9	70.3	54	1,677	89
Dough Mixed Severely.							
1925	Blackhull	47	12.1	69.4	56	1,680	89
	Turkey	47	12.1	68.9	60	1,860	93
	Kanred	47	12.3	69.4	59	1,808	96
1926	Blackhull	27	13.8	71.0	67	1,701	85
	Turkey	27	13.9	71.0	71	1,838	93
	Kanred	27	13.7	72.0	71	1,923	94

Protein Content. — It will be seen that Blackhull had essentially the same protein content on the average as Turkey and Kanred. In 1924 it was slightly higher than either Turkey or Kanred and in other years it was the same or intermediate. In no case are the differences important.

Per Cent of Flour. — There was very little difference in the per cent of flour milled from the different varieties although Blackhull mas materially above the others in test weight. In 1923 it produced slightly less flour than Turkey or Kanred and in 1924 slightly more. In 1925 it was equal to Kanred and in 1926 it was equal to Turkey.

Loaf Volume, Absorption, and Texture. — The quality of flour is best judged by the absorption, loaf volume and texture of bread. The data secured in 1923 and 1924 must be considered separately from those secured in 1925 and 1926 as previously explained. In the former case the dough was mixed gently, approximating hand-mixing, while in 1925 and 1926 it was mixed severely as is done in bakeries which have high-speed mixers.

