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Progress in Wheat Investigations

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W.L. Burlison

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BULLETIN NO. 128.

MAY, 1911.

AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE
AND MECHANIC ARTS

AGRONOMY DEPARTMENT

Progress in Wheat Investigations

BROOKINGS, SOUTH DAKOTA

From the Press of the
Mitchell Publishing Company
Mitchell, S. D.

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PROGRESS OF WHEAT INVESTIGATIONS.

By Clifford Willis, Chief in Agronomy and
W. L. Burlison, Chief Assistant in Agronomy.

Wheat rising is considered the foundation of South Dakota's agriculture. If the crop is good and the price fair the farmers feel that all will go well for another year; but if the yield is poor and the price meagre the future outlook is dark. Wheat ranks first in monetary value and first in acreage over any other crop grown in this state. Indian corn has greatly increased in acreage while the area devoted to wheat production is more or less fluctuating. When we consider the amount of new land that is being brought into cultivation in South Dakota it is evident that corn growing has increased more rapidly than that of wheat. The following table indicates the relative acreage and total production of wheat and corn for the last decade.

WHEAT				CORN			
Year	Acreage	Total Yield	Bu. per A.	Year	Acreage	Total Yield	Bu. per A.
1900	2,920,241	20,149,684	6.9	1900	1,200,697	32,418,819	27.
1901	4,004,830	51,662,307	12.9	1901	1,421,079	29,842,659	21.
1902	3,604,347	43,973,033	12.2	1902	1,577,398	29,812,822	18.9
1903	3,424,130	47,352,994	13.8	1903	1,530,076	41,618,067	27.2
1904	3,287,165	31,556,784	9.6	1904	1,560,678	43,855,052	28.1
1905	3,221,422	44,133,481	13.7	1905	1,623,105	51,614,739	31.8
1906	3,131,000	41,955,400	13.4	1906	1,875,000	62,812,500	33.5
1907	2,900,000	32,480,000	11.2	1907	1,850,000	47,175,000	25.5
1908	2,958,000	37,862,000	12.8	1908	1,942,000	57,677,000	29.7
1909	3,375,000	47,588,000	14.1	1909	2,059,000	65,270,000	31.7
Average..... 12.1				Average..... 27.4			

It will be observed from a study of the table that the

banner year for acreage and total production was 1901. The average yield for that period was 12.9 bushels per acre, only .8 bushels per acre more than the average for the 10 year period from 1900 to 1909. The highest average yield is noted for 1909, which was 14.1 bushels per acre. It is to be regretted that records do not show more than 12.1 bushels per acre as an average for the last ten years. In all probability the next decade will show a lower return than that recorded for the preceding period if more care is not exercised in the future in wheat growing than has been given in the past.

It is the object of this bulletin to report the progress and suggest methods for the culture and management of the wheat crop.

TILLAGE

Wheat responds readily to good culture. Poor tillage is one of the greatest avenues of loss to the growers of this country. Where one farmer gives his land a thorough preparation, three fail. If wheat raisers of South Dakota would stop long enough to realize the importance of good tillage we believe that greater advance in the production of wheat would be made. There is only one way to prepare the ground and that is the right way. Very few would expect profitable yields from a field which has been disked only and seeded to wheat. It is true, however, that such a practice is being employed in many sections of this state. Of course, seasonal conditions may be such in 10 or 12 years that a good crop would be harvested from a field treated in this manner. The method which should be followed in the preparation of the soil for any crop is the one which will give the greatest number of bushels for the greatest length of time.

TIME OF PLOWING.

Experience has shown that fall plowing is most satisfactory. Since the question of soil moisture is of vital importance in crop production, it is necessary to conserve

all that falls upon the field, especially in regions of limited precipitation. For this reason it is well to plow as early as possible, because a large proportion of the annual rainfall comes during the late summer and early fall months. If the surface is left smooth a small quantity of the water will be absorbed as compared to that which runs off. When the field is left unstirred evaporation takes place rapidly, owing to capillary action going on in the soil. Again, when the ground is stirred early in the season large quantities of plant food are liberated during the warm summer months. Weeds are also destroyed in great abundance by early plowing.

DEPTH OF PLOWING.

The depths to which a field is plowed will be governed largely by the length of time which will intervene between the time of plowing and seeding. In cases where the crop is to be planted soon after plowing, the soil should not be stirred as deeply as when the ground is plowed in the fall and seeded in the spring. For spring wheat the land may be plowed seven to eight inches deep during the late fall, because the soil will have ample opportunity to settle; thus it will be reduced to a firm, compact seed-bed by subsequent treatment and freezing and thawing. Seven inches seems to be the most satisfactory depth to plow for wheat.

