AGRICULTURAL EXPERIMENT STATION
BULLETIN 137

MINNESOTA WHEAT INVESTIGATIONS

SERIES II

MARQUIS WHEAT

I. HISTORY AND CULTURE

BY
A. C. ARNY
ASSISTANT AGRICULTURIST, DIVISION OF AGRONOMY AND FARM MANAGEMENT

II. MILLING QUALITY

BY
C. H. BAILEY
CEREAL TECHNOLOGIST, DIVISION OF AGRICULTURAL CHEMISTRY

UNIVERSITY FARM, ST. PAUL
FEBRUARY 1914

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*On leave, 1913-1914.

LETTER OF TRANSMITTAL

January 8, 1914

A. F. WOODS, Director,
University Farm,
St. Paul.

Dear Sir: Herewith we transmit a manuscript entitled Marquis Wheat. This manuscript is divided into two parts:

(1) History and Culture of Marquis Wheat, prepared by A. C. Arny, Assistant Agriculturist, Division of Agronomy and Farm Management.

(2) The Milling Quality of Marquis Wheat, prepared by C. H. Bailey, Cereal Technologist, Division of Agricultural Chemistry.

There has been wide inquiry as to the value of this variety of wheat in Minnesota. It was introduced two years ago from Canada and has been grown to some extent by the farmers of the State with satisfactory results. This report gives the results of cultural tests at University Farm, St. Paul, and at the Northwest Experiment Farm, Crookston, Minnesota. It gives also milling tests made in the Cereal Laboratory at University Farm.

While the manuscript contains reports covering only the tests of two years, the widespread demand for this variety of wheat seems to warrant its publication at this time as a Station bulletin.

Respectfully submitted,

ANDREW BOSS,
Chief of Division of Agronomy and Farm Management

R. W. THATCHER,
Chief of Division of Agricultural Chemistry

I. HISTORY AND CULTURE OF MARQUIS WHEAT

By A. C. Arny, Assistant Agronomist

HISTORY

Marquis wheat was developed at the Central Experimental Farm, Ottawa, Canada. It is the result of a cross between Red Fife and Hard Red Calcutta made by Dr. A. P. Saunders in 1892. From the mixture of related types, several were selected on high gluten content by Dr. C. E. Saunders in 1903. One of these selected types was afterwards named Marquis. It was first grown separately in 1904. In 1907 a baking test was made and flour from the Marquis wheat was found high in bread-making strength and good in color. It was then sent for field trial to Saskatchewan, where it proved very satisfactory. Following the harvest of 1908, Marquis was distributed regularly from the Central Experimental Farm, Ottawa, Canada.

