2-1-1923

Some Experiments with Spring Wheat in South Dakota

A.N. Hume

A.T. Evans

Bulletin No. 201 February, 1923

SOME EXPERIMENTS WITH SPRING WHEAT IN SOUTH DAKOTA

By

A. N. HUME and

ARTHUR T. EVANS

Agronomy Department

AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS

BROOKINGS, SOUTH DAKOTA

Summary of Bulletin 201

If the yield of Kubanka (durum) averages 25 percent higher than the yield of Marquis (common), in areas represented by Brookings, Highmore and Eureka, the price of common wheat (hard red spring) must be something more than 25 percent higher than that of durum, in order to be as profitable to produce.

Kota wheat yielded somewhat higher at Brookings and Highmore than Marquis in short-time trials; and Marquis yielded higher in similar trials at Eureka. Marquis is a wheat of established milling quality, and Kota is a promising wheat meriting further trial.

Change varieties of wheat conservatively. A good variety is as likely to continue good as a new and untried variety to prove good. For instance, Preston at Eureka yielded 7.7 bushels per acre as an average the first 7 years and 10.3 bushels per acre the following 7 years. Apparently, the variety did not "run out."

Seed seasonably early. At Highmore the almost unfailing indication is that seeding wheat should proceed in March. The early seeded wheat gets the yield.

Increasing the amount of seed sown per acre from 2 pecks per acre up to 7 pecks per acre at Brookings produced the highest average yield for the thickest seeding mentioned.

Sow 7 pecks per acre in Highmore area, whether common wheat or durum.

The best depth of seeding is sufficient to make a complete covering for the seed. Wheat on a clean seed bed (e. g. wheat after corn) at the places named usually produces yields high enough to cover cost of production.

The lowest average yields were produced by wheat where seed was merely disked in on stubble.

To sum up, in eastern South Dakota for spring wheat, increasing emphasis should be laid upon (1.) a **clean seed bed** (after a cultivated crop) (2.) **Seasonable** seeding, with treated seed of a suitable variety. There is no evidence in this bulletin that a system of continuous wheat, or wheat seeded on weedy land with untreated seed will produce a profitable yield. There is evidence that such systems will produce low yields and consequent loss.

SPRING WHEAT IN SOUTH DAKOTA

A. N. Hume and Arthur T. Evans

South Dakota lies in the great spring wheat belt of North America. It is exceeded only by North Dakota in acreage and yield of wheat and is followed closely by Minnesota. During the past few years, however, wheat growing has declined due in a large measure to lack of suitable varieties to withstand the ever increasing destructiveness of rust and scab. These two diseases alone have been responsible for cutting the crop several hundred thousand bushels. The years 1918 and 1919 proved to be very poor wheat years due to the severity of scab. In 1920 rust practically ruined the wheat crop of South Dakota. During the past season, 1921, scab and rust were not so destructive but severe drouth materially injured the crop.

Varieties of wheat resistant to rust and scab or methods of successfully combatting the diseases will materially aid the wheat raising industry in South Dakota. The South Dakota Experiment Station is making every effort to secure such information. During the past 23 years many new varieties have been tried out in variety tests. Some have proven quite satisfactory,—others have proven worthless or no better than well established varieties. The names and numbers of these numerous varieties, some of which have proven valuable and many of which have been eliminated by trial, are recorded in the appendix at the close of this bulletin. A number of the varieties discarded have been good yielders but have nevertheless been rejected because yielding capacity is not the only character of a good wheat. Good milling quality is much to be desired. Then too, a wheat that lodges badly is undesirable. These, together with other facts, have governed the choice and discarding of the many varieties tested. It is very unlikely that a wheat combining all the desirable characteristics and none of the undesirable will ever be secured. Keeping our wheats bred up will be a matter of constant care and selection. The wheat of today may have to be discarded tomorrow due to the breaking down of resistance or the entrance of new diseases into the region where it is grown.

The leading varieties of spring wheat in South Dakota at the present time are Marquis, Haynes Bluestem, Preston (velvet chaff), Glyndon Fife, Powers Fife, Kubanka, Arnautka, Acme, Monad, and D-5. Kota, a new wheat of the Preston group gives promise, because of its rust resistance, of becoming a leading spring variety.

Marquis, which has been raised in South Dakota since 1913 has proven one of our best wheats although for the past 4 years it has been damaged by rust and scab. For this reason, apparently, the acreage has been reduced materially. In 1919, 63.8 per cent of the South Dakota acreage was Marquis while in 1922 it was reduced to 49.9 per cent. During the same years, the durums increased from 22.7 per cent to 42.4 per cent. Marquis wheat is still one of our finest bread wheats. Its failure is the result of the splendid success realized when many farmers turned to wheat raising during the war years of 1916 and 1917. These two years proved to be very free from rust and scab so large crops resulted. An effort to repeat these successes in 1919 and 1920 with the prevailing high prices met with dismal failure thus leading many to believe that Marquis, which they had supposed to be resisting disease in 1916 and 1917, had completely lost its resistance and had to be discarded.

The search began for a new wheat to replace Marquis. Many turned to durum,—Acme, a product of the substation at Highmore became a common favorite. D-5, a red durum found its way into the state and has claimed many acres. To date no substitute for common wheat has been distributed. At present the development of Kota wheat, an importation made from Russia, gives promise. The results obtained in this state have not been striking but its general growth habit, its resistance to rust, and its promise of yield are encouraging. None of this wheat has been distributed until now. The fall of 1923 should see a goodly supply for sale. Other selections and hybrids are being experimented with in the hope that a suitable spring wheat will be developed for South Dakota conditions.

Since the decline of Marquis production in South Dakota, many farmers have turned to the raising of rust resistant durums. Acme, mentioned above, an amber durum selection from Kubanka S. D. 75, is one which has been commonly raised. This is due to its resistance to rust and its ability to yield well. It has the bad feature, however, of lodging somewhat under adverse conditions. In milling qualities it is not considered the equal of either Kubanka or Arnautka.

Kubanka S. D. 75 and Arnautka S. D. 1001 are two of our best milling amber durums and are in demand on the market. Neither is rust resistant. They are not pure lines but composed of a mixed population. Both yield well and during years when rust is not too severe they are generally satisfactory. They are both subject to severe attacks by wheat scab as are all the other durums. This is largely due to the compactness of the spike which holds moisture thus allowing a suitable place for spore germination.

Monad, or D-1, a North Dakota Experiment Station selection, is very similar to Acme. In fact it is quite indistinguishable. It is an amber durum, but as yet has not been raised so extensively as either Acme, Kubanka, or Arnautka.

D-5, a red durum, is a North Dakota product also. Although this wheat is very highly rust resistant it seldom pays to raise it because of its exceedingly poor milling record. At times when wheat production has been low, red durum has sold as high as common wheat, but during normal production it is sometimes difficult to dispose of it at all. It is not advisable generally to grow this wheat when rust resistant amber durums are available.

Among the common wheats raised, none have occupied more prominent places in the South Dakota wheat industry than the various varieties belonging to the Fife, Preston, and Bluestem groups. Some varieties from each of these groups have been raised at Brookings and Highmore for more than 20 years.

The Bluestem group furnished the most popular wheats during most of this period with the various Fifes a close second. The Preston group, although generally raised, lacked the wide popularity of the other two groups. With the coming of Marquis into South Dakota the Bluestem and Preston wheats were practically discarded and this new Fife became the most popular wheat. If Kota develops into a wheat worthy of wide distribution it will record the changing again from the old and popular Bluestem and Fife groups to Preston the group to which it belongs.

Several new varieties of Canadian wheats have recently attracted the attention of wheat growers in South Dakota. These varieties, if they are successful, may owe such success to the fact that some of them mature in a shorter number of days than wheats now raised. The most important of these wheats are Prelude, Ruby, Red Bobs, and Kitchener. The date of maturity is best shown by using Marquis as a basis of comparison. The order of maturity is Prelude, Ruby, Red Bobs, Marquis, and Kitchener. These wheats are reported to be successful under Canadian conditions. Whether or not they will be successful here remains to be seen. Their earliness may be the means of avoiding heavy rust infection as oftimes two or three days to a week in the date of maturity means the difference between success and failure in wheat raising. These wheats have been raised but a short time by the experiment station and the data available do not warrant a positive statement concerning them. Experiments are planned to carry them through several more years in comparable variety tests.

WHEAT VARIETY TESTS AT BROOKINGS

In November 1913, the South Dakota Experiment Station published Bulletin 146, which put down average yields of wheat from the several experiment station fields for years up to and including 1912. The following Table No. 1. makes record of wheat yields that have been secured at Brookings within the years 1913-1922, inclusive.

The following table includes not all the varieties nor even all yields of important varieties secured at Brookings since 1912. It includes yields of important varieties that may be arranged for direct comparison. It may be noted that the data arranged in several parts, each part including a period of years and the names of varieties tested for that period.

The first part of the table gives a comparison of Kubanka (durum) and Marquis (common) for the years 1919-1922. The average yield of Kubanka has been 17.4 bushels(omitting 1921), and of Marquis, 13.9. Attention was called in Bulletin 146 to the superior **yielding capacity of durum wheats over** common wheats; a fact then not so firmly established as now appears in the foregoing table.

In the second part of the table it appears again that Kubanka (durum) outyielded four common wheats in direct comparison, 1913-1920. The highest yielder of the common wheats in this comparison was **Marquis.**

The third part of the table gives a more recent series of comparisons, including Acme (durum), Monad (durum) and Pierson (durum) in comparison with Kota and Marquis, both common.

It is to note that in this short-time comparison 1919-1922, that **Kota** yielded not only ahead of Marquis, but ahead of one of the durums.

The last part of the table shows 2-year comparative tests of several new Canadian introductions, and older durums and Marquis, **Kota ranks best of the common wheats in this comparison also, though Marquis is only in second place below, and it is recognized that a 2-year yield test cannot establish the inferiority of Marquis to Prelude or even to Kota.**

TABLE NO. I.