It will be seen that in 1923 and 1924 Blackhull produced as good

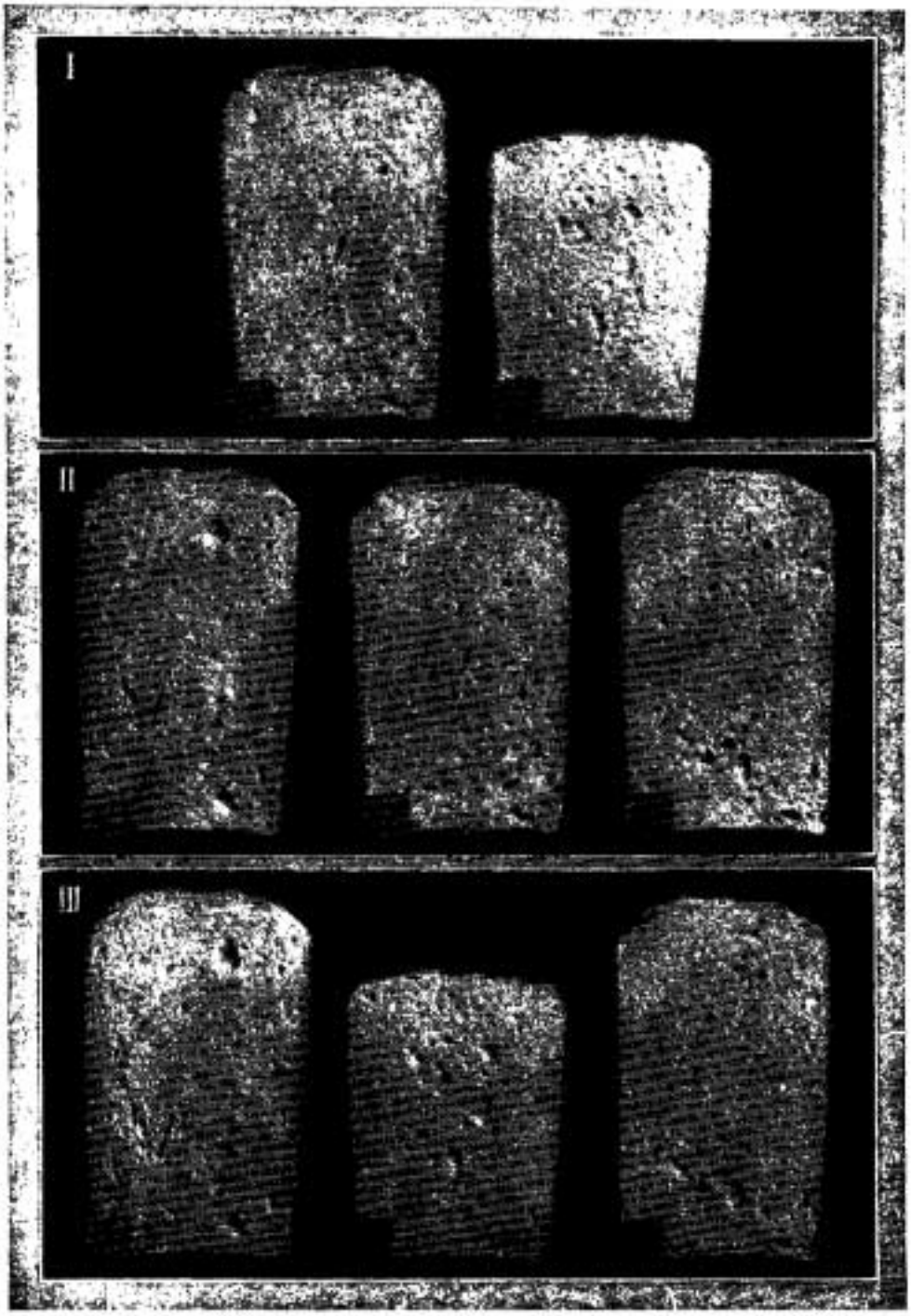

FIG. 1.—Baking tests with Blackhull, Turkey, and Kanred.

I. Bread from Blackhull wheat; (A) dough mixed gently as by hand and (B) dough mixed severely as by high-speed mixers.
II. (A) Bread from Kanred made by mixing dough severely; (B) bread from Blackhull made by mixing dough gently; and (C); bread from Turkey made by mixing dough severely.
III. Bread from (A) Kanred, (B) Blackhull, and (C) Turkey made by mixing the dough severely.

loaves as did the other varieties. In both years it was equal to Turkey and slightly better than Kanred in loaf volume and in texture. The differences are small and unimportant.

In 1925 and 1926, however, when the dough was mixed severely, Blackhull was considerably poorer than either Turkey or Kanred. Thus in 1925 the loaf volume of Blackhull was only 1,680 cubic centimeters as compared with 1,860 cubic centimeters for Turkey and 1,898 cubic centimeters for Kanred and the texture score was six points lower than Turkey and seven points lower than Kanred. In 1926 the loaf volume was only 1,701 cubic centimeters as compared with 1,838 cubic centimeters for Turkey and 1,923 cubic centimeters for Kanred. As before, the texture score was eight and nine points below that of Turkey and Kanred, respectively. In absorption Blackhull was several points below Turkey and Kanred when the severe method of baking was used. The differences here are great enough to leave no doubt as to the inferior quality of Blackhull flour when mixed in this way. The results may be clearly seen in figure 1, in which typical loaves of Blackhull, Turkey, and Kanred are shown.

Shollenberger and Clark[2] of the United States Department of Agriculture have milled a considerable number of samples of Blackhull and other hard wheats grown under comparable conditions. They state that Blackhull is softer and "In some respects somewhat inferior" to Turkey and Kanred.

Vaupel[3] milled and baked a number of samples of Blackhull, Turkey, and Kanred grown in Oklahoma. The Blackhull flour resembled that of a soft wheat. It lacked strength, had less absorption, and produced a loaf of smaller volume than Turkey or Kanred. It "proved to be the poorest of the three varieties."

It is only fair to say that not all are agreed as to the quality of Blackhull wheat. While a majority of millers in Kansas and in the Southwest in general are of the opinion that Blackhull is decidedly inferior, others, including some Kansas millers, have no complaint whatever to make or even regard it as superior to Turkey and Kanred in certain respects. Most cereal chemists, including those who commend it as well as those who condemn it, agree that it has less absorption than Turkey and Kanred, and the majority admit that

2. Shollenberger, J. H. and Clark, J. Allen. Milling and baking experiments with American wheat varieties. U. S. Dept. Agr. Dept. Bul. No. 1183:1-92. Illus.

3. Vaupel, H. F. Comparative milling and baking values of Kanred, Blackhull, and Turkey Red varieties-Oklahoma wheat. Jour. Amer. Assoc. Cereal Chem. Vol. VII, No. 4, Oct., 1922, pp. 167-173. Illus.

it has less stability or a narrower margin of safety in baking operations.

Just what the final results will be, no one can predict with certainty. It appears clear that good bread can be made from Blackhull wheat. It is equally clear that in order to do so it must be handled differently than Turkey and Kanred. It is also clear that it does not have the strength nor the ability to stand up under severe treatment so characteristic of the other varieties of hard wheat.. Whether millers and bakers will use large quantities of Blackhull or whether they will secure or attempt to secure their supplies of high-quality protein wheat from areas where Blackhull is not grown remains to be seen.