DESCRIPTION

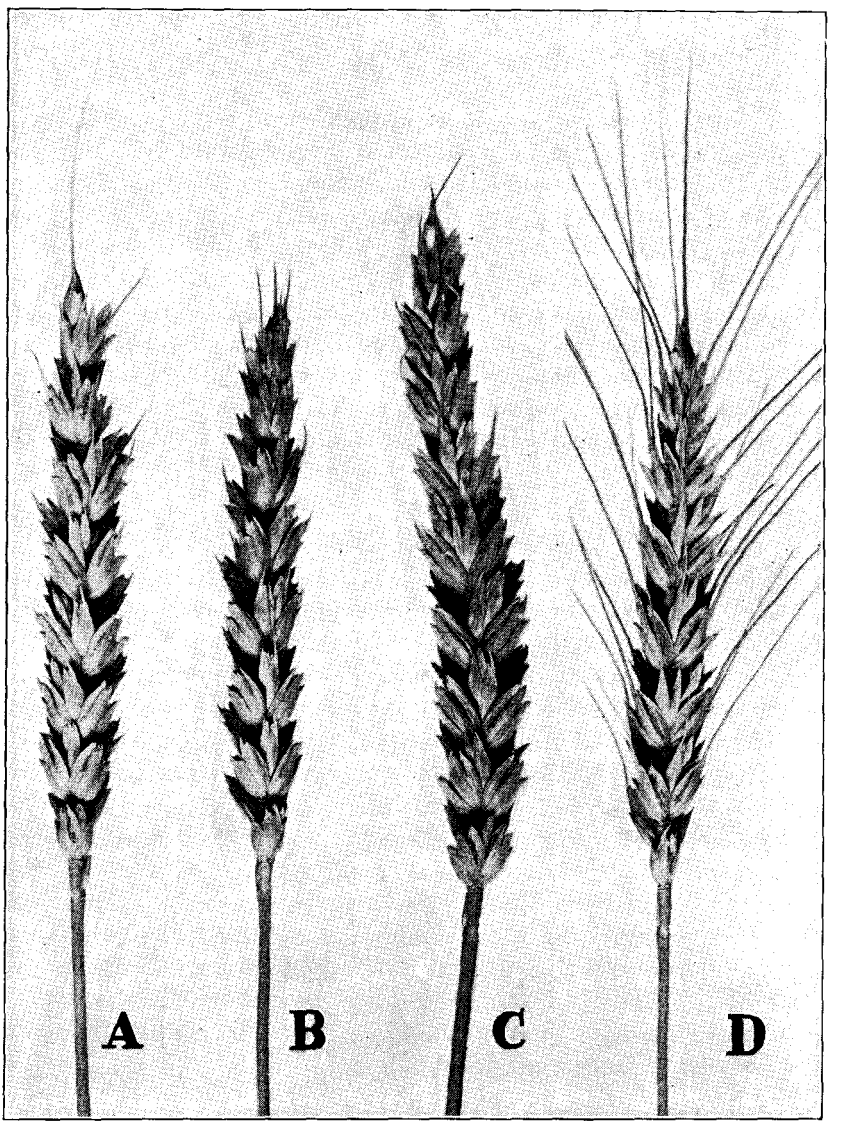
PLANT CHARACTERISTICS

The straw of Marquis wheat is stiff and usually below medium height. The spikes are medium in length, somewhat pointed, and usually beardless except for a few short awns near the tip. The chaff is smooth and usually yellowish in color. Bearded spikes and spikes with red chaff still appear in Marquis wheat on account of its hybrid origin and the fact that it has not yet been reduced to a pure type. The kernel is held firmly at maturity, thus reducing shattering to the minimum. Minnesota No. 169 and Minnesota No. 163 are similar to Marquis in this respect. Velvet chaff shatters more easily at maturity. Marquis wheat matures from five to seven days earlier than Minnesota No. 169 and two or three days earlier than Minnesota No. 163 and velvet chaff. An early-maturing wheat has the advantage over a later-maturing variety of equal productive power and milling quality, in that it more often escapes attacks of rust, and in northern latitudes escapes damaging frosts that come before the later varieties of wheat are mature.

KERNEL CHARACTERISTICS

Kernels of Marquis wheat are medium in size, short, broad, usually plump, and have the trough-shaped crease characteristic of

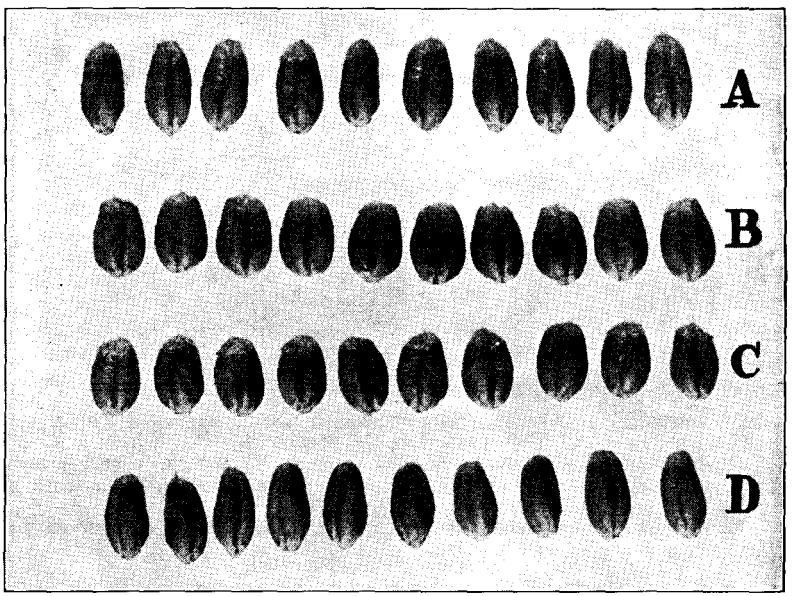
fife wheats. In color, the kernels are a medium to dark red. The texture of the kernels varies with the season and the soil on which the wheat is grown. The weight per measured bushel is usually over sixty pounds.



