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TWO NEW VARIETIES OF WHEAT.

"Minn. No. 163" and "Minn. No. 169."

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In 1888 the Minnesota Experiment Station began collecting the varieties of wheat offered for sale by the leading seed houses and seed wheat growers in the United States and in foreign countries. The several hundred kinds which gave promise of being useful in this climate were tested. To our surprise no variety of spring bread wheat was found which yielded better than Red Fife and Blue Stem. These are varieties almost universally grown in the state. Some sub-varieties of each of these two classes of wheats were found to yield better than others, notably Wellman's Fife and Haynes' Blue Stem. These sub-varieties were from stocks selected from best spikes

by Captain D. L. Wellman of Frazee City and Mr. L. H. Haynes of Fargo, North Dakota. Even better than either of these was Bolton's Blue Stem secured later from Thos. Bolton, Park River, North Dakota. Blue Stem was found to yield more value per acre to the farmers and to the mills than Fife and the farmers were urged to grow Blue Stem, especially in the southern two-thirds of the state. In some cases, as on some large farms, Fife wheat was preferred because it would stand longer after ripe before serious loss by shelling occurred. Time has proved this advice sound and Blue Stem now covers most of Minnesota's wheat acreage.

When it was found that the seed wheat markets of the world did not afford a better variety of bread spring wheat, for our soils and climate than those which were producing an average yield of only thirteen to fifteen bushels per acre for state averages of ten years, wheat breeding was resorted to, that the best available wheats might be improved and that others might be originated. Red Fife and Blue Stem wheats, also other varieties which approached these in value per acre, were used as foundation breeding stocks. Breeding by selection, also by hybridizing followed by selection, was practiced, and new methods of nursery breeding were devised. Thousands of new varieties have been produced, two of which have been widely distributed and are being grown on hundreds of thousands of acres, adding ten to twenty per cent to the value of the farmers' crops over what the parent varieties produce. Numerous other new, selected and hybrid varieties promise to make still larger gains in value per acre.

This work of breeding has proven so profitable to the state, and promises so much, that its scope is being extended. The plans in operation and the results secured have so met the approval of the United States Department of Argiculture and the state experiment stations of the four states adjoining Minnesota, viz: North Dakota, South Dakota, Iowa and Wisconsin, that the five stations in these states and the Bureau of Plant Industry at Washington, have entered into extensive co-operation in the breeding of wheat and other field crops.

The area to be permanently devoted to wheat in these states will be determined by the relative value per acre to the farmer of this crop as compared with the value per acre of other crops produced for sale or to be fed to live stock. The areas yet unbroken are being rapidly brought under the plow and the maximum acreage of prairie land under cultivation will soon have been reached. The production of live stock is increasing and with larger areas devoted to grass the acreage devoted to wheat is being reduced in many counties in Minnesota. Whether the grand total number of bushels of wheat

raised in the Northwest shall decline, which is not expected, or be increased depends largely upon its yield of value per acre. The average yield the farmer produces and the price per bushel he secures will combine to determine how much of the farm lands of the great Northwest shall be devoted to wheat raising. We are in competition with countries in which the average yield per acre is ten to thirty bushels. Our live stock, dairy and other farm enterprises are becoming more profitable, increasing the value produced from the average farm acre. To permanently hold its place in this section of the great world's farm, our hard spring wheats should yield an average of more than twenty bushels per acre (over one-third more than now), worth as money standards now are fifteen dollars per acre. The Minnesota Experiment Station has clearly shown that this can be done. Two of our best new spring wheats have averaged at University Farm for the past eight years 27.4 bushels and 28.4 bushels per acre. These are averages from twentieth acre plots under ordinary soil conditions, equivalent to twenty-five bushels in large fields. This is ten bushels more than is secured by the average farmer of the state, and the soil is by nature only average and not more highly fertilized with barn manures and clover than the average farm field can be enriched under a reasonable plan of farm management with the crops in rotation. Breeding and proper field management have brought this larger result.