WHAT GOOD-QUALITY WHEAT MEANS TO KANSAS

In this connection it may be well to remember that Kansas wheat competes with the spring wheat of Minnesota, the Dakotas, Montana, and Canada for premiums on high-quality wheat. If millers and bakers continue to be dissatisfied with Blackhull it is conceivable that they will prefer to draw their supplies of hard wheat from the spring-wheat region and from areas in Kansas and Nebraska that are known to be free of Blackhull. If this happens it will, of course, mean lower prices for wheat in Blackhull territory.

IDENTIFYING BLACKHULL WHEAT

The situation would be simpler if it were possible to distinguish between threshed samples of Blackhull and Turkey wheat. There are some differences in the characters of the kernels but unfortunately they are so modified by the conditions under which the wheat is grown that no one can as yet distinguish the grain of Blackhull wheat with certainty. Extensive studies have been made by the Agricultural Experiment Station to determine if any specific differences exist which can be used for this purpose, but so far without definite results.

WINTER HARDINESS OF BLACKHULL

Excepting dry weather there is no single condition which causes greater losses to the winter wheat crop than damage during the winter as a direct or an indirect result of low temperature. This damage is usually spoken of as winter injury or winterkilling. There has been practically no damage of this kind since Blackhull has been extensively grown and hence farmers have had little op-

portunity to observe the ability of this variety to survive severe winters. So one familiar with wheat growing in Kansas will deny the importance of information of this kind.

Fortunately such information has been secured in recent years. The United States Department of Agriculture in cooperation with the Kansas and other Agricultural Experiment Stations has for a number of years grown Blackhull in several northern states and in Canada where winterkilling normally occurs. Some of the pertinent data are presented in Table V. It will be seen that of all varieties included in the table none did so poorly as Blackhull. Even Nebraska 28, a variety known to be nonhardy for Kansas conditions, proved to be slightly more hardy in these tests. It should be explained that the very hardy varieties such as Minhardi and Minturki, because of late maturity and consequent, low yields, are not adapted to Kansas conditions.

TABLE V.—Relative winter hardiness of Blackhull and certain other varieties of wheat grown for five years or more at different locations in the United States and Canada.

VARIETY.	Number of trials.	Per cent survival (Kharkof = 100).
Minhardi	72	126.0
Minturki	72	118.0
Nebraska No. 60 (Turkey)	72	108.8
Nebraska No. 6 (Turkey)	40	105.7
Kanred	72	103.8
Turkey	57	100.4
Kharkof	72	100.0
Nebraska No. 28	57	86.5
Blackhull	63	80.9

During the past winter plants of Blackhull, Turkey, and Kanred grown out of doors in the field were taken up, placed in boxes with soil surrounding the roots, and frozen in a low temperature chamber by means of artificial refrigeration. In every one of forty or fifty trials Blackhull was injured more than Turkey or Kanred. In many cases Blackhull was entirely killed when Turkey and Kanred were scarcely injured. The results of two of these experiments are shown in figure 2.