The Oklahoma Station reports yields for three years on this phase of wheat production and the results are as follows: Disked three inches, plowed three inches, four inches, five inches, six inches, seven inches, eight inches, and nine inches. Yields increase as the depth was greater up to seven inches. From this point there seemed to be a gradual falling off from the seven inch plot to the nine inch treatment. The disked plots gave an average return of a trifle over three bushels per acre, while the seven inch area yielded an average of almost 23 bushels per acre for a three year period.

DISKING.

The disk will never take the place of the plow. However, its use in the preparation of wheat ground is almost indispensable. If it is not possible to plow the ground early in the season it will be very helpful to give the field a thorough disking in order to destroy any weeds that make their appearance, and to form a mulch on the surface, which is a greater factor in preventing the evaporation of soil water. In many instances where the ground has remained uncultivated and has become too hard to plow, by thoroughly disking the soil it will soon be in condition to stir with a mould board plow. This is due to the fact that moisture from below was brought near the surface by capillary action. The dust mulch produced by the disk checked capillary action and the moisture was held in the region of the plow line.

SUBSEQUENT TREATMENT.

Ground that is stirred in the fall for spring wheat should be left rough in order that as much snow as possible may be held where it will melt and pass into the soil. Where the surface is very smooth it is also very likely to blow badly. Fields which have been known to blow considerably during the fall months have had this trouble reduced to minimum by leaving the land just as it was turned in the fall. Of course, there are cases where a cloddy surface should be worked over in the fall with a disk or spike-tooth harrow. Ordinarily where careful attention has been given in stirring the land in the fall it will remain in good condition during the winter months.

MAINTAINING THE PRODUCTIVE STRENGTH OF WHEAT SOILS.

Wheat is a very exhaustive crop. Where a field is cropped continuously year after year the yield will be materially reduced. There are fields in this state which have been seeded to wheat ever since the soil was first turned; some of these are still producing fair returns,

while others hardly pay for the time required in cultivating them.

When possible, it is advisable to plan a systematic rotation so that wheat will not follow wheat. Nothing in the way of increasing plant food is gained by a systematic rotation of crops unless the scheme outlined is so outlined that it will include one of the legumes, such as peas, clover or alfalfa. Crops which have different rooting habits should come in succession when possible. Take for example, the old rotation of corn, wheat, oats and clover. The roots of the corn plant feed below the zone of the wheat roots; clover on the other hand in a measure will supply the nitrogen removed by the other crops if a portion of the hay is plowed under. The roots of the clover feed far below the roots of either wheat or corn and have a tendency to bring some plant food elements near the surface.

A well planned rotation for any section is one which involves the following facts:

Is it profitable?

Can it be followed with a minimum amount of labor?

Legumes should be included in every well planned rotation.

Will the rotation help in eliminating plant diseases?

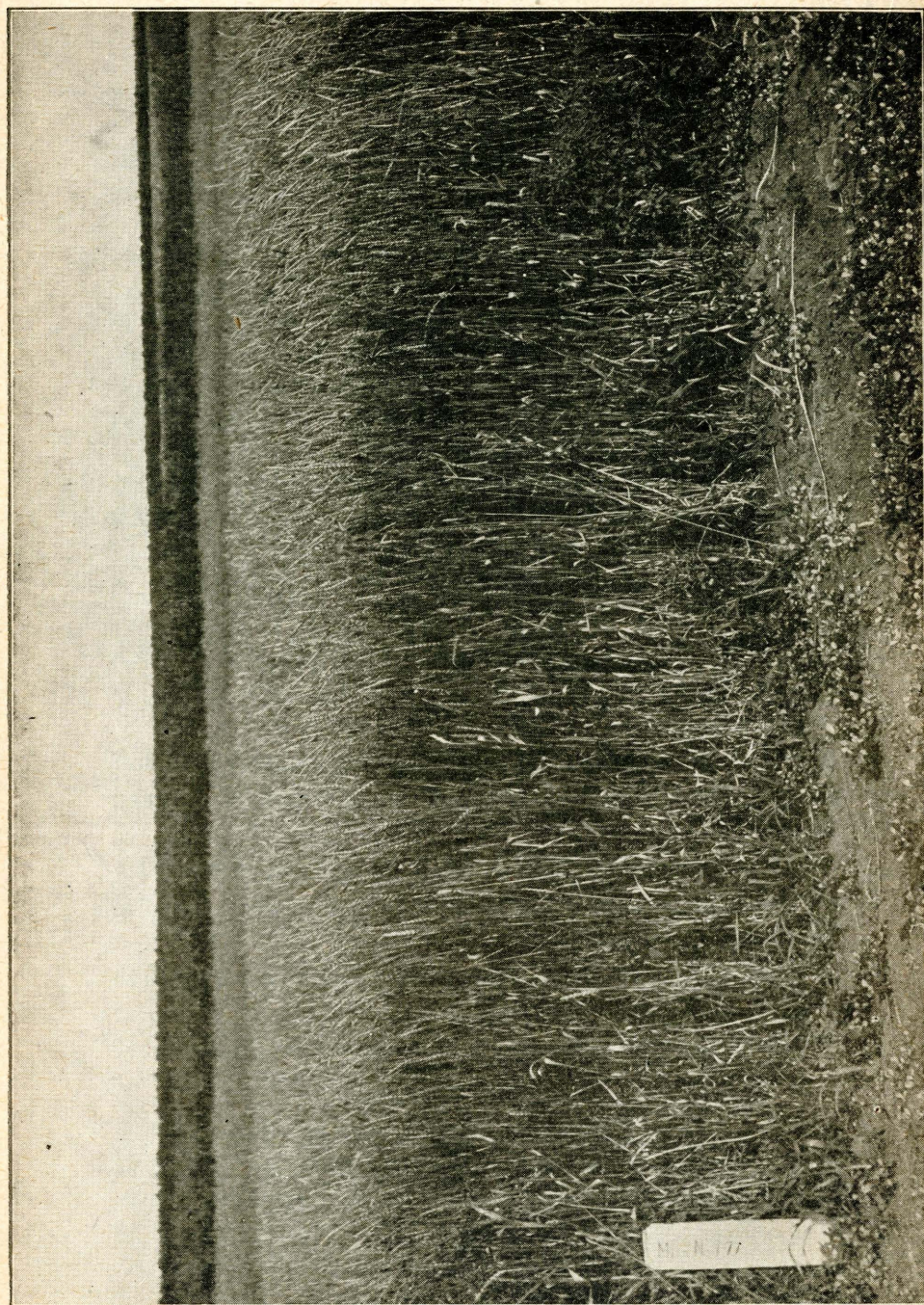
Are weeds easily held in check by crops which require inter-cultural tillage?