Yields of Varieties of Wheat Tested at Brookings 1913-1922

Name of Variety	S. D. No.	C. I. No.	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Aver
			Yield Produced in Trial Plots in Bushels per Acre in Given Year										
Kubanka	75	1440	28.3	15.0	17.0	11.4	17.4	30.8	10.0	6.7		20.0	17.4
Marquis	515	3641	29.3	15.8	25.0	7.2	14.7	23.3	3.3	3.3	7.5	10.0	13.9
Kubanka	75	1440	28.3	15.0	17.0	11.4	17.4	30.8	10.0	6.7			17.1
Marquis	515	3641	29.3	15.8	25.0	7.2	14.7	23.3	3.3	3.3			15.2
Preston	67	3081	27.6	12.7	23.0	7.5	12.8	15.4	0.8	tr.			12.5
Glyndon	163	2873	19.2	9.2	11.3	2.4	7.3	15.4	1.7	tr.			8.3
Haynes B.	169	2874	23.0	2.5	13.8	0.6	10.1	10.0	0.4	0.0			7.5
Acme	284	5284							8.3	11.7	17.5	16.7	13.6
Monad	1113	3320							6.6	6.7	15.4	24.2	13.2
Kota	1184	5878							5.8	3.3	13.3	14.1	9.1
Pierson	999	4163							9.0	2.5	8.3	9.2	7.2
Marquis	515	3641							3.3	3.3	7.5	10.0	6.0
Monad	1113	3320									15.4	24.2	19.8
Acme	284	5284									17.5	16.7	17.1
Kota	1184	5878									13.3	14.1	13.7
Prelude	1021	4323									5.8	12.5	9.1
Marquis	515	3641									7.5	10.0	8.7
Pierson	999	4163									8.3	9.2	8.7
Kitchener	1237										6.7	10.0	8.3
Ruby	1235										5.8	9.2	7.5
Red Bobs	1236										5.0	5.8	5.4

TABLE NO. II.

Yields and Averages From Varieties of Wheat at Eureka Within the Years 1909-1922

Name of Variety	Average Yield in Variety Tests in Given Years														
	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Aver
Kubanka S. D. 75..	22.5	10.7	0.0	0.0	4.5	9.3	42.9	10.3	22.6						13.6
Preston S. D. 67 ...	12.5	3.5	0.0	1.5	3.7	10 7	22.9	1.7	14.4						7.9
Haynes Bluestem Minn. 169	10.1	2.3	0.0	5.2	2.3	6.6	18.5	0.4	10.8						6.2
Marquis S. D. 515..						9.7	35.5	7.4							17.5
Preston S. D. 67....						10.7	22.9	1.7							11.8
Haynes Bluestem Minn. 169						6.6	18.5	0.4							8.5
Kubanka S. D. 75 ..						9.3	42.9	10.3		8.4	9.8	21.5	11 .2	21.9	16.9
Marquis S. D. 515 ..						9.7	35.5	7.4		6.6	7.2	17.5	10.8	23.3	14.8
Preston S. D. 67 ..						10.7	22.9	1.7		4.8	3.7	10.9	8.7	18.5	10.2
Acme S. D. 284										7.1	13.2	26.8	21.8	27.2	19.2
Kubanka S. D. 75 ..										8.4	9.8	21.5	11.2	27.2	15.6
Acme S. D. 284													21.8	27.2	24.5
Marquis S. D. 515 ..													10.8	23.3	17.0
Kota S. D. 1184 ...													10.5	16.5	13.5
Preston S. D. 67 ..													9.7	8.5	9.1
Kubanka S. D. 75 ..	22.5	10.7	0.0	0.0	4.5	9.3	42..9	10.3	22.6	8.4	9.8	21.5	11.2	21.9	14.0
Preston S. D. 67 ..	12.5	3.8	0.0	1.5	3.7	10.7	22.0	1.7	14.4	4.8	3.7	10.9	9.7	18.5	8.4

VARIETIES OF SPRING WHEAT AT EUREKA

The foregoing Table II puts down average yields of varieties tested at Eureka.

The foregoing table of yields from Eureka is arranged in parts, (similar to Table I. for Brookings) according to yields for the several varieties that may be brought into direct comparison. It is possible in the first part of the table to compare yields of Kubanka 75 (durum) which yielded an average of 13.6 bushels per acre (1909-1917) with Preston and Haynes Bluestem, yielding 7.9 bushels and 6.2 bushels per acre, respectively for the same years.

Every comparison of yields where the table makes possible a comparison between durum and common wheat helps establish the higher yielding capacity of the durums. The last section of the table offers a 14 year comparison between Kubanka S. D. 75 and Preston at Eureka with an average yield of the former of 14.0 bushels per acre and the latter 8.5 bushels per acre.

This is obviously not arguing the relative merits of Kubanka and Preston as wheats, but is presenting the grower as nearly as possible, facts of yield which may serve as a basis for operations of production. The grower may calculate whether an average of 14 bushels of durum is as good or better than 8.5 bushels of Preston.

It may be noted in the fourth section of Table II, consisting of only 2-year tests made at Eureka (1921-22), that Marquis wheat yielded an average of 17.0 bushels per acre for the 2 years while Kota yielded 13.5 bushels. Such result is due to the decidedly higher yield of Marquis in 1922, but insomuch it fails to corroborate the relatively higher yield of Kota over Marquis at Brookings and Highmore. There is as yet no evidence from Eureka that Marquis should be displaced as a common wheat, by Kota even from the standpoint of yield.

DO VARIETIES OF WHEAT RUN OUT?

At Eureka, Kubanka S. D. 75 (durum) and Preston S. D. 67 (common) have been tested continuously 1909-1922, 14 years. The average yield of Kubanka S. D. 75 for the 7-year period ending 1915 was 12.8 bushels per acre, and for the succeeding 7-year period ending 1922 was 15.1 bushels. Preston S. D. 67, yielded an average of 7.7 bushels and for the latter, 9.1 bushels per acre. Such a comparison indicates that it may be as profitable for growers to persist with established varieties as to make precipitate changes.

Make haste slowly when discarding established varieties, to take up something new and relatively untried. Such advice seems sound, not only for Eureka area but in general.

VARIETY TESTS AT COTTONWOOD

Certain variety tests of wheat have been carried out at Cottonwood since 1909. The yields are put down in the following Table 3, in such a way as to make direct comparison of yields for two or more varieties possible. Certain yields for separate years are omitted due to the fact that where one or more variety yields are not available the others are also omitted, in order that the average may contain yields for the same years.

The first part of the foregoing table emphasizes that Kubanka (durum) outyielded Preston (common). Durum outyields common wheat as an average in South Dakota.

In the years 1918-1922, Acme (durum) outyielded Kubanka S. D. 75 from which it was selected 5 years out of five. Marquis yielded 11.7 bushels per acre; close to the limit of profit for common wheat.

YIELDS OF WHEAT VARIETIES AT HIGHMORE

Bulletin 146 reported yields of varieties at Highmore secured up to and including the year 1912. The conclusions of that bulletin presented the higher average yields of durum wheats over common wheats, and also pointed out that Preston S. D. 67 (bearded fife) yielded higher than the beardless bluestems or beardless fifes.

Table Number IV of variety yields from Highmore is made up of yields of varieties that have been continued since 1912.

Table Number IV is also arranged, according to groups of varieties of wheat that can be compared for groups of years. The first group makes direct comparison between Kubanka (durum) and Marquis (common) and indicates the higher average yield of the former. In the last division of the table the high yielding ability of durum varieties over common varieties is brought out in a 3-year test and in the same 3 years it appears that Kota outyielded Marquis. The former variety yielded highest 2 years out of three. The variations are too great, however, to leave the higher yielding capacity of Kota, as an established fact. It is well enough to note that Kota is apparently rust resistant and a fair yielder, but also well to remember that Marquis is a spring wheat of first milling quality, and that it should be displaced conservatively in Highmore area, if at all, by Kota.

TABLE III.

Yields of Varieties of Wheat at Cottonwood Within Years 1909-22.

Name of Wheat	Yield of Variety in Year Given													
	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Aver
Kubanka S. D. 75	4.0	1.3	0.0	1.4		1.9	Hail	15.5	6.6	19.7	15.0			10.8	6.9
Preston S. D. 67	3.8	2.3	0.0	7.0		1.8	Hail	4.5	3.4	10.8	9.0			7.7	4.6
Acme S. D. 284										20.2	17.3	34.0	0.7	12.0	16.8
Kubanka S. D. 75										19.7	15.0	33.3	0.4	10.8	15.8
Marquis S. D. 515										15.9	10.3	21.8	0.3	10.4	11.7

TABLE NO. IV.

Yields From Varieties of Wheat That Have Been Tested at Highmore, 1913-1922.

Name of Variety	S. D. No.	C. I. No.	Yield of Variety in Given Year and Average										
			1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Aver
Kubanka	75	1440	2.0	19.7	33.3	12.2	15.2	12.9	15.5	27.5	6.9	29.2	17.4
Marquis			12.7	13.5	33.3	6.4	11.4	20.9	10.3	6.7	1.2	18.3	13.5
Acme				30.0	31.7	22.0	12.7	18.4	17.5	14.6	8.5	30.0	20.6
Kubanka	75	1440		19.7	33.3	12.2	15.2	12.9	15.5	27.5	6.9	29.2	19.2
Kubanka	75	1440	2.0	19.7	33.3	12.2	15.2	12.9	15.5				15.8
Marquis			12.7	13.5	33.3	6.4	11.4	20.9	10.3				15.5
Preston	67	3081	6.5	12.0	35.8	7.0	9.7	20.0	7.8				14.1
Kubanka	75	1440	2.0	19.7	33.3	12.2	15.2						16.5
Marquis			12.7	13.5	33.3	6.4	11.4						15.5
Ghirka	69	1517	6.5	11.3	16.7	7.2	9.9						10.3
Haynes	169	2874	7.3	7.5	18.3	1.7	9.7						8.9
Glyndon	163	2873	8.7	7.3	10.0	0.0	9.5						7.1
Acme										14.6	8.5	30.0	17.7
Monad										13.2	7.1	30.0	16.8
Kubanka	75	1440								27.5	6.9	29.2	21.2
Kota										4.7	6.5	21.7	11.0
Marquis										6.7	1.2	18.3	8.7

DURUM AND COMMON WHEAT

A wheat grower is bound to decide at seeding time if not before what variety he will put into the ground, and must use the best evidence available in making such decision.