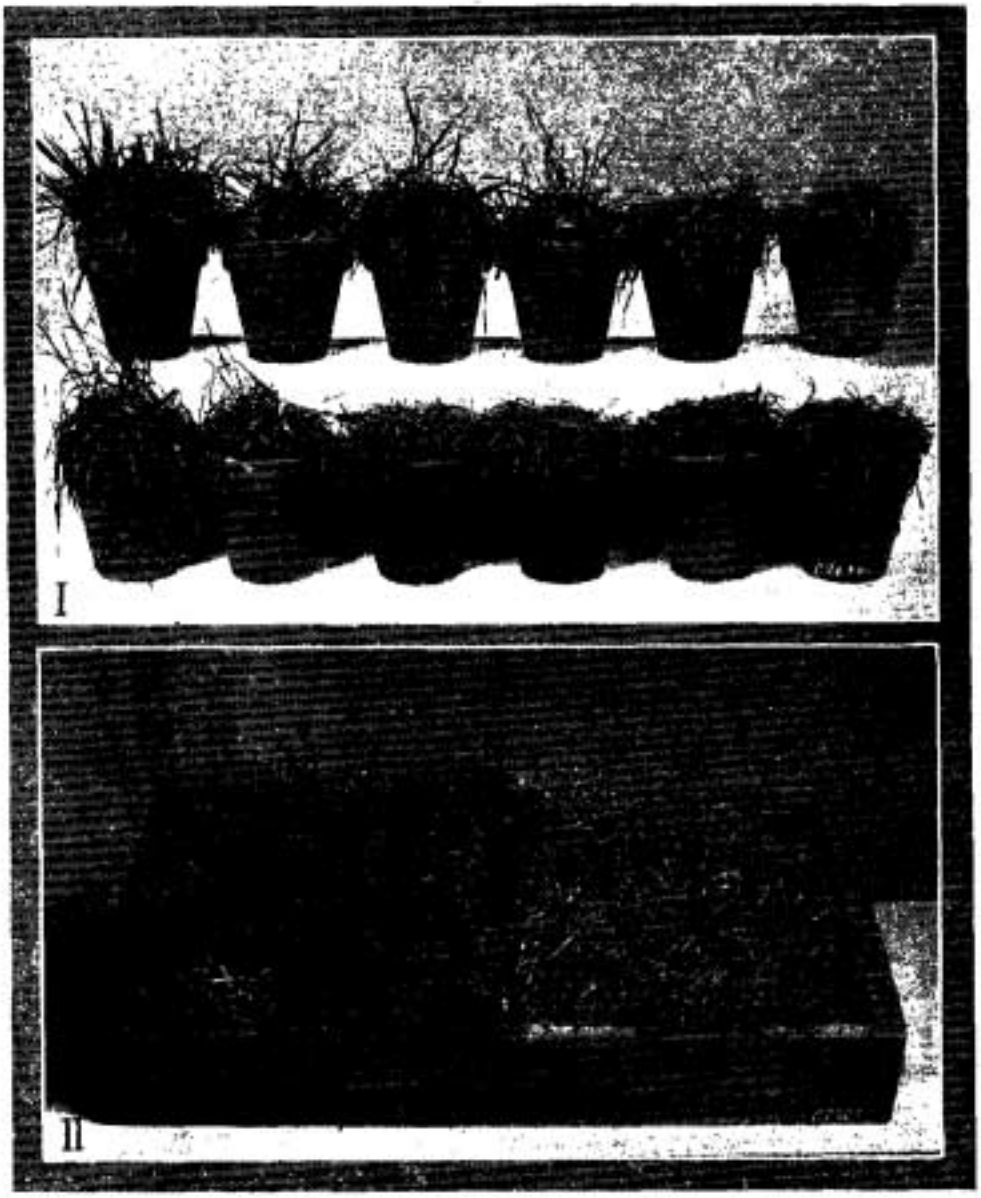

FIG. 2.—Freezing tests with Kanred and Blackhull wheat.

I. Top row, Kanred; bottom row, Blackhull; frozen at an approximate temperature of —10° F. for different periods of time. From left to right the pairs of pots were frozen 6, 12, 15, 18, 21, and 24 hours, respectively.

II. Left half, Kanred; right half, Blackhull; frozen 15 hours at an approximate temperature of —10° F.

It will be noted that all Blackhull plants were killed when frozen for more than 12 hours, whereas Kanred survived when frozen for 18 to 21 hours.

Many farmers have observed in periods of cold weather that the leaves of Blackhull freeze more easily than those of other varieties. In general this may be taken as a fairly reliable index of hardiness or lack of hardiness. Altogether it may be said that the experiments leave no room for doubt as to the deficiency of Blackhull in this respect.

THE IMPORTANCE OF WINTERKILLING

The importance of growing winter-hardy varieties may be seen by considering the losses that have occurred in the past. According to reports of the Kansas State Board of Agriculture, Kansas lost approximately 30 per cent of the total wheat acreage of the state in 1910; 17.5 per cent in 1912; and 63 per cent in 1917. In 1917 the loss was attributed to a combination of dry weather, soil blowing, and winterkilling; in 1912, mainly to winterkilling; and in 1910, entirely or almost entirely to winterkilling. Probably chinch bugs were responsible for some of the damage in 1910 and 1912. The United States Department of Agriculture estimated the loss in yield in Kansas due to winterkilling as 20.8 per cent in 1910; 7.3 per cent in 1912; and 15.7 per cent in 1917. There have been no large losses as a result of winterkilling since 1917. It may be observed that the above losses occurred in years when practically the only wheats grown were the relatively hardy varieties, Turkey and Kharkof.