Will this system give ample opportunity for thorough preparation of the seed-bed?

Does the system have a tendency to distribute labor?

WINTER WHEAT.

Winter wheat has been slow in coming to South Dakota, but it is here to stay. It is gratifying to know that already good reports have been sent in from several western counties. At the Brookings Station the average yield for a six year period was more than 16 bushels per acre. The lowest yield for any one season during the six year



period was eight bushels per acre. A great deal of interest is being centered about this crop west of the Missouri river and many farmers are adding to their winter wheat acreage every year.

PREPARATION OF THE SEED BED.

Preparation of the seed-bed for winter wheat of course involves the same principles as for spring wheat mentioned before in this pamphlet, except that the work must be done much earlier in the season where best results are expected. During the month of July is the best time of the year for plowing if we expect to develop an ideal seed-bed, because much time is required for the soil to settle.

VARIETY TO SOW.

Extensive varieties have been conducted in many of the neighboring states. There are instances where Turkey Red is one of the leading strains and some of the trials point to the fact that it is without an equal. From the work that has been done in South Dakota we are of the opinion that Turkey Red is one of the best varieties to plant in this state. It is a hard bearded strain, tillers fairly well, stands drouth and cold weather admirably. The variety produces fair pasture and the grain sells first class on our general wheat markets.

SEEDING WINTER WHEAT.

Since the winter season comes on quite early, this crop should be planted during the latter part of August or the first days in September. If the plants do not get a good start early in the fall, in all probability they will not be able to withstand the exceedingly cold weather of the year.

SPRING PRECAUTIONS.

In sections of the state where the soil is subject to heaving or packing, spring cultivation may be found helpful or necessary. If the soil is compact, harrowing will prove of benefit in maintaining a dust mulch, which is a

controlling factor in conserving soil moisture. The injury done to the crop by harrowing will be very slight, while on the other hand the value to the crop has been clearly pointed out by a number of experiment stations. Rolling is of little value in South Dakota.

MANURING.

If farm manure is used judiciously it will affect a permanent improvement in the yield of wheat. When manure is applied to the soil new stores of plant food are added and the crop is able to secure more food material. Manuring also improves the physical condition of the soil, thereby increasing the water holding capacity. In a measure the incorporation of organic matter will prevent the soil from blowing badly. Large quantities of manure are being wasted every season by farmers of South Dakota and it is not at all unusual to see large piles of this material lying out exposed to the weather throughout the entire rainy season. Much of this by-product has been bleached and washed until its value is practically lost from the standpoint of the plant substances which it contained in the beginning. Much of the refuse products of the crop grown on the farm is also burned simply in order to get it out of the way. Straw stacks are burned by the hundreds about threshing time, and believe that if the organic matter which is destroyed in one way or another could be placed on our wheat fields, it would be found that the yield of grain would be greatly increased.

SEED SELECTIONS.