Spike of Marquis Wheat Compared with those of Minnesota Standard Varieties (Natural size)
A Minnesota No. 163, or Glyndon Fife; B Marquis; C Minnesota No. 169, or Haynes' Bluestem; D Velvet Chaff.

RESULTS OF TESTS

Marquis wheat has not been grown in Minnesota long enough to give it as thorough a test from the production standpoint as is desirable. It has been tested and compared with other wheats for one year at University Farm and two years at the Crookston Substation. In these trials the Marquis has not shown itself distinctly superior in yield. In the Crookston trial it averaged less than Minnesota No. 169 and practically the same as velvet chaff. In the 1913 trial at Crookston, the yields of Minnesota No. 163 and Marquis were practically the same. At University Farm in the one-year trial on duplicate plots, Marquis excelled Minnesota No. 163 and Minnesota No. 169 and nearly equaled velvet chaff in yield.



Kernels of Marquis Wheat Compared with those of Minnesota Standard Varieties (Twice natural size)
A Minnesota No. 169, or Haynes' Bluestem; B Marquis; C Minnesota No. 163, or Glyndon Fife; D Velvet Chaff.

From the trials at University Farm and at Crookston and from reports from a number of farmers who grew the Marquis wheat in comparison with common wheat in 1912 and 1913 in different sections of the State, it is evident that Marquis wheat should be sown largely on the heavier, more productive soils. On the lighter soils, usually more subject to drought, better results may be expected from the use of bluestem.

It is always advisable to test any new variety on a small scale at first, comparing it with varieties of known productive power under local conditions. If it gives satisfactory results, the acreage devoted to it may be gradually increased.

MARQUIS COMPARED WITH STANDARD MINNESOTA WHEATS AND COMMERCIAL VELVET CHAFF

Variety	Days to Mature		Height		Yield Per Acre		Wt. per bu.
	1912	1913	1912	1913	1912	1913	1913
University Farm			In.	In.	Bu.	Bu.	Lbs.
Bluestem, Minnesota No. 169		111		35		31.62	57.0
Glyndon Fife, Minnesota No. 163		110		36		34.2	59.5
Velvet chaff* ..		110		33		37.12	61.0
Marquis		107		35		36.37	59.5
Crookston†							
Bluestem, Minnesota No. 169	114	104	39	44	29.12	20.44	60
Glyndon Fife, Minnesota No. 163		103		38		20.26	61½
Velvet chaff* ..	113	103	37	42	26.66	21.28	63½
Marquis	108	100	32	34	27.79	20.17	61½

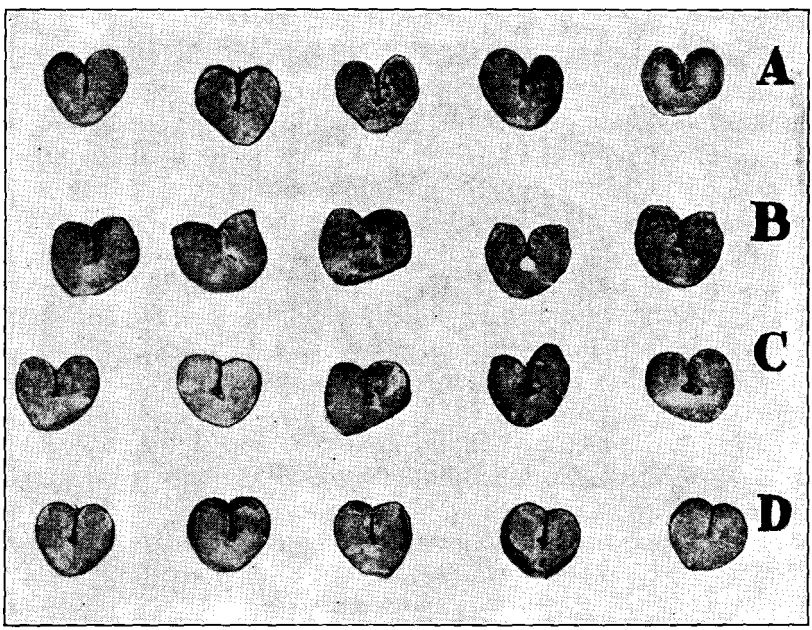
*Velvet chaff, as used throughout this bulletin, applies to a group of bearded spring wheats. This group should not be confused with the so-called velvet chaff wheats which have pubescent glumes. The figures here presented in connection with velvet chaff are composite figures secured from work with several varieties of this group.