WHY BLACKHULL HAS NOT WINTERKILLED IN RECENT YEARS

Some people seem to think that because Blackhull has not winterkilled since it has been grown there is no danger from this source. It is extremely doubtful if this viewpoint can be justified by the facts. On the contrary it seems clear that Blackhull has escaped winterkilling because the state has enjoyed a series of rather mild winters. This is shown by the winter temperatures as well as by the fact that no serious winterkilling in any variety has occurred in recent years.

Thus Table VI gives the average daily minimum temperatures at Manhattan since 1858, for January and February, which are usually the coldest months of the year. In making the calculations all days were omitted during which the temperature was at all times above freezing. The last column of the table gives the average lowest daily temperatures for the coldest month of each year regardless of whether that month was December, January, or February. It will be seen that the lowest temperatures for the period, 1919 to 1926, average about 4.5 degrees higher than the immediately preceding

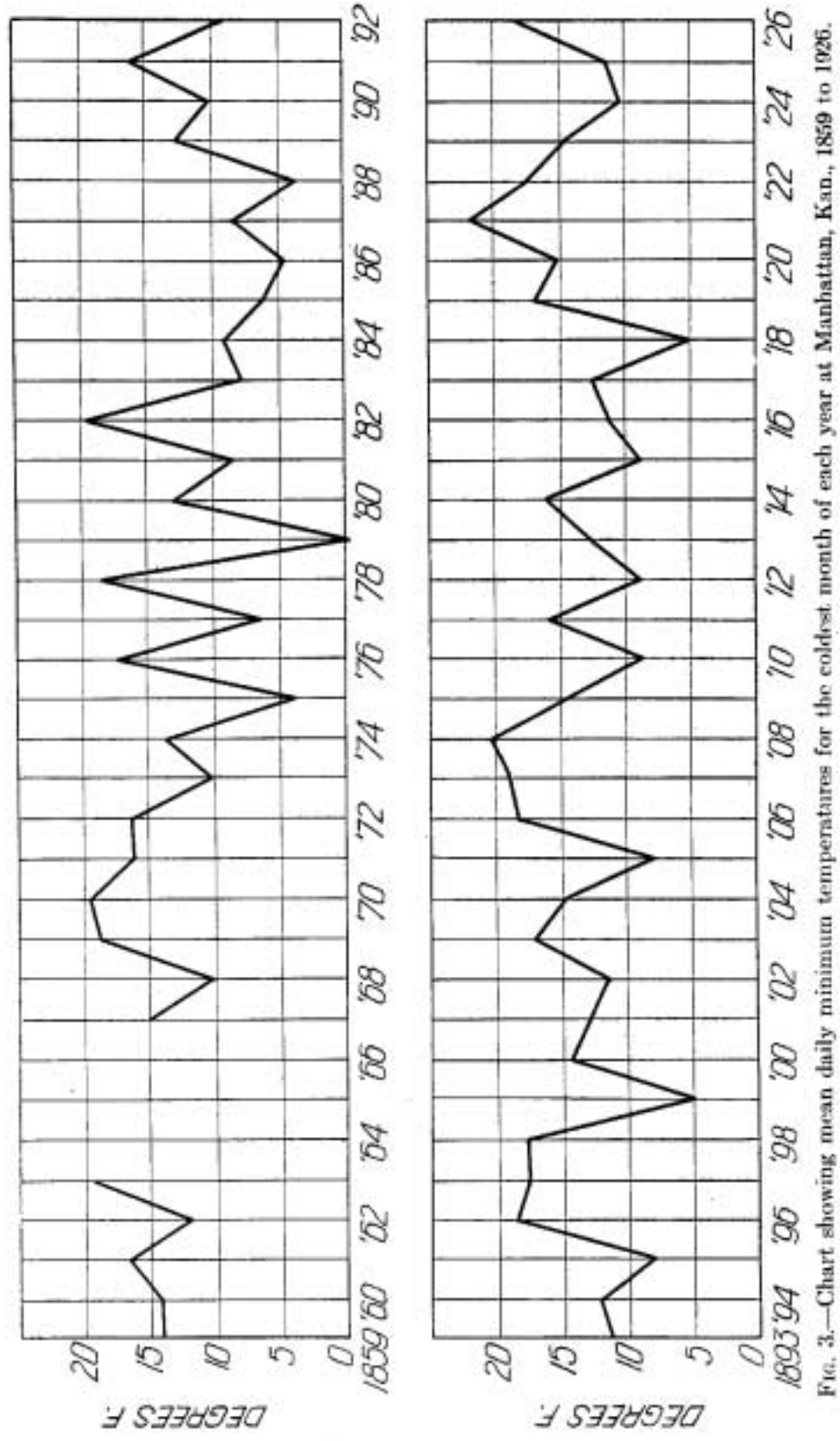

FIG. 3.—Chart showing mean daily minimum temperatures for the coldest month of each year at Manhattan, Kan., 1859 to 1926.