Seed is an important factor in wheat production. Frequently very little attention is given to this feature of the work. About one farmer in ten is in the habit of fanning his grain before sowing and small and inferior seed is planted with the first class grain. Experimental evidence has shown conclusively that large seed, well fanned and graded, will produce greater return, where an equal number of grains are planted per acre. There is some



1 Red Fife 2 Blue Stem 3 Velvet Chaff 4 Minnesota 51 About 17 A and 17 B

experimental evidence from the Brookings Station bearing directly on this problem. The following results are of considerable interest to the man who wishes to examine the proposition of clean seed.

Famed and Unfamed Seed

Variety	Year	Fanned Bu. Per Acre	Unfanned Bu. Per Acre	Difference Bu. per Acre
Ghirka	1905	11.3	9.7	1.6
S. D. Climax	1905	19.2	17.8	1.4
Kubanka	1905	20.8	19.5	1.3

The table shows a gain of more than one bushel per acre which in many cases would pay for one half the expense in preparing the seed bed. Benefit derived from fanning out weed seed is worth consideration.

We believe it is possible for every farmer to do a certain amount of crop improvement if he will take a small share of his time just before his crop is harvested. The object of all wheat growers is to produce the greatest number of bushels of wheat on every acre which is cultivated. After the soil has been thoroughly prepared it is a waste of time—and time is money for the farmer—for him to sow a poor, inferior strain of wheat. When the proper variety is obtained for a given locality, one of the great avenues of income is to increase the value of this type by selection; that is, to make it produce more bushels per acre. This can be done without any complicated details being involved. Let us go into the field and select many of the best heads, those that display superior characteristics, plants which mature earlier with the greatest number of grains per head. See to it that these heads have not had any advantage during the growing season. Those

plants must be chosen which have accomplished the most where competition has been the greatest. Plants which will beat their neighbors when they have all been striving under like conditions are the desirable ones. Ten pounds of grain will seed one-tenth of an acre. One-tenth of an acre will yield enough seed to sow more than one acre if properly distributed, and after only a few seasons the amount of grain with a known record will be threshed for a general field. This scheme is practical and will pay for time and money required to carry it out.

TIME OF SEEDING SPRING WHEAT.

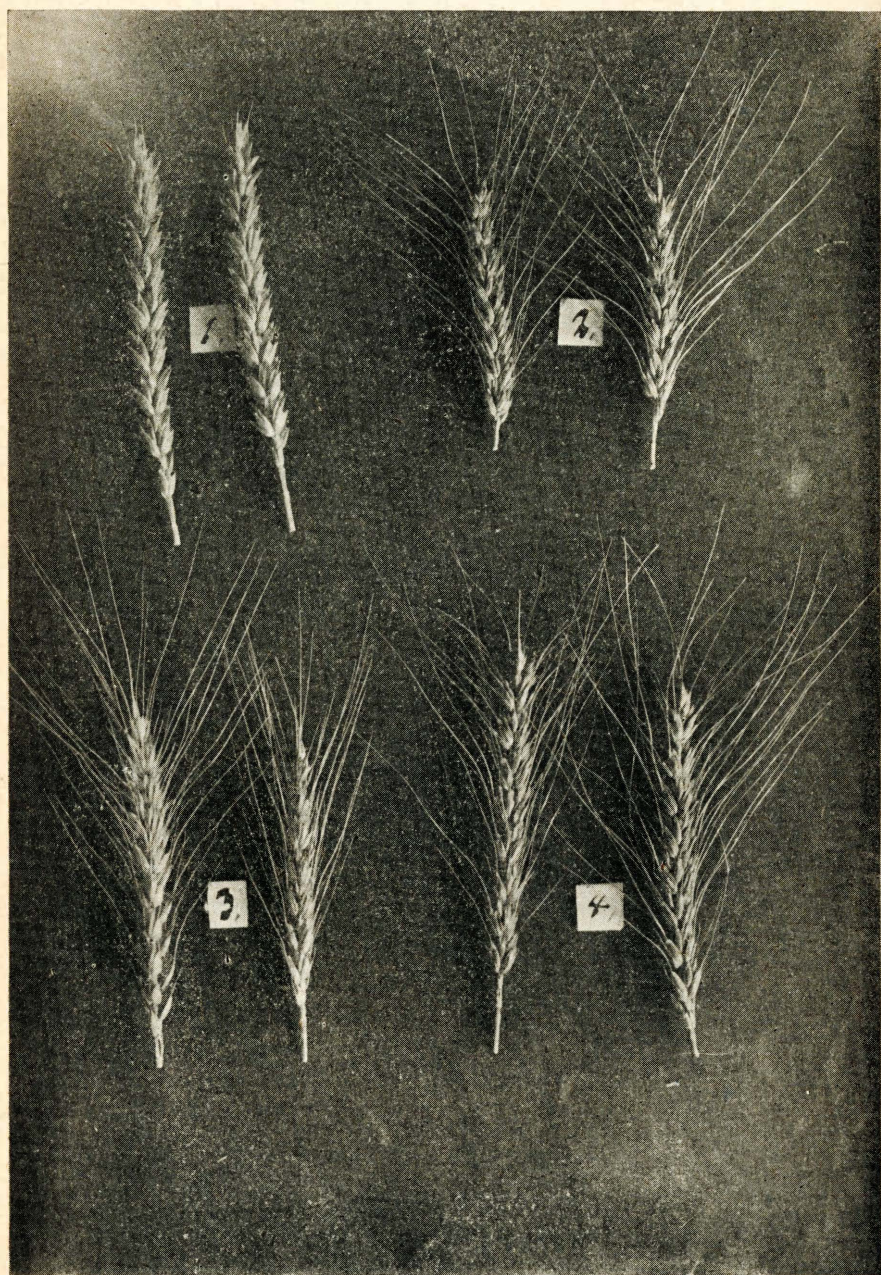
The time of seeding spring wheat will be governed by the nature of the soil, preparation of the seed-bed and the season. The earliest date for planting at this Station is April 7. The latest date for the last five years is May 6. A safe rule to follow is to plant the seed as early in the spring as possible after the ground has been thoroughly prepared and danger from severe freezing is past.