† Data from the Crookston Substation furnished by Superintendent C. G. Selvig.

II. THE MILLING QUALITY OF MARQUIS WHEAT

By C. H. BAILEY, Cereal Technologist

The intrinsic value of wheat is dependent in large part upon its milling and baking qualities. The market grading of this cereal is based as closely as possible upon its value for these purposes. Consequently those wheats which most closely approach the ideal of the miller and the baker command the highest prices when marketed. In order to sustain the high reputation which northwestern spring wheats have attained in the markets of the world, no variety of wheat



Cross Sections of Wheat Kernels—Marquis Compared with Minnesota Standard Varieties (Three times natural size)
A Minnesota No. 169, or Haynes' Bluestem; B Marquis; C Minnesota No. 163, or Glyndon Fife; D Velvet Chaff.

should be widely disseminated or grown which does not compare favorably with the best varieties commonly grown in this section.

The measure of quality in wheat is not the simple matter that it may appear to be on first thought. There are a number of factors which must be considered, most of which are independent of the

others. Those which are of the greatest importance may be briefly summarized as follows:

(1) Relative plumpness of the kernels, which influences the yield or percentage of flour which can be produced from the grain.

(2) Density of the kernels, which also affects the yield of flour, since, other things being equal, a larger proportion of the endosperm or "floury" portion of the kernel can be separated as flour when it is hard or vitreous in texture rather than soft or "starchy."

(3) Moisture content of the grain, which affects its keeping qualities, ease of milling, and losses which occur through evaporation during the process of milling.

(4) Soundness of the grain, as indicating its freedom from fermentative changes.

(5) Baking strength of the flour, or its ability to produce a large, well-raised loaf of bread. The relative strength of flour is influenced by at least two groups of factors: (a) The percentage and physical properties of the two principal proteins of wheat flour, known collectively as "gluten," and (b) the quantity and nature of the yeast food originally present in the flour and formed during the process of fermentation.

(6) Absorption, or percentage of water necessary to make a dough of proper consistency from the flour, in bread-making, since the more water that can be employed per unit of flour, the greater the weight of bread which can be produced from it.

(7) The color of the flour, the demand being for a very white product.

While other factors doubtless have some bearing upon the question of quality, those mentioned are the most important and the greatest stress should be laid upon them. It is evident, however, that certain of them will not be affected to any appreciable extent by varietal characteristics. For example, the moisture content and the soundness of the grain will be controlled almost entirely by the method of curing and handling the grain after it is harvested. In the study of a new variety, therefore, particular attention should be paid to the plumpness and hardness of the kernels as influencing the flour yield; and to the gluten content and general baking qualities, including the strength, absorption, and color of the flour produced.

INFLUENCE OF ENVIRONMENT UPON QUALITY

In addition to its varietal characteristics, the quality of any wheat will be influenced greatly by the soil and climatic conditions under which it is grown. Thus the protein content and baking strength will almost invariably be lower when the wheat is grown in a moist soil than when it is produced under arid conditions. On the other hand,

unfavorable conditions, such as drought, rust, and hot winds, will result in more or less shriveled grain, giving lower flour yields when milled.

Since environmental conditions produce such marked effects upon the composition of wheat, it was necessary to obtain samples of both Marquis wheat and the older and better-known varieties such as fife and bluestem produced in the same localities, for the purposes of comparison. In a number of instances samples of two or more varieties which were produced on the same farm were tested. This gives results of greater value than would the promiscuous collection of samples, the conclusions in the latter instance being of little value unless a great number of samples are secured and tested.