8-year period, that is, 1911 to 1918, and from 3.3 to 4.8 degrees above those for the 59-year period, 1859 to 1918. The period from 1883 to 1895 seems to have been especially cold, since the lowest temperatures for the winter averaged from about six to eight degrees below those for the last eight years. The monthly minimum temperatures for the coldest month of the year are shown graphically in figure 3. It may be seen that about one-fourth of the years have had colder winters than the coldest winter since 1919.

TABLE VI.—Average daily minimum temperatures from 1859 to 1926.
(Manhattan, Kan.)

PERIOD.	Average daily minimum temperatures.		
	Jan.	Feb.	Coldest month of year.
1919 to 1926 (8 years)	18.1	21.7	15.8
1911 to 1918 (8 years)	13.9	17.1	11.3
1883 to 1895 (13 years)	10.0	15.5	9.2
1859 to 1918 (60 years)	14.8	16.9	12.5

It is well known, of course, that average low temperature is not the only factor that determines winterkilling. However, it has been shown to be among the most important and in general it may be expected that, with other things equal, winterkilling will be greater in winters of low average temperature than in those of high average temperature.

The United States Weather Bureau made the following statement regarding recent winters in the United States:[4] "The United States has experienced in recent years a remarkable series of mild winters. The winter of 1917-'18 was severe practically everywhere east of the Rocky Mountains, but following this, year after year, the winters have been moderate to unusually mild as a rule and that of 1926-'27 just closed was one of the mildest of a long series." It is, of course, conceivable that the climate has undergone a permanent change and that severe winters will not occur again, but no one who has studied weather records believes that such is the case. Everything points to the conclusion that winters as severe as those from 1883 to 1895 will again occur and that when they do the wheat growers of the state will suffer losses from winterkilling. It seems almost certain that those farmers who are then growing Blackhull will suffer greater losses than those who are growing Turkey or Kanred.

4. Weekly Weather and Crop Bulletin, March 15, 1927. Issued by the Section Center of the Weather Bureau, Topeka, Kan. S. D. Flora, Meteorologist.

IS BLACKHULL SAFE IN SOUTHERN KANSAS?

It is well known that lower temperatures prevail in northern than in southern Kansas and also that Blackhull is grown much more extensively in the south central part of the state than elsewhere. The question naturally arises: Can Blackhull be safely grown in this area?

Turning again to reports of the Kansas State Board of Agriculture it is found that in 1910, when the state as a whole lost 30 per cent of the wheat acreage, the loss seemed to be as great in south central Kansas as elsewhere. Thus in Kingman, Harper, Sumner, Sedgwick, Harvey, McPherson, Marion, Butler, and Cowley counties, which may be regarded as the center of the Blackhull area, the average acreage that had been abandoned by May 1 in 1910, was 40.7 per cent. In 1912 when the loss for the state totaled 17.5 per cent of the acreage, the loss in the above mentioned counties was 17.7 per cent; and in 1917 when the average loss for the state was estimated at 63 per cent, the loss in these counties was 27.6 per cent. The losses by individual counties in this part of the state are given in Table VII.

TABLE VII.—Per cent of total area of wheat abandoned in south central Kansas in 1910, 1912, and 1917, principally as a result of winterkilling.

COUNTY.	Per cent of total area abandoned.		
	1910.	1912.	1917.
Barber	10	1	8
Pratt	15	11	33
Stafford	15	46	65
Barton	27	17	78
Rice	58	30	30
Reno	27	9	37
Kingman	29	6	18
Harper	18	11	5
Sumner	49	26	2
Sedgwick	43	10	25
Harvey	70	12	30
McPherson	90	53	28
Marion	95	11	30
Butler	42	8	23
Cowley	23	15	2
Average	40.7	17.7	27.6