SEEDING.

Wheat planted with a good disk drill will bring better returns for a ten year period than broadcasting, because the drill distributes the seed more evenly and at the same time the kernels are put down in the moist earth out of reach of slight freezes which may come after seeding. Broadcasting is scarcely ever a safe way to plant any small grain crop, especially wheat or oats. Of course, there are some conditions where broadcasting will have to be practiced in order to seed the field at all. When this is the case every precaution should be given to cover the grain as deeply as possibly and to distribute it evenly over the field.

VARIETY TESTS.

This Station has been conducting variety trials with wheat for about ten years. Strains from many parts of the United States and foreign countries have been included in these tests. Several types are grown in the field for

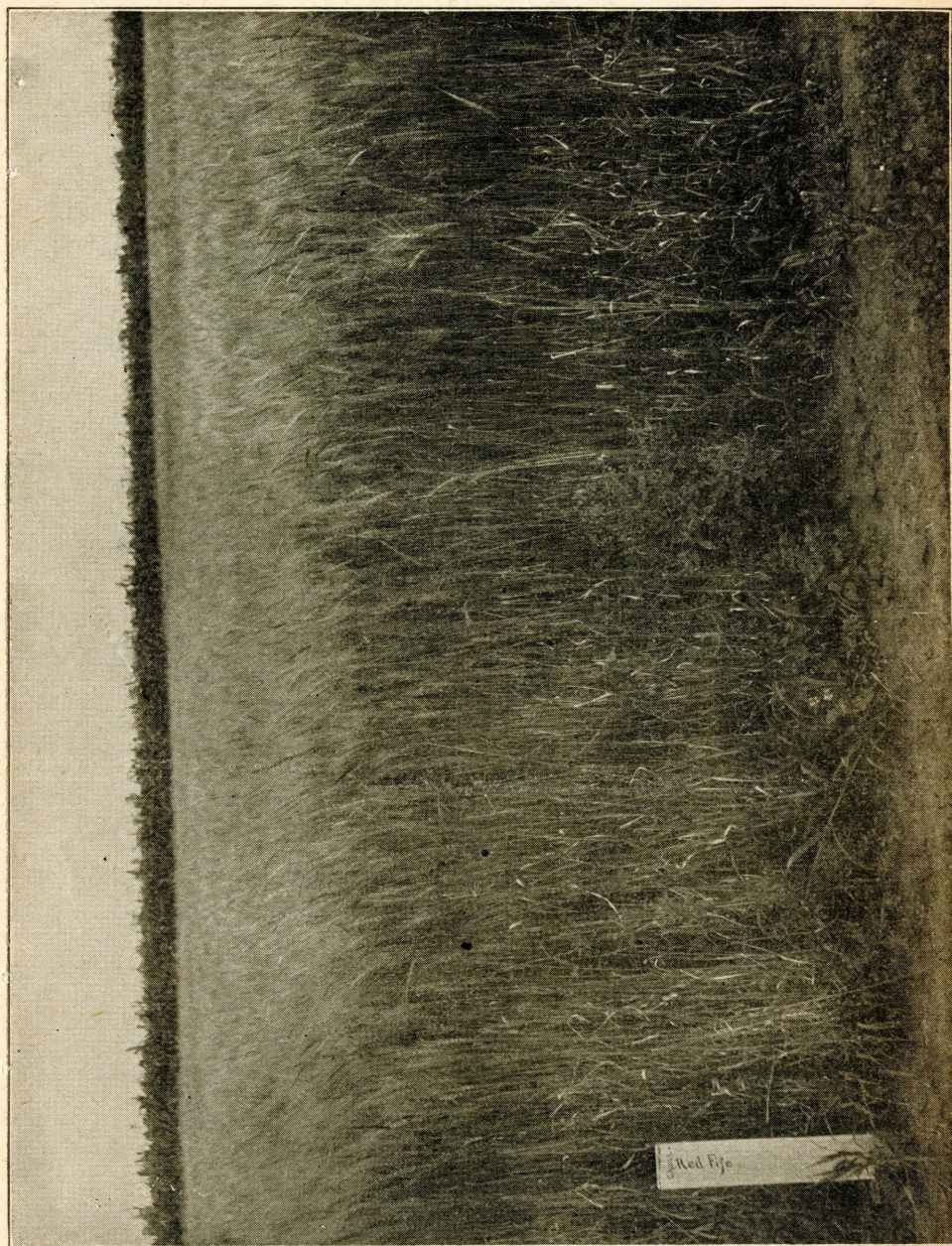


1 Minnesota 171 2 Manchuria 2492 3-4 Early Java About 17-A-17B

Macaroni or durum wheats have also been under trial and are still being observed, for it is a type which seems to be well suited to some sections of South Dakota. Bread making qualities and disease resitsance are facts now under study.

DURUM WHEAT—Yields By Years

Variety	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	Av'g.
Arnautka						37.2	20.	24.1			27.1
1590					26.0	37.0	21.2	22.5			26.7
Arnautka											
1530											
Taganro											
1570	25.5	35.4		19.0	26.2	31.4	11.7				24.9
Arnautka	17.5	29.2		26.0	25.0	35.8	20.8	25.8	16.5	12.0	23.2
Arnautka											
1494						38.9	22.7	25.3	11.7	13.0	22.8
Wild Goose											
1493				23.5	25.0	36.4	17.5	23.1	17.3	11.0	21.9
Charnouka											
1546				16.1	22.2	32.5	13.8	20.1			20.9