The Experiment Station and Agricultural College are rapidly solving the problems of how to rotate the crops to get better crop yields and to make the whole farm more profitable. As part of the land used by the Experiment Station is rented and all of it is no better cleaned of weeds than the average farm can be easily kept by rotation and reasonably good cultivation for best profits, this wheat has been grown under normal conditions with one exception, viz., the small plots allow the wheat to feed in the border alleys. Ten per cent reduction as above made in the average yield more than makes up for this advantage. It is conservative to say that Minnesota should permanently devote 4,000,000 to 5,000,000 acres to wheat, and at twenty bushels per acre produce a total of 80,000,000 to 100,000,000 bushels. Eventually the average yield per acre should be pushed to a still higher point.

Since low average yield per acre is the worst fault of Minnesota's wheat crop, the problem of first importance is securing varieties which have bred into them the ability to yield more heavily per acre of good grain under Minnesota conditions. Of nearly equal importance is the re-organization of each of our farms which raises wheat so that this crop will come in that place in the rotation supported by live stock which will fur-

nish the proper conditions for a maximum crop. In fact, this may prove of first importance. On the best crop rotations at University Farm our wheat crops with our best old varieties average, for a series of years, 24.5 bushels per acre on fields of one-half acre in size. The re-organization of farms so that the crops will be rotated in the light of the best information obtainable from experiment stations has been found thoroughly practicable. Farm management is being reduced to an engineering basis and in the agricultural college the pedagogies of the subject are being rapidly wrought out. How best to have the fields prepared for wheat and for each other crop by having it follow the crop which prepared the soil for this crop is being worked out by means of actual rotation experiments with field plots at the several experiment farms. Of very great importance, also, is the quality of our bread wheats, that our conquest of the world's best flour markets may be permanent. Without an outlet for our surplus wheat and flour at superior prices, we cannot raise wheat, because we cannot keep up the selling price per bushel and per acre in competition with the other crops the farmer can raise. The reputation of patent flour from hard spring wheats is a valuable asset to the Northwest, and farmers, millers, dealers and experimenters should guard it zealously.

The enemies of wheat present problems of a magnitude annually measured by millions of dollars. The successful control of chinch bugs and Hessian flies would repay any reasonable cost of experimentation. Rust, however, is wheat's greatest enemy. It is to wheat what the white plague, consumption, is to man, the unobtrusive enemy of health and growth. The thread-like mycelium originating from spores penetrating the tissues of the young plantlet and producing more spores on leaves and stems, saps tens of millions of dollars annually from the profits of our farms and mills. Our best yielding varieties of wheat are superior in yield to other wheats, in part because they are more rust resistant. Under our climatic conditions no remedy is known except breeding for rust resistance. Evidence is accumulating that by very extensive search for immune plants, especially among hybrids, varieties are being produced with a higher degree of immunity to this disease.

The methods of breeding wheat have been reduced to practical plans, comparable to modern systems of manufacturing. After securing the best foundation varieties, a large number of seeds, say 10,000, are selected, preferably from the best heads chosen from the field of a given variety. These seeds are planted in nursery beds, one seed in a hill, four inches apart each way. This gives to each plant the same area of land and the same opportunities as to each other plant. When ripe all