However, the losses in these years cannot be attributed entirely to winterkilling since some fields were injured by chinch bugs and others failed to get a good start in the fall because of dry weather. The records indicate that nearly all the loss in 1910 was due to winterkilling of one kind or another. Thus the State Board of Agriculture in its report for April 27, 1910, makes the following statement: "This failure of nearly a third of the area sown is ascribed principally to winterkilling, although there is much diversity of

opinion as to the specific cause, some saying the wheat was smothered by the long continued coating of ice, others that is was the severe freezing when the ground was oversaturated, and still others ascribe it to the alternate freezing and thawing upheaving the soil and leaving the plant roots exposed or broken. A dozen reporters all told, state that some damage should be charged to the chinch bug." The report of May 1, 1912, states: "The wheat abandoned has been mainly from winterkilling, especially where the snow by drifting has left parts of the ground bare; and from winds, the former being more often mentioned as the cause in the eastern half of the state and the latter in the west where the soils have considerable sand. In some of the southern and western counties lack of sufficient moisture in the fall caused loss." It is probable that in 1917 more of the loss was due to dry weather than to winterkilling.

YIELDS OF BLACKHULL

Blackhull has frequently given higher yields than other varieties grown in comparison with it. This fact is shown in Table VIII, which gives the comparative yields of Blackhull, Turkey, and Kanred at the Agricultural Experiment Station at Manhattan and at the branch stations at Hays, Colby, Tribune and Garden City, and in Table IX, which gives the average yields secured in cooperative tests with farmers in all parts of the state.

Blackhull averaged 2.8 bushels more than Turkey and 1.4 bushels more than Kanred at Manhattan; 6 bushels more than Turkey and 2.2 bushels more than Kanred at Hays; and 8.9 bushels more than Turkey and 1 bushel more than Kanred at Garden City. At Colby and Tribune, where some winter injury occurred, Blackhull produced less than Kanred although at Colby it made higher yields than Turkey.

TABLE VIII.—Yields of Blackhull, Turkey, and Kanred on Kansas Agricultural Experiment Station fields at Manhattan, Hays, Colby, Tribune and Garden City, 1919 to 1926.

LOCATION OF STATION.	Years tested.	Average yield—bushels per acre.		
		Blackhull.	Turkey.	Kanred.
Manhattan	8	34.8	32.0	33.4
Hays	6	26.8	20.8	24.6
Colby	8	28.5	25.7	30.4
Tribune	4	12.1	14.0	15.4
Garden City	3	34.3	25.4	33.3

TABLE IX.—Relative yields of Blackhull, Turkey, and Kanred in 403 coöperative tests with farmers.

YEAR.	Number of tests.	Yield in bushels per acre.			Gain of Blackhull over—	
		Blackhull.	Turkey.	Kanred.	Turkey.	Kanred.
1919	10	27.2	20.4	23.4	6.8	3.8
1920	27	22.9	21.6	22.6	1.3	.3
1921	48	21.4	18.5	22.3	2.9	—.9
1922	57	25.3	21.9	22.9	3.4	2.4
1923	99	18.8	18.4	17.3	0.4	1.5
1924	61	26.1	25.9	26.8	0.2	—.7
1925	52	19.6	16.6	17.5	3.0	2.1
1926	49	23.6	20.9	21.7	2.7	1.9
Average, 8 years		23.2	20.5	21.8	2.7	1.4

For those who are primarily interested in the comparative yields of Kanred and Turkey wheat, it should be explained that these varieties were grown for several years before Blackhull was distributed. Hence, this table and others in this bulletin give only a part of the data relating to these two varieties.

In cooperative tests with farmers, Blackhull outyielded Turkey every year and Kanred in six of the eight years. In two of those years, however, the superiority over Turkey is negligible, while in five years the average difference is greater than two bushels per acre. Blackhull averaged more than two bushels higher than Kanred in three years while in two years the difference was too small to be of importance.

In south central Kansas alone, 147 tests have been conducted. The average yields in these were 21.8 bushels for Blackhull, 19.9 for Turkey, and 20.9 for Kanred.

The figures as a whole may be accepted as showing that Blackhull has definitely produced higher yields than Turkey and Kanred for the period of years under consideration. Ordinarily an eight-year test involving more than 450 comparisons would be considered sufficient to establish the relative yielding ability of two or more varieties. In the present case this is believed not to be true since as previously brought out the past eight years have been abnormal ones from the standpoint of winter temperatures, and since Blackhull is known to be less hardy than other varieties. For these reasons the authors consider it doubtful if the advantage in yield in favor of Blackhull as shown above will be maintained over a long period of years including the usual number of hard winters.