Kubanka											
1346					18.8	29.8	13.0				20.8
Kubanka											
1356				21.0	18.8	38.5	15.6	16.0	16.2		21.0
Sleaford						29.4	11.5	.			20.5
Arnautka											
28-8-C									19.0		19.0
Kubanka											
1490				22.5	18.5	28.4	11.1	12.6			18.6
Beloturka				16.5	19.8						18.2
Kubanka											
1541				18.6	16.5	30.4	12.7	15.8	18.0	9.2	17.3
Kubanka											
1516				29.3	20.8	30.3	6.2	12.8	15.7	5.5	17.2
Sleaford											
2472								17.0			17.0
Wild Goose											
1547						33.5	20.5	23.1	13.5	10.0	16.8
Kubanka											
(5639) 1440 G I.				18.8	16.3	28.6	14.5	16.1	11.8	12.7	16.9
Jumillo											
1736					23.2	26.0	5.3	10.0			16.1
Arnautka											
Higmore											
1539									21.7	10.7	16.2
Kubanka											
1349								14.5		14.5	14.5
Xerxes											
2415					25.9	7.5	10.8				14.7
Toganroy											
1570								14.0			14.0
Beldow								13.6			13.6
Trimena						24.8	5.2	8.8			12.9



SELECTION OF A VARIETY.

It is not the variety of wheat that will give the highest yield for any given season that should be chosen under general conditions. The strain which will give the highest return for a long period of years will be found more profitable. Climatic conditions are variable in South Dakota and for this reason it seems that no two seasons are exactly alike. Because of this, one variety might yield well one year and fail when conditions are different the following year. A variety that is least affected by annual changes will prove more valuable than those which cannot thrive when these unexpected variations occur. The bread-making quality and general market demand must be taken in consideration, as well as the yielding qualities, when making a study of specific types.