The fact that was pointed out in Bulletin 146, namely, that durum varieties are almost certain to yield higher than common varieties has become a generally accepted fact among growers. It is also generally known that there is objection to durum, from millers and from the market generally. The price of durum has suffered accordingly, and has recently fallen somewhat below the price of common wheat. **How much below the price of common wheat could durum fall in order that the two kinds of wheat would yield relatively the same income to growers?** Or perhaps it should be stated, how much would the price of common wheat need to rise above durum in order to induce growers to assume the apparent risk in growing the former.

It is possible to arrange comparative yields of durum and common wheats at four points in South Dakota, using the most representative averages available, from the foregoing variety tests.

Kind of Wheat and Difference of Yield	Rep. Av. Yield at Given Location			
	Brookings	Highmore	Eureka	Cottonwood
Kubanka (durum)	17.4	17.4	16.9	15.8
Marquis (common)	13.9	13.5	14.8	11.7
Bushels more for durum	3.5	3.9	2.1	4.1
Percent higher yield for durum	25.2	28.9	14.2	35.0

The foregoing short table indicates in the last line of percentages that Kubanka (durum) has outyielded Marquis (common) by varying amounts, from practically 14 to 35 percent at the several points in the state. **Considering the wide divergence between yields of durum and of common wheat at Cottonwood one might decide with a degree of certainty that common wheat should not be produced in the area represented.**

The problem is not exactly the same in the areas represented by Brookings, Highmore and Eureka. Assuming that the chance for error is great it may be estimated that Kubanka yields 25 percent higher than Marquis at these points.

If the yield of durum wheat is 25 percent more than the yield of common wheat, the price of common wheat must be something more than 25 percent more than that of durum in order to be as profitable to produce. Such a hypothesis would seem to be conservative enough to serve as a basis for calculation by growers.

MARQUIS AND KOTA

The following table is an abstract of comparative yields of the two varieties, Marquis and Kota, at the three stations where these varieties have been tested, both for periods extending from two to four years.

		1919	1920	1921	1922	Aver
	Marquis			10.8	23.3	17.1
EUREKA	Kota			10.5	16.5	13.5
	Marquis		6.7	1.2	18.3	8.7
HIGHMORE	Kota		4.7	6.5	21.7	11.0
	Marquis	3.3	3.3	7.5	10.0	6.0
BROOKINGS	Kota	5.8	3.3	13.3	14.1	9.1

It is possible to make comments on the data of the foregoing table.

At Brookings: Kota wheat outyielded Marquis 3 years out of four,—average, 9.1 for Kota; 6.0 for Marquis.

At Highmore: Kota wheat outyielded Marquis 2 years out of three,—Average, 11.0 for Kota; 8.7 for Marquis.

At Eureka: Marquis outyielded Kota 2 years out of two,—Average, 13.5 for Kota; 17.1 for Marquis.

It would be possible to show also from the above table that the general average of average yields at the three points is 10.6 bushels for Marquis and 11.2 bushels for Kota.

It is to be pointed out that the number of trials included in the above table is not large and that the probable error is great. Moreover, when it comes to a consideration of purchasing large quantities of seed wheat of a new variety like Kota at very advanced prices, the prospective purchaser should notice that the highest average yield in any event at Highmore or Brookings is not above 11 bushels per acre. Accordingly, when we are discussing comparative average yields of these two wheats at Highmore and Brookings for the last 4 years we are mainly discussing yields that are below the limit of profitable production.

Eureka yields which obviously cover only a period of 2 years, we find noticeably higher, in fact, high enough for both Marquis and Kota to come within the range of profit for wheat growing. Moreover, under these conditions the variety already established and for which seed is plentiful, namely, Marquis, yielded higher than Kota.

Dr. Evans points out that Kota is evidently a more rust resistant variety than Marquis. This observation from the South Dakota Experiment Station agrees with that at North Dakota. Neither variety is rust free. It seems possible from our observations also that Marquis has a higher yielding capacity than even Kota under favorable conditions when rust is not very prevalent. Such a hypothesis would accord with the fact that Marquis outyielded Kota at Eureka in 1921 and 1922.

The agronomy department put out 50 lots of Kota wheat this spring to growers, mostly in bushel amounts and in no case more than 2 bushels. These lots represented the surplus from experiment plots and they were sold to growers at moderate prices. They were put out because of our belief that Kota seems to be a rust resistant wheat, well worthy of further trial.

DISEASES OF WHEAT

RUST (**Puccinia graminis**)

This is one of the most important of South Dakota's wheat diseases. Although epidemics do not occur yearly, yet they are sufficiently regular to make the growing of spring wheat problematic.

Black stem rust is caused by a microscopic fungal plant. As with all other plants its best growth is largely dependent upon conditions of moisture. It first appears upon stems and leaves the last week of June or the first week of July. Foggy weather or damp cloudy weather followed by sun is very conducive to its development. This has led to the popular belief that the disease is caused by rain or damp weather. No amount of rain or dampness would cause rust to appear on wheat or any other grain if the spores of the disease were not present. Bright warm sunshine with little or no dew during the last week of June and the first week of July will prevent the development of any widespread epidemic of rust. In fact, under such conditions rust is not even likely to occur. Since the weather during this period is quite uncertain and some precipitation is likely to occur, rust is almost always sure to be present in varying amounts. This makes the raising of non-rust resistant varieties uncertain.

Rust resistant varieties of wheat have been developed among the durum wheats but little success has yet been met with among common wheats. Stakman (1) has found that black stem rust, as it is generally known, is not a simple fungus but is made up of numerous strains which are called physiological strains. Some of these physiological strains will attack one variety of wheat and not another. Any variety, therefore, may be susceptible to a number of these physiological strains and resistant to a number of other strains. Then, too, these physiological strains are variously distributed throughout the United States. This means that a variety resistant to rust in one locality may rust badly in another locality, not that this variety is less rust resistant in the second locality, but that it is being attacked by different physiological strains probably indigenous to that community. This complicates the matter of selection of rust resistant strains and may result in wheats which are resistant to rust in one state rusting freely in South Dakota when imported here. Thirty-seven physiological strains of rust have been identified. Where the equipment is available in the way of green houses and nurseries, rust resistant selections of wheat may be inoculated with these various physiological strains and the strains to which a wheat is resistant determined at once.

At present Kota, S. D. 1184 wheat gives the greatest promise of rust resistance for South Dakota. Its success or failure and the maintenance of rust resistance is uncertain and depends largely upon whether physiological strains are already present which will attack it.

Each year a mass of data are added to the already apparent confusion, but great strides have been made in the last 8 years towards a better understanding of it. The future will undoubtedly clarify many facts which now appear confusing. Our most successful method of combatting rust, then, is through the development of rust resistant strains. This may be done either by selection or by crossing. This appears now to be a continuous process which will require the active experience of trained scientists at all times.

Scientists have long ago proven a very direct relationship between the barberry bush and the black stem rust. The early spring stage of rust comes from barberries to the grain

(1) Stakman, E. C.
1917. Biologic Forms of Puccinia graminis on Cereals and Grasses. In Journal of Agricultural Research, Vol. 10, No. 9, P. 429-495.

fields. Every farmer should know this fact and make an effort to eliminate the bushes from one's own farm as well as the neighbor's. Single bushes may be readily killed by applying about two gallons of salt at the base of each bush. As this gradually leaches into the ground the bush is killed This avoids the many sprouts which are bound to follow careless digging.

The rust problem is not a simple one. There are numerous other wheat diseases in South Dakota but they may be considered as minor when compared with the one already mentioned. In some localities these become somewhat of a local problem but seldom have any become epidemic and caused such great losses as rust, scab and smut.

WHEAT SCAB **(Gibberella saubinetii)**

Wheat scab has become a menace to successful wheat production in South Dakota. It has been known to be present here for many years. In 1919 it practically ruined the wheat crop reducing the yield materially and destroying the quality. Again in 1920 it was present in quantity. Together with rust this disease is one of the worst the farmers of this state have to combat.

The disease is caused by a fungus which is microscopic. It is best distinguished by a blighting of single spikelets or of even whole spikes. A short time after its appearance salmon-pink incrustations appear near the base of the glumes. These inhibit the proper development of the kernel which appears shrunken and covered with a whitish felted mass of the fungus. This disease is likely to appear about the last of June.

The best method to suggest for combatting it is a proper rotation. Such a rotation should include oats, which is not severely attacked by the disease, between corn and wheat. Also a legume between wheat and corn. This makes a good 4 year rotation of corn, oats, wheat and legumes.

Such a suggestion may not be a cure-all but since conclusive evidence is lacking experience seems to indicate that this is right. Experimental data might change it later.

SMUTS

Loose smut of wheat is not a great factor as a disease of South Dakota wheats. Covered smut or stinking smut of wheat does do considerable damage. The simplicity of treatment for the prevention of this disease does not warrant its neglect. For a few cents, an acre of wheat can be treated and this loss prevented.

There can be no real argument brought against the treatment of cereal grains for smut. Since 1890, when the first treatments were introduced, the methods have gradually been simplified and have become more and more efficient. Where treatment is constantly practiced smut is seldom found.

Smut not only reduces yield but also makes the marketable grain subject to dockage which is a loss that should not occur. The treatment is so cheap and so simple that anyone can use it with good chances of promising results.

The following directions may be given for the successful treatment of covered smut of wheat, covered smut of barley, and loose and covered smut of oats:

Sprinkle Method. Secure a pint of formaldehyde (commercial strength 40 per cent) from some reliable drug store. Add it to 40 gallons of water. This will make sufficient solution to treat about 40 to 50 bushels of grain. As the grain is scooped into a wagon sprinkle this solution from a common garden sprinkler upon it. If there is any chance that it is not all being wet, the grain may be stirred with a garden rake. By the time the wagon is full there will be a great deal of the solution leaking out. There is little danger of getting the grain too wet as it soaks up a large amount of the solution and will be found quite dry the following day. Cover the treated grain with a canvas and allow to stand over night. It should be planted the following day. If the grain is slightly swollen it should be noted so allowance may be made to get on the correct amount per acre.