SUPERHARD BLACKHULL

During the past season a considerable quantity of a new strain of Blackhull known as Superhard had been distributed for seed. This variety was originated by Mr. Earl G. Clark, of Sedgwick, Kan., and is claimed by him to be superior to Blackhull in several re-

spects, including hardness of grain, quality, and yield. Seed was secured by the Kansas Agricultural Experiment Station and sown at several locations in the state in the fall of 1925. Yields were determined and samples of the grain were milled and made into bread, all in comparison with ordinary Blackhull. The data do not show that, the Superhard is better than the ordinary Blackhull in any respect. It cannot be recommended until more information is available.

SUMMARY AND CONCLUSIONS

In the preceding pages an attempt has been made to present impartially all the information available regarding Blackhull wheat. This information will be interpreted in various ways by different people, according to their temperament, previous experience, present occupation, and their interest, financial and otherwise, in Blackhull and other varieties of wheat. Complete data are given so that those who may question the authors' conclusions may at least, have complete information on which to base their own. It seems to the authors that the data which have been presented lead essentially to the following conclusions:

The available evidence shows clearly that, Blackhull has a stiffer straw and lodges less than other hard red winter wheats. It also heads and ripens a little earlier, which enables it to escape to some extent the effects of hot winds and drouth. As an average of numerous experimental tests it has produced larger yields than Turkey and Kanred, except in northwestern Kansas, where it has winterkilled. Thus as an average of 403 experimental trials with farmers it has averaged 2.7 bushels per acre more than Turkey and 1.3 more than Kanred.

These results may be taken as good proof that Blackhull tends to yield more than Turkey and Kanred where winterkilling does not occur. In an eight-year test at the Agricultural Experiment Station at Manhattan, Blackhull outyielded Turkey by 2.8 bushels and Kanred by 1.4 bushels per acre. At the Fort Hays Branch Station at Hays, Kan., it has outyielded these varieties 6 bushels and 2.2 bushels per acre, respectively; at the branch station at Garden City, it has outyielded them by 8.9 bushels and 1 bushel per acre, respectively; at the branch station at Colby it has yielded 1.2 bushels more than Turkey but 1.9 bushels per acre less than Kanred; and at the branch station at Tribune it has yielded 1.9 bushels per acre less than Turkey and 3.3 bushels less than Kanred.

Blackhull wheat is materially less able to survive low temperatures than are the commonly grown strains of Turkey wheat, as

shown by experimental field trials and by special tests in which Blackhull and other varieties have been subjected to low temperatures in the laboratory.

Records of the United States Weather Bureau and of the Kansas State Board of Agriculture show conclusively that Kansas has enjoyed a period of unusually mild winters as measured by winter temperature and damage from winterkilling. Since severe losses have occurred in the past it is reasonable to expect such losses in the future, and when they occur it seems certain that Blackhull growers will suffer more than those growing Turkey and similar varieties. Because of these facts Blackhull must be considered a dangerous variety for the northern, western, and especially the northwestern parts of Kansas.

Although Blackhull ordinarily tests from two to three pounds per bushel more than Turkey and Kanred, it has a thicker bran and, hence, produces little if any more flour. The higher test weight is, therefore, of little advantage to the miller and probably in the long run will prove of little or no benefit to the farmer.

Blackhull contains as much protein or gluten as the Turkey types of wheat, but the protein is not so strong. The flour has some of the characteristics of a soft wheat flour and therefore is not so well suited to commercial bakeries using hard wheat flour. The splendid reputation of Kansas wheat has been established upon the excellent quality of its hard wheat flour, and it would be extremely unfortunate for all citizens of the state if this reputation should be lost by widespread use of a variety unsuited to the trade requirements of a large part of the milling industry. It would, therefore, seem to be the part of wisdom for a majority of Kansas farmers to grow other varieties.

Blackhull will perhaps prove to be the most satisfactory variety for limited areas in south central Kansas where a stiff straw and earliness are more important than ability to survive low temperatures. This area will in part depend upon the premiums paid for strong protein wheat, and this in turn will depend upon the scarcity of the latter. When there is an abundance of strong protein wheat this premium will be small; when there is a scarcity, it will be large.

No satisfactory method of distinguishing the threshed grain of Blackhull from other hard red winter wheats is known.

A new strain of Blackhull known as Superhard Blackhull has been distributed recently. Several yield and baking trials have failed to show any material difference in its favor. It cannot be recommended until more information is available.