DESCRIPTION OF VARIETIES

RED FIFE

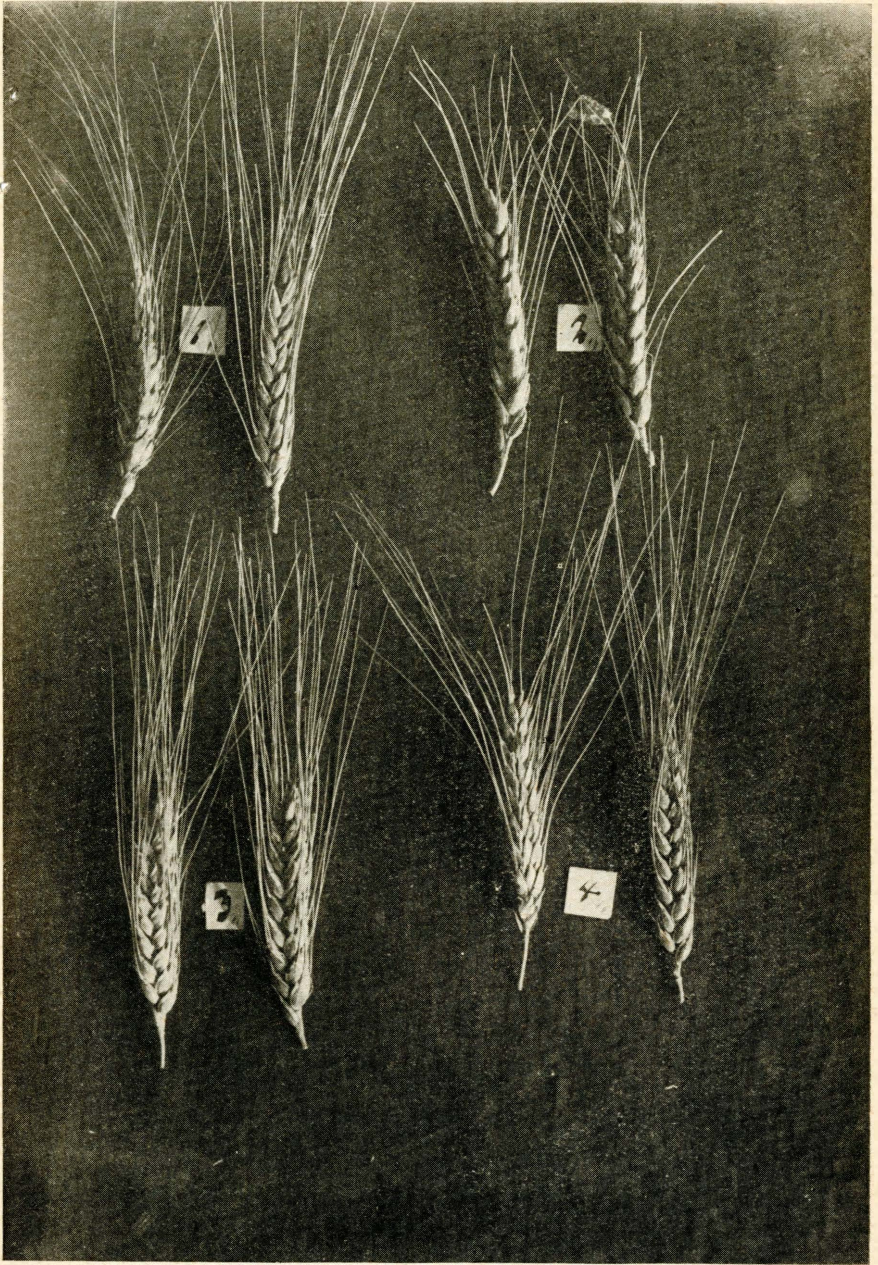
Red Fife is a bearded variety, commonly known as Velvet Chaff, yellowish white in color and smooth. Grains average two to the spiklet, are plump, with slight creases. The bran is somewhat thicker than Bluestem varieties. Number days required to mature: 88 to 100. This variety has proven very valuable for the central part of the state. On the market it is docked about 5 per cent, but it seems as if the additional yield of this type over others will more than make up for this loss. Two of the popular names for Red Fife are Golden Fife and Johnson's Fife.

SOUTH DAKOTA CLIMAX.

South Dakota Climax is a descendant of a selection from Red Fife, but has not proved enough better than Red Fife to warrant distribution. Its botanical characteristics are practically the same as Red Fife.

BLUESTEM.

Haynes pedigree is a beardless spring variety, one of the hard wheats of the North; chaff white, velvet of



DURUM WHEAT

1 Wild Goose 2 Arnautka 3 Kubanka 5639 4 Arnautka Highmore About 18-B

pubescent; grains average from two to three in the spiklet. They are red colored, and may be distinguished from the Red Fife type by the deeper crease and thin bran. It ripens late, which is a serious objection. The number of days required to mature is 95 to 100. The variety is more valuable for the eastern part of the state, especially in Sioux Valley. Bluestem ranks the highest of any of wheat on our general market.

Minnesota 51, 169 and Okanogan are the same as the Bluestem from a botanical standpoint. Minnesota 51 was obtained from Brandon, Manitoba, in 1890 by the Minnesota Station. Okanogan is of Canadian origin as its name indicates. Minnesota 66 is a beardless spring variety. Chaff white and smooth. Grains two to three in the spiklet. They are similar to the Bluestem type. Number of days required to mature: 92 to 105. It matures somewhat earlier than the Bluestem, but grades equal to the latter variety. In all probability Minnesota 66 should be more widely grown in the central part of the state. Some of the popular names are Powers' Fife, Ristings' Fife, Scotch Fife.

Minnesota 163 is a descendent of a selection of Minnesota 66.

Minnesota 171 also comes from Minnesota 66.