the smaller plants are removed, leaving about 500 of those which appear to be the best yielders. The several heads of each of these are placed in a separate packet. In the seed breeding laboratory in the winter all the heads from each plant are weighed and all plants are discarded but about one hundred of those yielding heaviest. Each of these is shelled and the net weight of the grain secured, and the grades of the grain are determined by inspection. About fifty of the best plants, combining superior yield and grade, are chosen for mother plants. The second year one hundred seeds are planted in a nursery bed, four by four inches apart from each of these fifty mother plants. When the plots are ripe they are harvested and the exact number of plants in each plot reaching maturity is determined. The weight of the grain is divided by the number of plants and the average yield of the progeny of each of the fifty mother plants is thus secured. One hundred seeds of each of these fifty new nursery varieties are planted the second and third years and at the end of the third year all are discarded, except the five to ten of these nursery stocks or varieties which average the strongest in value per plant for the three years. These five new varieties are grown for a year in larger plots to get sufficient seed to plant them in field test plots. During the three following years they are grown in plots one by eight rods in area under field conditions beside all the best varieties, and their average yields, milling and baking qualities are compared with the standard wheats. If either of the five new wheats proves more valuable per acre than the wheats which before have been in the lead, it is rapidly increased for distribution. In the meantime the Minnesota sub-stations, and the experiment stations in adjoining states, test it as a part of the co-operative work of the several stations. The area to which a new wheat is adapted is thus pretty well determined and after increasing the amount to a few thousand bushels, it is sold to several hundred seed wheat growers, that they may grow and sell it in large quantities. These seed growers are chosen by the officers of the Experiment Station and the U. S. Department of Agriculture, as seed co-operators, and are given certificates as to the genuineness of the variety of seeds sold them.

MINN. NO. 163 WHEAT.

Two new varieties, the mother plants of which were grown in 1892, have been distributed by the Minnesota and North Dakota stations, which earliest began the plan of co-operation. These varieties are named by giving to each a number following the name of the state. Minnesota No. 163 wheat, ordinarily

written, "Minn. No. 163," was thus distributed in 1899 and no doubt was planted on 100,000 to 200,000 acres in 1903. The following tables of yields, comparing Minn. No. 163 wheat with other wheat, show that it is superior in yield to the common varieties grown at University Farm and on the farms of the best wheat growers chosen by the Experiment Station as its co-operators:

TABLE I. Minn. No. 163 Compared With Haynes' Blue Stem. Eight Trials at University Farm.

	'95	'96	'97	'98	'99	'00	'01	'02	Ave.
Minn. No. 163...	42.7	23 0	19.9	25.0	30.8	34.3	24.3	24.3	28.4
Haynes' B. S.	21.6	24.6	20.4	23.3	25.9	30.5	17.6	21.7	28.2

Difference in favor of Minn. No. 163, 5.2. Gain 23%.

TABLE II. Minn. No. 163 Compared With Common Wheat by 38 Farmers Throughout the State in 1899.

No. of Farmers Reporting.	Kind of Wheat Compared.	Gain.	Ave. Yields.	Gain.
Ave. yield throughout the state—38 trials	Fife, B S., etc.		16.7	
	Minn. No. 163	1.4	18.1	8%
Ave. yield throughout the state—6 trials	Fife		15.1	
	Minn. No. 163	4.4	19.5	
Ave. yield throughout the state—29 trials	Blue Stem		17 2	
	Minn. No. 163	.9	18.1	
Ave. yield north part of state—12 trials	B. S and Fife		15.0	
	Minn. No. 163	2.4	17.5	14.6%
Ave. yield south part of state—26 trials	Fife and B. S		17.5	
	Minn. No. 163	.9	18.4	5%

Milling and baking tests, made with the assistance of Mr. C. E. Foster of the Consolidated Milling Company, Minneapolis, showed that this wheat was equal for milling and baking to its parent variety, the hard Red Fife. Recent tests made by Prof. Harry Snyder of this Experiment Station also show this to be a good milling variety. This wheat continues to give excellent satisfaction, especially in the northern part of the state, in both yield and quality. Those who wish to grow spring wheat and cannot secure Minnesota No. 169 wheat will make no mistake in securing Minnesota No. 163, especially in northern districts. Those who have wheat of this variety suitable for seed should advertise it widely in Northern Minnesota and ask a price sufficient to pay for advertising, extra expenses of cleaning, grading, freights and profits beside. Some growers of Minn. No. 163 wheat have reported added profits of hundreds of dollars from growing this wheat for seed.

MINN. NO. 169 WHEAT.