Dipping Method. This method may be used in either of two ways. The sacked grain may be immersed in the solution of water and formaldehyde (1 pint to 40 gallons of water) and allowed to soak until all of it is thoroughly wetted when it is lifted from the solution and allowed to stand over night. It is then ready to sow.

If one prefers he may clean and treat his seed at the same operation. A large galvanized tank or similar receptacle is necessary. A convenient amount of solution is placed in the tank varying, of course, with the amount of grain to be treated. One pint of formaldehyde is used to 40 gallons of water. The grain to be treated is then scooped directly into the solution. If it is scooped slowly the smut balls and debris will float to the top where they may be skimmed off.

When the grain has been scooped into the solution, the solution is then drained off, and the grain scooped back into the wagon where it is covered and allowed to stand over night. It is not necessary to allow the grain to stand in the solution as wetting is sufficient treatment.

Dry Method of Treatment. Mix 1 pint of commercial strength formaldehyde with 1 pint of water. This makes 1 quart of solution which should be sprayed with an ordinary hand sprayer upon the grain as it is scooped into a wagon. One stroke of the sprayer is sufficient for each scoopful of grain. The sprayer should be held from about one to two feet away from the grain so that a fine spray settles evenly over the grain. As one may see this is a very rapid and convenient method of treatment. The quart of solution should be sufficient to treat 40 to 50 bushels of grain thoroughly. The points to be emphasized are to see that no drops of the liquid are formed on the grain and to supply about one quart of solution to from 40 to 50 bushels. By spraying with the draft, one avoids inhaling the strong formaldehyde fumes.

When the grain is treated it should be covered and allowed to stand over night. It is well to seed the following morning. When possible allow it to remain covered until seeding can be done.

Any one of these methods is safe and effective if used as directed. Although slight deviation from these directions may do no real harm, it is quite advisable to follow them closely for the best results.

Copper Carbonate. A new method of treatment for cereal grain with copper carbonate dust is being worked with as a disinfectant and is yielding good results. Two ounces of this disinfectant is sufficient to treat 1 bushel. It is applied as follows: Mix the required amount of disinfectant with each bushel of grain. Mix thoroughly so that the grain is coated with a layer of the powder. A concrete mixer, or a barrel churn where smaller amounts are mixed, works well.

This year we treated wheat with formaldehyde and copper carbonate comparing the two methods. The formaldehyde reduced the germination so that the plot had to be reseeded. However, there was no smut. Grain treated with copper carbonate produced a 100 percent stand and no smut. The check plot produced 98 percent stand and 90 percent smut. Indications seem to be that copper carbonate actually stimulates germination as well as prevents smut. Besides being a simple and safe method of treatment, copper carbonate is also a cheap method of treatment.

One should be able to purchase copper carbonate at not more than 25 to 30 cents per pound. If your local druggist does not have it, this department will be glad to furnish the name of a company where an available supply can be had at this cost.

IMPORTANCE OF EARLY SEEDINGS

A study of Table V. shows that early seeding is one of the important factors in increasing yields at Brookings.

TABLE NO. V.

Brookings Tests

Dates of Seeding 0.02 Acre Plots for Varieties and Years Given.

		1913	1914	1915	Aver
Kubanka S. D. 75					
4-14		10.8	14.6	Hail	8.5
5-1		4.5	10.0	Hail	4.8
5-15		3.3	.0	Hail	1.1
Preston S. D. 67					
4-21		26.7	12.7	29.1	22.8
5-1		30.6	Lost	13.3	21.9
5-15		3.3	Fail	4..1	2.5

As it will be noted from the foregoing Table 5, results at Brookings favor early seeding. The experiment was discontinued because of the lack of land and time. The April 21 seeding produced as much better yield than did the May 1 seeding whereas May 15 seeding proved almost worthless.

DATE OF SEEDING TESTS WITH WHEAT AT HIGHMORE

Table VI. reports a series of tests with several varieties of wheat seeded at consecutive dates at Highmore. Following Table VI., the yields are summarized in the effort to make the conclusions that may be drawn from them more complete.

A careful observation of the averages in the last column of Table 6 will make it evident that the highest yield of wheat, regardless of variety is secured from seeding March 14-16. The one exception in the case of the trial with Manchuria C. I. 2492 relates to a single year,—1914, which need not disturb the final conclusion. Accordingly, it is feasible to construct the following table of averages in order to arrive at a general average which shall express the general result.

TABLE NO. VI.

Annual and Average Yields Obtained in Date of Seeding Test With Kubanka, Preston, Marquis, Dakota and Manchuria Spring Wheat at Highmore, South Dakota. (Blank spaces represent no experiment)

	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Aver
Kubanka S. D. 75 Also Acme S. D. 284												
Mar. 1							8.3			11.25		9.8
Mar. 14-16			23.3		32.5		20.8			10.42		21.8
April 1-12		2.0	25.8	36.7	28.3	23.5	10.8	21.5	25.8	11.7	28.3	21.4
Apr. 15-22		2.0	24.3	40.0	25.0		8.3	21.7		8.3	36.6	20.8
May 1-7		1.0	13.8	25.0	18.3	15.0	10.8	15.8	15.0	2.50	21.6	13.9
May 15		0.3	1.2			5.8	10.0	7.1	6.6		15.	6.6
June 1											7.0	7.0
Preston S. D. 67												
Mar. 14-16			19.3									19.3
Apr. 1-12	1.9	0.2	16.3	35.0								13.4
Apr. 15-22	1.3	0.5	16.7	30.0								12.1
May 1-7		0.8	9.3	20.8								10.3
May 15	0.0	0.2	0.5									0.4
Marquis S. D. 515												
Mar. 1							15.0			8.33		11.7
Mar. 16					21.7		16.8			9.58		16.0
Apr. 1-12					13.3	19.1	16.8	13.1	15.0	8.33	20.83	15.2
Apr. 15-22					13.3		15.8	7.8		5.41	24.16	13.3
May 1-7					3.0	17.5	14.1	6.5	8.33	2.50	11.66	9.1
May 15						8.7	9.2	2.12	5.00		8.33	6.7
June 1											1.87	1.9
Dakota C. I. 3083												
Mar. 14-16			10.3									10.3
April 1-12		1.3	11.0	18.3								10.2
Apr. 15-22		1.0	5.0	16.0								7.3
May 1-7		0.8	1.2	7.5								3.2
May 15		0.5	0.2									0.4

TABLE NO. VI.—(Concluded)

Manchuria C. I. 2492

March 14-16			16.2									16.2
April 1-12		8.3	18.7	31.7								19.6
April 15-22		5.3	18.7	26.7								16.9
May 1-7		4.3	17.3	15.8								12.5
May 15		2.5	2.0									2.3

TABLE OF AVERAGES

Date of Seeding	Average Yield in Bushels per Acre for Given Variety, Seeded on Given Date					
	Kubanka S. D. 75 or Acme S. D. 284	Preston S. D. 67	Marquis S. D. 515	Dakota C. I. 3083	Manchuria C. I. 2492	Average
March 1	9.8		11.7			10.7
March 14-16	21.7	19.3	16.0	10.3	16.2	16.7
April 1-12	21.4	13.3	15.2	10.2	19.6	15.9
April 15-22	20.8	12.1	13.3	7.3	16.9	14.1
May 1-7	13.9	10.3	9.1	3.2	12.5	9.8
May 15	6.6	0.4	6.7	0.4	2.2	3.3
June 1	7.1		1.9			4.5

The general averages of the last column in the preceding table are well nigh self explanatory, if not final. They strongly indicate that from the standpoint of securing the highest yield, **wheat seeding should proceed in Highmore area on March 14-16.** Any delay may evidently cause some loss and delaying after April 15 causes a very appreciable loss.

At Highmore, representing the central part of South Dakota, it is very seldom that spring seeding cannot be seeded by the middle to the last of March on fall plowing or on clean cultivated ground of the previous season. A study of the weather records show that only about 1 year in 15 is so cold and backward as to prevent seeding before April 1st. It is necessary to have everything ready to be able to start spring work on the field as soon as the weather becomes favorable. Frequently only a few days are favorable for field work before another storm or cold prevents further work for some time to come. In the tests at Highmore, the seedings previous to April 15 are made on ground that grew a clean cultivated crop the year previous. The soil where wheat is thus seasonably seeded receives no extra spring or fall treatment. The grain is seeded with a double disk drill. The grain thus seeded gets an early start so that it smothers any weed growth that would compete with the grain for moisture. Later seedings receive a double disking and double harrowing.

It is worthy to note here that there is not only a distinct gain in yield but also in weight per bushel in most cases where early seeding is practiced. Thus the market grade is affected. This is important. In a characteristic study of variations between No. 1 and No. 2 Northern spring wheat, when No. 1 was worth $1.70, No. 2 was 6 cents less per bushel. Further, between No. 2 and No. 3, the spread was 15 cents. From No. 3, which should weigh not less than 54 pounds to the bushel, the loss is roughly 5 cents per pound for each pound less than 54. In the durum market the spread is a little wider on the first three grades, and not so wide on the lighter weights. From these figures, it will be seen that larger profits may accrue by growing No. 1 wheat through early seeding, other things being equal.

The disease factor is one which should not be overlooked. Observations made by this department lead us to the conclusions that early planting is likely to have less of covered smut than later plantings. Then, too, early planted grain will mature earlier which gives such grain a better chance to avoid the attack of black stem rust. The avoidance of these diseases is a factor in the raising of the market grade. Not a little to be desired is the advantage of an early supply of moisture which is available to early seedings but which is lacking in late maturing grain.

RATE OF SEEDING

Experiments were started in 1913 at Brookings, and 1912 at Highmore to determine the most desirable rate of seeding for the different groups of spring wheat. Results are put down in the following Table VII, which gives yields secured at Brookings for seeding Kubanka S. D. 75 (durum) and Preston S. D. 67 (common) and Marquis S. D. 515 at rates varying from two pecks per acre to eight pecks per acre.