Ghirka 1517 is very much like Fife in appearance, except the spiklets are further apart on the rachis. It has proved to be one of the most valuable wheats in some of the western sections, because it withstands drouth, and requires 88 to 100 days to mature. Chirka was obtained from the Grodno Government in Russia in 1890.

Manchura, a beared spring wheat; chaff mixed in color brown and white. Grains, two to the spiklet, are plump and large, larger than either Fife or Bluestem; reddish but somewhat lighter colored than Bluestem.

Kubanka includes Kubanka 1541, 1516, 1440 (5639)

and 1354. These types are drouth resisting and ripen earlier than any of the other durum wheats. They seem to be well suited to central and eastern parts of South Dakota. These Kubanka wheats were obtained from the Russian government several years ago.

Arnautaka includes Aranautka 28.Sc, 1494, and 1537. These types have proved valuable for the eastern part of South Dakota. They mature somewhat later than Kubanka.

Wild goose is a common durum wheat of the United States. It has been grown in the eastern part of this country and Canada for a good many years, but does not seem to be as productive in this state as the Kubankas or Arnautkas.

WHEAT DISEASES.

Loose Smut.

"This fungus belongs to the same genus as the smut so commonly found on maize. The spores adhering to the grains, germinate and enter the young wheat plant through the sheath of the first leaf. The fungus grows within the wheat plant without external manifestations until the plant is about to flower, when the whole spike, except the rachis, is reduced to a mass of blackish smut spores. The loss from loose smut is rarely large although as high as 8 per cent has been reported."

Stinking Smut.

Stinking smut is closely allied to loose smut in form and habits, although differing from it in the character and extent of its injury. It affects only the grains which are considerably enlarged, the contents being indicated by a blackish, offensive smelling mass of spores which, when they find their way into the flower, make it unfit for use. The glumes being unaffected, the disease often escapes observation until after the grain is thrashed. Loss from this smut is very general, and often very heavy, amounting in some instances to at least 40 per cent, which practically speaking, ruins the crop.

TREATMENT.

The formalin treatment is the most satisfactory method of combating smut in wheat. The following scheme has been devised by the South Dakota Experiment Station.

Apparatus.

A barrel, several gunny sacks, and a supply of formalin.

Mixture.

Use one pint formalin to 25 gallons water.

Treatment.

Dip the gunny sacks, in which the wheat was placed, into the barrel containing the mixture of formalin and water. Be sure that all the wheat is submerged, allowing it to remain in the mixture 10 to 15 minutes, after which it can be removed and planted at once. If the grain is permitted to drain a few minutes upon removal from the water, 25 gallons will treat about 20 bushels.

Cost.

Formalin can be obtained of your druggist at about 40 to 60 cents per pint. Two men can treat enough seed in one day to sow 40 acres.

LIST OF AVAILABLE BULLETINS

89. Preliminary Experiments with Vapor Treatments for the Prevention of Stinking Smut in Wheat.
90. Tankage and other By-Products for Pigs; Shrunken Wheat for Swine.
91. Co-operative Vegetable Tests in 1904; Peas, Beans, Sweet Corn. Cabbage.
92. The Milling Qualities of Macaroni Wheat.
94. Alfalfa and Red Clover.
95. The Treatment of Nail Pricks of Horse's Foot.
96. Forage Plants and Cereals at Highmore Sub-Station.
97. Speltz and Millet for the Production of Baby Beef.
98. Crop Rotation.
99. Macaroni and Durum Wheats. A continuation of Bulletin 92.
100. The Value of Speltz for the Production of Beef and Pork.
101. Forage Plants at the Highmore Sub-Station, 1906.
102. Evergreens for South Dakota.
103. Breeding Hardy Strawberries.
104. Breeding Hardy Raspberries.
105. Stock Food for Pigs.
106. Sugar Beets in South Dakota.
107. Sheep Scab.
108. New Hybrid Fruits.
109. Rusts of Cereals and other Plants.
110. Progress in Variety Tests of Oats.

111. A Study of South Dakota Butter with Suggestions for Improvements.
112. The Killing of Mustard and other Noxious Weeds in Grain Fields by the use of Iron Sulphate.
113. Progress in Variety Tests of Barley.
114. Digestion Coefficients of Grains and Fodders for South Dakota.
115. Report of Work for 1907 and 1908 at Highmore Sub-Station.
116. Acidity of Creamery Butter and its Relation to Quality.
117. Sugar Beets in South Dakota.
118. Corn.
120. Progress in Variety Tests of Alfalfa.
121. Sugar Beets in South Dakota.
122. Creamery Butter.
123. Milk Powder Starters in Creameries.
124. Progress of Grain Investigations.
125. Fattening Steers of Different Ages.
126. Alkali Soils.
127. Breeding and Feeding Sheep.