Minnesota No. 169 wheat was distributed by the Minnesota Experiment Station in 1902, ten years after it was started from a single seed of blue stem wheat. It had been increased at University Farm to 1,500 bushels. This was offered in lots of four bushels at $1.50 per bushel, by private letter, to 1,300 recommended farmers distributed in the various counties of the state, 375 purchased it. At the end of the threshing season, in answer to a letter of inquiry, most of these co-operators reported their yields to the Experiment Station and sent samples of the crop. These reports were carefully assorted and it was found that 89 of these farmers had reported this wheat sown at the same time, on the same kind of soil, and in the same manner as the wheat commonly grown by them. The tables below, giving the yields of this wheat at University Farm and on the farms of these 89 co-operators, show the records of yield on which the claims of this wheat are based:

TABLE III. Minnesota No. 169 Wheat Compared With its Parent Variety Through 8 Trials at University Farm.

Year	'95	'96	'97	'98	'99	'00	'01	'02	Ave.
Minn. No. 169	37.8	25 0	24.3	26.3	28 8	30.9	22.9	23.4	27.4
Minn. No. 51	21.6	24.6	20.4	23.3	25.9	30.5	17.6	21.7	23.2

Difference in favor of Minn. No. 169, 4.2. Gain, 18%.

TABLE IV. Minn. No. 169 Compared With Common Wheat. Average of Trials by 89 Farmers Throughout the State in 1902.

Average yield of Minn. No. 169	21.5 bu.
Average yield of Common Wheat	18.2 "

Difference in favor of Minn. No. 169, 3.3. Gain, 18%.

This variety was also tested as to its flour and bread making qualities with the assistance of Mr. C. E. Foster, at the same time as Minnesota No.163 was tested. Recent tests made by Prof. Harry Snyder, also show this to be a very good quality of Blue Stem Wheat. It was found to have as good milling and baking qualities as its parent, a hard Blue Stem Wheat.

Many of our co-operators sold seed of Minnesota No. 169 wheat in 1903, and there was probably upward of 150,000 bushels grown and is already in demand for seed in carload lots. Every bushel in which there are "king head" or "wild oat" weed seeds, which cannot well be cleaned out, and which can be graded so as to be No. 2 Northern or better, should be sown in 1904. It is yielding over two dollars per acre above the

wheats it is displacing. Seed is certainly worth as much more than common wheat as it will add to the value of the first crop. Men who paid six dollars for four bushels in 1902, or three dollars more than the price of common wheat, more than got their money back in increased yields the first year.

It is known that there is now available for seed in the state between 50,000 and 100,000 bushels of this wheat, much of which is offered for sale by the station's official co-operators, including the general seed firms of Minnesota, and by second growers to whom co-operators sold seed in the spring of 1903.

Good prices for seeds of a new variety furnish the necessary means to bring about its rapid and general use. Farmers who pay a good price for valuable new varieties originated by the Experiment Station and the U. S. Department of Agriculture, at once co-operate with these state and national agencies and receive varieties which give them larger profits. The U. S. Government and the State Government will co-operate with the farmers in proportion as they show their appreciation of substantial services rendered.

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SEED WHEAT GROWERS SHOULD USE FORMALDEHYDE.

All varieties of wheat are subject to smut, and all seed should be treated with formaldehyde, or, as it is sometimes called, formaline. Make a solution of one pound of formaldehyde in forty gallons of water and sprinkle enough on the wheat to moisten it. Shovel over until dried, or sow after a few hours, opening the seeder to sow several quarts more per acre of the swollen seed. The cost of the medicine and labor is so slight, only about three cents per acre, that whoever sends smutty wheat to market is advertising that he is a negligent farmer. All who aspire to be seed growers, and especially official seed co-operators for the State Experiment Station, should clean their seed every year with this effective remedy. Even where the seed is not known to be affected, this remedy should be applied if the crop is designed to be sold for seed.

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