TABLE VII.

Yields in Bushels of Wheat per Acre at Brookings, first with Durum (Kubanka S. D. 75) and second, with Common (Preston S. D. 67 and Marquis S. D. 515), seeded at Rates Increasing from Two Pecks Up to Eight Pecks per Acre.

Rate of Seeding Test with Kubanka S. D. 75, C. I. 1440. 1913-16 (Inc.)

Year	1913	1914	1915	1916	1917	1918	1919	Aver
2 pecks								
3 pecks	18.3	10.0	Hail					9.4
4 pecks	25.0	17.5	Hail	9.2	18.3	24.2	6.6	14.4
5 pecks	25.0	19.2	Hail	11.7	19.3	29.2	10.0	16.3
6 pecks	23.0	20.0	Hail	13.3	21.1	28.3	9.0	16.4
7 pecks	26.6	20.0	Hail	13.3	19.3	35.0	10.8	17.9
8 pecks		21.7						

Rate of Seeding Test with Preston S. D. 67. 1913-17 (Inclusive)
Rate of Seeding Test with Marquis S. D. 515. 1918-1921 (Inclusive)

Year	1913	1914	1915	1916	1917	1918	1919	1920	1921	Aver
2 pks.	25.8	7.5	23.3							
3 pks.	28.3	10.0	25.0							
4 pks.	31.7	14.2	26.7	Rust	20.3	26.3	3.1	7.	14.7	16.0
5 pks.	33.3	14.2	27.5	Rust	19.7	27.0	4.3	7.3	14.8	16.5
6 pks.	35.	16.7	26.7	Rust	21.7	27.0	6.0	7.1	13.8	17.1
7 pks.	36.7	17.5	25.8	Rust	22.7	24.8	6.8	8.3	13.5	17.3
8 pks.	32.5	17.5	27.5	Rust						

RATE OF SEEDING RESULTS AT BROOKINGS

By studying the foregoing results obtained at Brookings for Kubanka, we find that **there is a gradual increase in yield at Brookings from three to seven pecks, although the rates**

of increase for seeding more than 5 pecks are not large. With common wheat also a gradual increase in the average yield is obtained as the rate of seeding is increased from four to seven pecks.

RATE OF SEEDING WHEAT AT HIGHMORE

The following table VIII sets down yields and averages from seeding varying amounts from four to eight pecks of both common (Preston and Marquis) and durum (Kubanka and Acme) at Highmore.

It may be observed from the average yields in the following table that at Highmore an increase in the rate of seeding common wheat from four to eight pecks per acre was attended by a corresponding increase in yield, the slight exception being that the yields from seeding 6 pecks and 7 pecks per acre were the same. The highest average yield per acre was secured by seeding 8 pecks. The highest average yield of durum wheat in the rate of seeding test at Highmore was secured from seeding 7 pecks.

It is further to note that the averages of the last column of Table 8. are computed from the yields of 1916-1922, inclusive, which are the years showing comparative tests. **These averages indicate that 7 pecks per acre is a practicable amount of wheat to sow, from the standpoint of yield, in Highmore area whether common wheat or durum.**

TABLE NO. VIII.

Yields of Wheat in Bushels per Acre from Plots Sown at Varying Rates at Highmore

Yields from Common Wheat (Preston Until 1916; Marquis Thereafter)

Rate of Seeding	Yield from Seeding on Given Date in Given Year											Aver
	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1916–
	4–16	4–17	4–16	4–22	4–18	5–10	4–22	4–25	5–6	4–4	4–24	1922
4 pecks	0.3	2.3	16.2	35.8	3.0	9.1	18.3	Fail	8.33	3.12	19.2	8.7
5 pecks	0.5	0.8	17.5	27.5	5.0	10.0	22.5	Fail	7.5	4.16	20.8	10.0
6 pecks	0.7	1.7			7.5	12.9	25.8	Fail	8.33	4.16	22.5	11.6
7 pecks					8.3	12.5	25.0	Fail	7.5	4.58	23.3	11.6
8 pecks					10.0	13.7	23.3	Fail	10.8	4.58	22.5	12.1

Yields from Durum (Kubanka Until 1917; Acme Thereafter)

Rate of Seeding	Yield from Seeding on Given Date in Given Year											Aver
	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1916–
	4–16	4–17	4–16	4–22	4–18	5–10	4–22	4–25	5–6	4–4	4–24	1922
4 pecks	.22	13.0	26.2	Fail	6.7	8.3	13.3	Fail	15.0	2.5	35.8	11.7
5 pecks	7.1	12.0	27.5		8.3	10.7	16.7	Fail	14.2	2.5	36.7	12.7
6 pecks	1.5				13.3	11.8	15.0	Fail	15.8	5.41	38.3	14.2
7 pecks					13.3	11.0	16.7	Fail	19.2	2.5	38.3	14.4
8 pecks					15.0	11.0	10.8	Fail	15.8	2.9	37.5	13.3

TABLE NO. IX.

Rate of Seeding Durum Wheat at Cottonwood. (Kubanka S. D. 75; Acme S. D. 284 after 1919.)

	Yields per Acre in Given Years						
Peck Rate	1917	1918	1919	1920	1921	1922	Aver
Three	2.58	7.8	6.5	23.08	0	10.15	8.4
Five	2.04	10.	5.9	22.00	0	12.6	8.8
Seven	2.39	3.8	7.2	26.1	0	11.5	8.5

In the rate of seeding test at Cottonwood which has been carried on since 1917, the 5 peck rate has given the highest average yield. The 7 peck rate is second, while the 3 peck rate gives the lowest yield. Although the differences in the yields making up these averages are not consistent, it seems reasonable to recommend tentatively that 5 pecks be seeded in Cottonwood area, which may be stated with reference to durum wheat.

DEPTH OF SEEDING WHEAT

Experiments in depth of seeding spring wheat have been conducted at Highmore Station. The results are presented in Table 10.

TABLE NO. X.

Depth of Seeding Experiments, Highmore, 1912-1917
Kubanka C. I. 1440 and Acme C. I. 5284

Depth of Seeding	1912	1913	1914	1915	1916	1917	Aver
One inch		12.0	25.5	41.7	14.2	14.4	21.6
Two inches		14.8	22.3	40.0	12.5	14.8	20.9
Three inches		16.3	22.8	48.3	13.3	14.6	23.1
Four inches		15.3	21.7	43.3	12.5	14.4	21.4

Preston S. D. 67 and Marquis S. D. 515

One inch	0.9	13.8	17.3	35.8	0	14.1	13.6
Two inches	0.8	13.3	16.2	25.8	0	12.9	11.5
Three inches	3.7	7.5	12.5	35.0	0	13.8	12.1
Four inches	1.4	12.5	15.3	35.0	0	15.0	13.2

The 5 years that this test was conducted (1913-1917) the average for the durum is in favor of the 3-inch depth. The marked increase for this depth is due to the exceptionally high yield obtained from it in 1915. In only two of the 5 years has the 3-inch depth given the highest yield.

The results with the common wheat would indicate very little difference in yield from the various depths of seeding. The low average yield for the 3-inch depth can be traced to the exceptionally low yield for this depth of seeding in 1913. All circumstances would indicate that this was due to unfavorable location, rather than depth of seeding.

It would seem that the only recommendation to be made in regard to depth of seeding from the evidence available, is that **seeding should be sufficiently deep to furnish a suitable seed bed.**

WHEAT IN ROTATIONS

The question is bound to arise in farm practice, with wheat as with other crops, whether such crop is worth producing in any given locality. Such a question in itself is a matter of prime importance in field management.

The following Table No. 11 furnishes yields of wheat in bushels per acre from several crop rotations that have been recorded at Brookings since 1912; thus they cover a 10-year period. The size of the table makes it necessary to put it down in parts in order to produce the yields for the several separate years. The average yields are put down in the last column.

It should be noted also that certain sub-numbers are inserted above some of the numbers indicating yield per acre. These sub-numbers indicate, usually, the names of the varieties from whence the yields were harvested. The varieties corresponding to the subnumbers as follows:

(1) Average of 3 plots, 050, 054 and 059. Minn. 171
(2) Cut for hay
(3) One plot. Manchuria C. I. 2492.
(4) One plot. Okanagan
(5) One plot. Kubanka S. D. 75
(6) Minnesota 171. One plot
(7) Red Fife, one plot
(8) Kubanka S. D. 75, One plot
(9) Preston
(10) Acme

The chief value of inserting the names of various wheat varieties employed in rotations within the several years is to indicate that the variety was not always the same; and to state further that when changes of variety on rotation plots were made it was endeavored to make them consistently throughout, so that the comparison of rotations would still be possible. The indications are that any average errors introduced by change of variety are smaller than average differences in yield produced by the variation in crop sequence.

TABLE NO. XI.

Wheat Yields From Several Crop Sequences at Brookings

Number of Rotation and Name of Crop Included	Yield in bushels per acre in given year							
	1912	1913	1914	1915	1916	1917	1918	1919
	3	7	7	8	9	8	10	
4—Corn, **wheat**, peas	32.6	17.7	5.8	23.8	4.2	35.2	32.7	4.7
	5	8	8	8	9	8	10	
10—Oats, **wheat**, peas	30.3	13.3	12.3	25.6	4.3	30.3	24.5	0.0
	5	8	8	8	9	8	10	2
9—Oats, **wheat**	26.6	11.3	17.8	23.6	5.2	30.0	24.5	0.0
		7	7	8	9	8	10	10
3—Corn, **wheat**, clover		21.3	6.8	21.9	4.7	33.0	26.2	4.5
	6	7	7	8	9	8	10	2
17—Corn, **wheat**	19.6	18.5	6.5	17.6	3.8	26.8	26.2	0.0
	4	8	7	8	9	8	10	10
6—**Wheat**, oats, clover	24.0	10.7	5.0	22.2	1.0	27.8	25.2	4.0
	4	7	7	8	9	8	10	10
12—Millet, **wheat**, barley	20.0	11.5	3.7	18.0	3.2	20.7	17.8	3.9
	4	7	7	8	9	8	10	2
14—**Wheat** (Continuous, 1912)	21.0	11.8	3.8	17.6	3.7	27.2	24.2	0.0
	6		7	8	1	8	10	1
18—**Wheat**, peas	13.3	15.5	4.0	12.6	3.2	27.8	16.3	0.0
		7	7	8	9	8	10	2
13—**Wheat**, barley, peas		12.0	4.2	20.2	3.3	23.7	17.0	0.0
	6	7	7	8		8	10	2
19—**Wheat** (Continuous, 1897)	18.1	9.3	4.0	16.8	0.0	26.7	13.0	0.0

TABLE NO. XI.—(Continued)

	1920	1921	1922	Aver
4—Corn, **wheat**, peas	13.8	14.3	25.33	19.1
10—Oats, **wheat**, peas	15.1	13.2	24.25	17.5
9—Oats, **wheat**	11.3	11.8	23.33	16.8
3—Corn, **wheat**, clover	10.5	12.7	23.16	16.5
17—Corn, **wheat**	4.8	13.2	21.83	14.4
6—**Wheat**, oats, clover	11.3	9.2	8.16	13.51
12—Millet, **wheat**, barley	13.0	11.2	22.83	13.3
14—**Wheat** (Continuous, 1912)	18.3	6.5	8.16	12.9
18—**Wheat**, peas	12.1	8.7	19.33	12.1
13—**Wheat**, barley, peas	16.5	7.5	3.33	10.77
19—**Wheat** (Continuous, 1897)	10.1	4.7	5.66	9.8

One may observe in the last column of Table XI that the highest average yield of wheat, namely, 19.1 bushels per acre, was produced under the conditions of these comparative cropping systems from a rotation of corn, **wheat,** peas. It is also an outstanding fact that the lowest average yield of 8.9 bushels per acre was produced from a plot that had been continuously in wheat since 1897. The observation of this old continuous wheat plot has been made annually, and especially of recent years, that the material produced was indeed not all wheat but much of it wild oats. Such observation is put down here in general terms, and there is no question that one great factor in producing a difference in yield between 19.1 bushels per acre and 8.9 bushels per acre is the comparative cleanness of the wheat from weeds in the first rotation mentioned (No. 4) and the prevalence of weeds (wild oats) in the continuous wheat rotation (No. 19). In this instance weeds were mainly wild oats.

In this connection, the newer continuous wheat rotation (No. 14) yielded 12.9 bushels per acre, which although a comparatively low yield is higher than that of the plot which has been in wheat a much longer time. It accords with our observation that weeds (wild oats) have taken more complete possession of the oldest continuous plot, perhaps due to the fact that they have had a longer continuous time to do so.

The principal spring wheat varieties in South Dakota ripen at such time that wild oats which may exist therein as a weed will have ripened just previously and reseeded the ground. Thus continuous wheat in Brookings area practically prepares an annual seed bed for wild oats. At first the wheat sown interferes somewhat with the growth of the oats, but as seasons succeed one another the wild oats practically takes possession of the land.

This is emphasized by the average yields put down in Table No. XI that a cultivated crop (corn) in a crop sequence along with wheat apparently cleans the land from weeds, whatever else. Whatever objectionable factors may be found in following wheat after corn, as a crop, are evidently overshadowed under the conditions of this experiment so far as comparative yield of wheat in bushels per acre is concerned.

WHEAT ROTATIONS AT HIGHMORE

At Highmore, wheat has been produced in several comparative crop sequences through the 10-year period 1912-1922. Also two additional rotations were added in 1917. The following Table XII presents an outline of wheat yields in the several years resulting from putting wheat into these crop sequences.

TABLE NO. XII.

Wheat Yields From Several Comparative Crop Rotations at Highmore
1912-1922

Name of Crops in Sequence and Number of Rotation	Yield in Bushels per acre of Wheat in given year of given Rotation.										
	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Aver
No. 1 Oats, corn, wheat, peas and oats, kaoliang, alfalfa	0.5	5.6	9.7	29.2	18.5	18.3	28.4	20.0	24.4	9.94	32.66	17.9
No. 2 Corn and wheat...	3.7	8.5	9.2	23.9	15.6	19.0	21.5	18.8	19.8	11.83	28.9	16.4
No. 10 Corn, wheat, legume		1.0	10.9	25.3	18.1	15.9	9.6	17.4	18.99	6.27	23.64	14.7
No. 3 Corn, wheat, legume	0.37	0.8	9.9	15.9	16.2	17.1	27.6	17.7	16.7	7.88	30.55	14.6
No. 5 Summer fallow, wheat	0.55	3.33	10.1	19.3	13.3	15.6	24.3	20.8	13.4	10.	29.44	14.5
No. 6 Oats, wheat, & corn	.32	1.3	10.1	22.9	14.6	11.6	19.9	10.5	14.6	2.73	15.99	11.3
No. 9 Continuous wheat ..	0.33	0.4	8.2	18.9	12.4	7.7	5.5	16.1	18.33	3.39	23.99	10.5
No. 1 Oats, corn, **wheat,** peas and oats, kaoliang, alfalfa.......						18.3	28.4	20.0	24.4	9.94	32.66	22.3
No. 2 Corn and **wheat**...						19.0	21.5	18.8	19.8	11.83	28.9	20.0
No. 3 Corn, **wheat,** legume						17.1	27.6	17.7	16.7	7.88	30.55	19.6
No. 5 Summer fallow, **wheat**						15.6	24.3	20.8	13.4	10.00	29.44	18.9
No. 4 Corn, rye, sweet clover, millet, **wheat,** cow peas, rape						11.2	13.8	19.5	22.0	5.33	40.83	18.8
No. 8 Alfalfa, corn, **wheat,** potatoes, wheat						17.5	17.7	20.9	9.66	10.42	26.8	17.2
No. 10 Corn, **wheat,** legume						15.9	9.6	17.4	18.99	6.27	23.64	15.3
No. 6 Oats, **wheat,** and corn						11.6	19.9	10.5	14.6	2.73	15.99	12.6
No. 9 Continuous **wheat**..						7.7	5.5	16.1	18.33	3.39	23.99	12.6

It is to note that Table XII consists of two parts, the first including wheat yields that have been continuing since 1912, and second, wheat yields that have been continuing since 1917. These two groups include the same yields in a number of cases, but the arrangement makes direct comparison possible.

In both these groups of yields, whether based on longer or shorter terms, **from Highmore the lowest average yield of wheat comes from continuous wheat, averaging 11.3 bushels in rotation 9.**

In this connection, as in connection with continuous wheat at Brookings (p. 544) one of the principal factors causing low yield apparently is the impossibility of preventing growth of weeds in continuous wheat. At Highmore it is reported that continuous wheat plots become increasingly infested with biennial sweet clover. In contrast also it should be noted again that a cultivated crop in rotation helps to prepare for a high yield of wheat in part by clearing the land of weeds (as sweet clover and wild oats.) Other possible factors are not discussed here from the standpoint of crop sequence.

It is to be emphasized here that both at Highmore and Brookings continuous wheat fell so low in yield as to be below profit, and that one evident cause easy to observe was the prevalence of weed growth in such wheat. Furthermore, if there were disadvantages in practice in having wheat follow corn directly at Highmore such as scab infection of this wheat, these were overshadowed as far as yield is indicated.

WHEAT IN ROTATION AT EUREKA

At Eureka, as well as at Highmore and Brookings wheat is produced in several crop sequences, or rotations. The several yields and averages of wheat from these rotations are put down in the following Table XIII. It may be noted that the table is arranged in two parts, first, recording yields that have been secured through all the seasons 1912-1922 inclusive, and second, some of the same yields and others that have secured through the years 1918-1922, inclusive. The average yields of both parts of this table, in the right hand column are put down in order, by arrangement of the table.

TABLE NO. XIII.

Yields of Wheat from Several Rotations at Eureka, 1912-1922

Names of Crops in Sequence and Rotation Number	Yields of Wheat in Bushels per Acre in Given Year										
	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Aver
No. 7 Corn, **wheat,** sweet clover, millet, oats, potatoes, flax, alfalfa, 6 years	1 0.41	1 8.4	1 13.16	1 45.9	1 13.03	1 15.9	1* 5.8	1* 13.6	1* 23.6	1* 13.99	23.8	16.1
No. 6 **Wheat,** legume, sorghum, barley, corn	1 2.16	1 7.7	1 9.3	1 45.1	1 10.3	1 15.9	1 6.6	1* 13.6	1* 24.9	1* 10.94	22.5	15.3
No. 1 **Corn, wheat,** legume	1 1.70	1 9.9	1 11.2	1 42.5	1 9.4	1 7.2	1* 4.9	1* 12.2	1* 22.3	1* 14.71	24.7	14.6
No 5 **Corn,** oats, **wheat**..	1 1.30	1 3.1	1 12.5	1 40.6	1 12.3	1 10.1	1* 3.4	1* 11.7	1* 18.8	1* 18.77	25.5	14.4
No. 3 Fallow **wheat**	1 1.08	1 11.3	1 12.3	1 42.5	1 9.4	1 14.0	4 7.2	4 13.1	4 15.0	4 11.41	18.58	14.2
No. 4 Continuous **wheat** Spring Plowing		1 5.76	1 8.56	2 42.2	2 3.3	2 3.9	2 1.5	14.3	2 17.1	2 15.83	18.50	13.1
No. 4 Continuous **wheat** Fall Plowing		3 3.25	3 8.15	3 37.1	4 5.2	4 8.2	4 2.4	2 14.2	2 15.5	2 8.66	13.66	11.6
No. 4 Continuous **wheat** D. D. H. H.		1 1.9	1 7.5	2 33.2	2 6.3	2 2.8	2 0.7	4‡ 9.7	4‡ 15.3	4‡ 10.41	12.33	10.0
No. 9B. Listed corn, **wheat**							4 15.6	4 18.2	4 27.5	4 15.8	18.4	19.10
No. 9A. Drilled **corn,** wheat							4 6.7	4 15.3	4 26.6	4 15.4	17.6	16.32
No. 7 Corn, **wheat,** sweet clover, millet, oats, potatoes, flax, alfalfa, 6 years							1* 5.8	1* 13.6	1* 23.6	1* 13.99	23.8	16.16

No. 9* Checked **corn,** wheat							[4] 6.7	[4] 15.	[4] 29.2	[4] 12.4	16.3	15.92
No. 1 Corn, **wheat,** legume							[1*] 4.9	[1*] 12.2	[1*] 22.3	[1*] 14.71	24.7	15.76
No. 6 **Wheat,** legume, sorghum, barley, corn							[1*] 6.6	[1*] 13.6	[1*] 24.9	[4*] 10.94	22.5	15.71
No. 5 Corn, oats, **wheat**							[1*] 3.4	[1*] 11.7	[1*] 18.8	[1*] 18.77	25.5	15.63
No. 4 Cont. **wheat,** Sp. Plowing							[2] 1.5	14.3	[2] 17.1	[2] 15.83	18.50	13.45
No. 3 Fallow **wheat**							[4] 7.2	[4] 13.1	[4] 15.0	[4] 11.41	18.58	13.06
No. 4 Cont. **wheat,** Fall Plowing							[4] 2.4	[2] 14.2	[2] 15.5	[2] 8.66	13.66	10.88
No. 4 Cont. **wheat,** D. D. H. H.							[2] 0.7	[4*] 9.7	[4*] 15.3	[4*] 10.41	12.33	9.69

(1) Red fife, 3 plats, Kubanka, 1914-17.
(2) One plot Kubanka, S. D. 75.
(3) Average of 4 plots, Kubanka, S. D. 75.
(4) Average of 2 plots, Kubanka, S. D. 75.
(1*) 3 plots, Acme
(4‡) 2 plots, Acme
(*) Spring wheat is sowed in November on Rotation 9, 9A, 9B.

In the foregoing table it appears again, that the lowest yield of **wheat** secured from any crop sequence tried came from **continuous wheat.** Recall that the same was true at Highmore and at Brookings. At Eureka continuous wheat has been seeded on three preparations (1) D. D. H. H. (Double disked, double harrowed); (2) fall plowed, and (3) spring plowed. Not only does continuous wheat permit weed growth, but it accords with observation of these experiments to say that "stubbled in" wheat, put in by merely disking the previous stubble and harrowing, permits more weeds to grow than plowing; whether fall plowing or spring plowing. It is possible that spring plowing prevents weeds more efficiently than fall plowing. But at Eureka and the part of the state represented such weeds as Russian thistle(perhaps also wild oats and sweet clover) and weeds of the later part of the season surely reduce the yield of continuous wheat; without necessarily serving as the only cause of reduced yield. At Eureka the highest yields of wheat follow a **cultivated crop.** namely corn. Corn, among other things furnishes a seed bed for wheat clean from weeds. At Eureka as also at Highmore and Brookings it would seem that in case there are harmful effects of corn upon wheat as a preceding crop, such effects are overcome so far as yield is concerned under the conditions of this experiment.

The rotations 9, 9A and 9B containing wheat after various methods of planting corn is interesting in that the spring wheat is always planted in November, thus it remains ungerminated in the ground until spring when it gets an early start. For the past 4 years this has done well.

YIELDS OF WHEAT FROM SEVERAL ROTATIONS AT COTTONWOOD

The following Table XIV puts down yields of wheat from several rotations at Cottonwood, extending over a period of years from 1912-1922.

From inspecting Table XIV it becomes evident that a number of failures or near failures have made the average yields of wheat in the last column low. In such years as 1920 and 1922 the yields are higher.

However **variable the yields, not only in the several years** but on the several plots in the same year, certain indications can be compared with the yields from rotations at Highmore, Eureka and Brookings. Yields from Rotation No. 8 (continuous wheat) regardless of other qualifications are low. **Continuous wheat at Cottonwood** is a near failure,

TABLE NO. XIV.
Yields of Wheat in Different Rotations, 1912-1922
Cottonwood

Crops in Rotation	Bushels per Acre											
	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Aver
No. 1 Corn, flax, potatoes, sweet clover, alfalfa, and **wheat**	5.9 [1]	1.5 [1]	2.4 [1]	0.0 [5]	7.9 [1]	3.3 [1]	9.6 [7]	8.4 [7]	22.94 [7]	.73 [7]	11.06 [7]	6.7
No. 2 Corn, wheat, oats	4.6 [1]	0.	1.4 [1]	0	7.6 [1]	2.8 [7]	6.15 [7]	5.61 [7]	20.78 [7]	.06 [7]	11.4 [7]	5.5
No. 3 Corn, **wheat**, sweet clover	9.4 [1]	0.5 [1]	4.0 [1]	0	8.0 [2]	9.3 [1]	4.55	4.80 [7]	23.6 [7]	.97 [7]	12.1 [7]	7.02
No. 6 Corn, **wheat**, clover, sorghum, oats, peas	0.33 [1]	0.45 [1]	3.0 [1]	0	12.3 [7]	2.4 [7]	6.32 [7]	12.4 [7]	30.38 [7]	.00 [7]	10.03 [7]	7.06
No. 7 Corn, **wheat** Fall. Pl. 3-row Group			3.9 [2]	0	12. [10]	2.5 [10]	0 [9]	12.06 [10]				5.07
Solid	2.22 [1]	0. [1]	1.7 [1]	0	15.5 [3]	1.32 [3]	0 [8]	11.15 [9]	29.8 [9]	.22	9.99	6.53
No. 8 Continuous wheat												
DDHH	.72 [1]	0.	1.2 [3]	0				6.4 [10]		.00		1.4
Spring Plow		0.	1.8 [3]	0		0 [3]	0 [8]	5.2 [6]	30.16 [6]	.00	5.5	4.7
S. P.		0.	3.2 [1]	0	12.7 [6]							3.98
F. P.			2.4 [1]	0	6.3 [6]	0 [6]	2. [6]	3.3 [6]			6.35	2.91
D. D.			2.4 [4]	0	12.0 [6]	0 [6]						3.6
F. P.—5 in.			1.7 [3]	0	6.8 [6]	0 [6]	0	2.7 [6]	28.94 [10]	.00	6.3	5.2

(1) 3 plats Red Fife, S. D. 67, C. I. 3081
(2) 3 row group planting 30 inches apart, Red Fife, S. D. 67, C. I. 3081
(3) 1 plat Red Fife, S. D. 67, C. I. 3081, solid planting.
(4) 2 plats, Red Fife, S. D. 67, C. I. 3081
(5) Hail
(6) Kubanka, S. D. 75, 1 plat
(7) Kubanka, S. D. 75, 3 plats—Acme after 1919.
(8) Kubanka, S. D. 75, cut for hay.
(9) Kubanka, S. D. 75, 3-row group—cut for hay.
(10) Kubanka, S. D. 75, 3 plats, solid seeding.

which is true of continuous wheat at all points tried. Likewise a seed bed prepared by only double disking, and double harrowing (D. D. H. H.) judging from the standpoint of yield makes the poorest possible seed bed; perhaps due to the prevalence of weeds from such preparation or lack of it. Wheat after corn, in several crop sequences is certainly better than continuous wheat, perhaps in considerable part because corn tends to clear land from such weeds as Russian thistle and pigweed (Amaranthus).

ACKNOWLEDGEMENT

Acknowledgement is hereby made by the writers of the assistance of Professor Manley Champlin, formerly connected with this department as associate agronomist and collaborator with the Office of Cereal Investigations; J. D. Morrison; Edgar McFadden, also collaborators with said office; George Janssen, former assistant; and of the foremen at the several substations.

APPENDIX TABLE I.

A List of Varieties and Strains of Wheat that Have Been Tested in Trial Grounds Within the Years 1898-1922 at Several Points in Order to Determine Whether they Should or Should Not Be Further Disseminated, on a Basis of Yield and Quality.

WHEATS TESTED AT BROOKINGS

Name of Wheat	Durum or Common	South Dakota Number	Cereal Investigation Number
Acme	Durum	284	5284
Adjini	Durum		1594
Algerian	Durum		1568
Algerian	Durum	340	3310
Argentine	Durum		1569
Arnautka	Durum	149	1493
Arnautka	Durum	148	1494
Arnautka	Durum		1530
Arnautka	Durum		1537
Arnautka	Durum		1539
Arnautka	Durum	357	1547
Arnautka	Durum		1590
Arnautka	Durum	1001	4064
Arnautka	Durum	150	4072
Arnautka	Durum	151	1574
Beloturka	Durum		1372
Beloturka	Durum		1520
Beloturka	Durum	72	1513
Berdianish	Durum		1586
Black Don	Durum		1446
Black Don	Durum		2100
Black Poulard	Durum		2085
Ble Dur	Durum		1448
Ble Dur	Durum		1450
Ble Dur	Durum		1451
Ble Dur	Durum		1452
Ble Dur	Durum		1453
Yellow Gharnovka	Durum		2096
Kubanka Sel. 75-3-15	Durum		
Buford	Durum	1159	5295
Mindum	Durum	1160	5296
Early Java	Common		
Prelude	Common	1021	4323
Pioneer	Common	1022	4324
Preston, Minn. 188	Common		2958
Preston, Minn. 188	Common	67	3081
Preston, Minn. 188	Common	714	3318
Preston, Minn. 188	Common	715	3328
Preston, Minn. 188	Common	716	3316
S. D. Climax	Common		
Kota	Common	1184	5878
Ghirka fife	Common	69	1517
Glyndon fife, Minn. 163	Common	163	2873

Name of Wheat	Durum or Common	South Dakota Number	Cereal Investigation Number
McKindreig fife, Minn. 181	Common		
Power fife, Minn. 149	Common		1574
Power fife, Minn. 66	Common		2898
Power fife	Common	1039	3697
Marquis	Common	515	3641
Rysting fife, Minn. 171 ..	Common		3022
Bolton bluestem, Minn. 146	Common		1573
Dakota bluestem	Common		3083
Haynes bluestem, Minn. 51	Common		1505
Haynes bluestem, Minn. 169	Common	169	2874
Haynes bluestem	Common	140	
Marvel	Common		3082
Okanogan	Common		
Advance, Minn. 185	Common		
Ak.	Common		3076
Crawford's Hybrid	Common		
Erivan	Common		2397
Huron	Common		
Kara	Common	70	3078
Larson	Common		
Manchuria	Common		2492
Prelude	Common		
White Ear	Common		1514
Iumillo Hybrid	Common	718	4783
Iumillo Hybrid	Common		4787
Iumillo Hybrid	Common		4788
Iumillo Hybrid	Common		4789

WHEATS TESTED AT COTTONWOOD

Name of Wheat	Durum or Common	South Dakota Number	Cereal Investigation Number
Kubanka	Durum	75	1440
Acme	Durum	284	5284
Marquis	Common	515	3641
Preston	Common	67	3081
S. D. Climax	Common		
Glyndon fife, Minn. 163 ..	Common	163	2873
Power fife, Minn. 66	Common		2898
Rysting fife, Minn. 171 ..	Common		3022
Dakota	Common		3083
Haynes bluestem, Minn. 51	Common		1505
Haynes bluestem, Minn. 169	Common		2874
Okanogan	Common		
Advance	Common		
Bearded bluestem	Common		
Manchuria	Common		2492

WHEATS TESTED AT HIGHMORE

Name of Wheat	Durum or Common	South Dakota Number	Cereal Investigation Number
Acme	Durum	284	5284
Adjini	Durum		1594
Algerian	Durum		1568
Algerian	Durum	340	3310
Argentine	Durum		1569
Arnautka	Durum		1431
Arnautka	Durum	149	1493
Aranutka	Durum		1537
Arnautka	Durum	357	1547
Arnautka	Durum		3080
Arnautka	Durum	1001	4064
Arnautka	Durum	150	4072
Beloturka	Durum	72	1513
Beloturka	Durum		1520
Berdiansk	Durum		1586
Black Don	Durum		1446
Black Don	Durum		2100
Ble Dur	Durum		1481
Ble Dur	Durum		1483
Ble Dur	Durum		1509
Ble Dur	Durum		1510
Chernokoloska	Durum		1540
D-5	Durum	1112	3322
Egyptian	Durum		1428
Gharnovka	Durum		1443
Gharnovka	Durum		1447
Gharnovka	Durum		1546
Iumillo	Durum		1736
Kahla	Durum		1595
Kahla	Durum		2088
Kubanka	Durum		1354
Kubanka	Durum	75	1440
Kubanka	Durum		1490
Kubanka	Durum		1516
Kubanka	Durum		1541
Kubanka	Durum		2094
Kubanka	Durum		2234
Kubanka	Durum		2246
Kubanka	Durum		3303
Kubanka	Durum		4063
Mahmoudi	Durum		2099
Marouani	Durum		1593
Medeah	Durum		1381
Medeah	Durum		1597
Mohamed Ben Bachir	Durum		2087
Monad	Durum	1113	3320
Nicaragua	Durum		1492
Nova Rossick	Durum		1567
Pierson	Durum	999	4163

Name of Wheat	Durum or Common	South Dakota Number	Cereal Investigation Number
Pelissier	Durum		1584
Pelissier	Durum		2086
Pererodka	Durum		1350
Pererodka	Durum		1515
Realli Forte	Durum		1377
Richi	Durum		2089
Saragollo	Durum		2228
Spring	Durum		1508
Taganrog	Durum		1570
Velvet Don	Durum		1445
White Ear	Durum		1514
White Turkish	Durum		3290
Yellow Gharnovka	Durum	121	1444
Yellow Gharnovka	Durum		2096
Afrikanski	Durum		3287
Afrikanski	Durum		3302
Althani	Durum		4700
Americanka	Durum	1032	
Anchuelo	Durum		3280
Argentina	Durum		5109
Australia	Durum		4992
Banatka	Durum	1035	
Bansi	Durum		4506
Bansi of Balaghat	Durum		4702
Beloturka	Durum		5014
Buford	Durum	1159	5295
Dahutia	Durum		4561
Deshi Althani	Durum		4698
Housea Broach	Durum		4690
Howrah	Durum		4562
Julalia	Durum		4563
Kopergaon	Durum		4699
Lal of Batala	Durum		4701
Potia Nadial	Durum		4691
Sarymagis	Durum	1031	
Shet Parner	Durum		4692
Sineshka	Durum		3289
Sisihiika	Durum	1034	
Sivouska	Durum	1033	
Talinka	Durum		5016
Tigharia	Durum		4564
Tunal	Durum		3307
Tunalg	Durum		3309
White Spring	Durum	937	
	Durum	779	3715
	Durum	1060	3717
	Durum	1068	3733
	Durum	1051	3734
	Durum	1066	3739
	Durum	1069	3742
	Durum	1072	3743
	Durum	1057	3756

Name of Wheat	Durum or Common	South Dakota Number	Cereal Investigation Number
	Durum	1056	3758
	Durum	1064	3760
	Durum	1067	3764
	Durum	1058	3769
	Durum	1062	3774
	Durum	1059	3777
	Durum	1061	3778
	Durum	1065	3779
	Durum	1063	3780
	Durum	857	4082
	Durum	1070 &872	4131
	Durum	1114	4525
	Durum	1115	4526
Golden Ball	Durum	1187	6227
Peliss	Durum	1256	1584
Sloat's Kahla	Durum	1158	6046
Kahla	Durum	1174	6252
Mindum	Durum	1160	5296
Benzer Wis. Wonder			
Kota	Common	1184	5878
Prelude	Common	1021	4324
Red Bobs	Common	1239	
Kitchener	Common	1237	4800
Pioneer (Preston)	Common	1022	4324
Kharkof	Common	191	
Turkey	Common	144	3689
Kharkof	Common	76	1583
Theiss	Common	352	1561
Red Rock	Common	1239	
Kanred	Common	1098	5146
Turkey	Common	558	
Crimean	Common	353	2943
Neb. No. 6	Common	1137	6249
Kanred	Common	1138	6250
Minturki	Common	1182	6155
Minhardi	Common	1189	5149
Neb. Hybrid	Common		
Ruby	Common	1235	
Preston	Common	67	3081
Power	Common	1039	3697
Haynes bluestem, Minn. 169	Common	169	2874
Dakota bluestem	Common		3083
Haynes bluestem, Minn. 51	Common		1505
Marvel bluestem	Common		3082
Okanogan	Common		645
Ghirka fife	Common		1517
Glyndon, Minn. 163, fife	Common		2873
Power fife, Minn. 66	Common		2989
Power fife	Common		3025
Power fife	Common		3697
Marquis fife	Common		3641

Name of Wheat	Durum or Common	South Dakota Number	Cereal Investigation Number
Rysting, fife, Minn. 171	Common		3022
Fretes (Preston)	Common		1596
Preston, Minn. 188	Common		2958
Ak	Common		3076
Bugdai	Common		
Chul	Common		2899
Erivan	Common		2397
Galgalos	Common		2398
Kara	Common		3078
Kara	Common		3269
Manchuria	Common		2492
Prelude	Common		4323
Turbat	Common		3077

WHEATS TESTED AT EUREKA

Name of Wheat	Durum or Common	South Dakota Number	Cereal Investigation Number
Kubanka	Durum	75	1440
Acme	Durum	284	5284
Preston, Minn. 188	Common		2958
Preston	Common	67	3081
S. D. Climax fife	Common		
Ghirka fife	Common	69	1517
Glyndon fife, Minn. 163	Common	163	2873
Power fife, Minn. 66	Common		2898
Marquis	Common	515	3641
Rysting fife, Minn. 171	Common		3022
Dakota bluestem	Common		3083
Haynes, Minn. 51	Common		1505
Haynes, Minn. 169	Common	169	2874
Okanogan	Common		
Advance, Minn. 185	Common		
Bearded bluestem	Common		
Kota	Common	1184	5878

LIST OF AVAILABLE PUBLICATIONS

Annual Reports, 1917, 1918, 1919, 1920.

Bulletins

106. Sugar Beets in South Dakota
129. Growing Pedigreed Sugar Beets
131. Scabies (Mange) in Cattle
132. Effects of Alkali Water on Dairy Products
142. Sugar Beets in So. Dak.
143. Roughage for Fattening Lambs
147. Effect of Alkali Water on Dairy Cows
153. Selecting and Breeding Corn for Protein and Oil in So. Dak.
154. The Pit Silo
156. Kaoliang, A New Dry-land Crop
157. Rape Pasture for Pigs in Cornfield
158. Proso and Kaoliang for Table Use
159. Progress in Plant Breeding
160. Silage and Grains for Steers
161. Winter Grain in So. Dak.
162. First Annual Report of Vivian Experiment and Demonstration Farm
163. Comparative Yields of Hay, from Several Varieties and Strains of Alfalfa in South Dakota
164. Making Butter and Cheese on the Farm
165. Corn Silage for Lambs
166. Factors Affecting Milking Machines
167. Transplanting Alfalfa
168. Breakfast Foods and Their Relative Value
169. Flax Culture
170. Quack Grass Eradication
171. Cream Pasteurization
173. Sugar Beets in So. Dak.
174. Sorghums for Forage in South Dakota
175. The Role of Water in a Dairy Cow's Ration
177. The Sheep
179. Emmer in South Dakota
180. Root Crop Culture
181. Corn Culture
182. Corn Silage for Steers
183. Barley Culture in S. D.
184. Yields From Two Systems of Corn Breeding
185. Ice on the Farm
186. Corn Families of So. Dak.
187. The Influence of Length of Wheat Heads on Resulting Crops
188. Relative Values of Feed Proteins for Dairy Cows
189. Corn and Millet Silage for Fattening Cattle
190. The Webspinning Sawfly of Plums and Sandcherries
191. Water as a Limiting Factor in the Growth of Sweet Clover
192. Rations for Pigs
193. Soybeans in South Dakota
194. Acme Wheat
195. Feeding of Dairy Cattle
196. Potatoes in South Dakota
197. Milk Testing in Practice
198. The Influence of Purebred Dairy Sires
199. Sunflower Silage for Steers, Smutted Corn Silage for Cows.
200. Winter Wheat in South Dakota.

Circular No. 1 Nitrogen from the Air.

Note—We do not add the names of non-residents to the regular mailing list.