In this study of Marquis wheat two-kilo samples (about four and four-tenths pounds), previously cleaned, scoured, and tempered, were milled into flour in the small experimental mill. The methods employed in experimental milling, as well as in making the other tests and analyses, are described in Minnesota Agricultural Experiment Station Bulletin 131. It is evident from the results that so far as yield of flour is concerned the Marquis samples rank high. This is undoubtedly due to the fact that the kernels were in most instances plump and hard. The different climatic and other conditions under which the samples were produced caused some variations in this regard, but in general the samples of Marquis wheat gave yields of flour equal or superior to those of the bluestem and other varieties produced under the same conditions.

So far as protein content and baking strength are concerned, the Marquis samples seem to be somewhat superior. In certain instances, however, this rule did not hold true. Such differences as were found may be due in part to variations in the time of maturity. It has been observed that the climatic conditions prevailing during the ten or fifteen days immediately preceding the harvest seem to have the greatest influence upon the percentage of protein in the grain, and consquently of gluten in the flour. If, as is commonly reported, the Marquis wheat matured several days before the fife or bluestem with which it was compared, a higher percentage of protein would be expected if the moisture available to the plants was less during the last ten or fifteen days, whereas if more moisture was available to it than to the later-maturing varieties, a lower percentage of protein would be expected. In general, however, the earlier-maturing varieties of spring wheat contain a slightly higher percentage of protein, since unless conditions are such as to induce an accelerated rate of starch-production by the plant, the interval of time through which the deposit of starch in the kernels takes place is decreased, and conse-

	LAB. No.	SOURCE		VARIETY
		Town	Sender	
1	C 586	Montevideo	Chippewa Milling Co.	"Average bluestem"
2	C 642	Montevideo	Peter Ingvaldson	Velvet chaff
3	C 644	Montevideo	Jos. V. Erickson	Velvet chaff
4	C 587	Montevideo	W. J. Evans	Marquis
5	C 590	Montevideo	Ole Skuttleberg	Marquis
6	C 637	Montevideo	H. P. Peterson	Marquis
7	C 641	Montevideo	W. A. Schulke	Marquis
8	C 645	Montevideo	H. W. Lawrence	Marquis
9	C 651	Montevideo	C. H. Olson	Marquis
10	C 654	Crookston	Substation	Minn. No. 163, fife
11	C 655	Crookston	Substation	Minn. No. 169, bluestem
12	C 656	Crookston	Substation	Velvet chaff
13	C 657	Crookston	Substation	Marquis
14	C 591	Crookston	Joseph Ball	Marquis
15	C 619	St. Paul	University Farm	Minn. No. 163, fife
16	C 620	St. Paul	University Farm	Minn. No. 169, bluestem
17	C 621	St. Paul	University Farm	Velvet chaff
18	C 622	St. Paul	University Farm	Marquis
19	C 635	Detroit	B. L. Wheeler	Fife and bluestem
20	C 634	Detroit	B. L. Wheeler	Marquis
21	C 584	Lester Prairie	Burtman Brothers	Minn. No. 169, bluestem
22	C 585	Lester Prairie	Burtman Brothers	Marquis
23	C 653	Warren	A. D. Vansickle	Minn. No. 163, fife
24	C 652	Warren	A. D. Vansickle	Marquis
25	C 593	Glyndon	O. A. Christenson	Minn. No. 169, bluestem
26	C 592	Glyndon	O. A. Christenson	Marquis
27	C 588	Breckenridge	A. Danicourt	Marquis
28	C 589	Breckenridge	Frank Tehle	Marquis

SPRING WHEAT SAMPLES, CROP OF 1913

TOTAL FLOUR	TESTS OF MIDDLINGS FLOUR				CRUDE PROTEIN IN WHEAT (Nx5.7)	
	Loaf Volume	Water Used	Color Score	Crude Protein (Nx5.7)		
Per ct.	cc.	Per ct.		Per ct.	Per ct.	
73.5	2,550	57.6	97	11.69	12.31	1
69.9	2,550	54.1	99	13.05	13.91	2
70.5	2,580	57.4	99	11.17	12.54	3
73.6	2,560	59.7	99	11.43	13.14	4
72.8	2,490	59.7	97	12.05	13.85	5
71.9	2,520	56.2	99	11.34	12.31	6
70.9	2,540	57.6	98	12.26	13.85	7
71.9	2,550	59.7	98	12.20	13.68	8
68.6	2,590	60.6	97	14.31	15.45	9
73.4	2,530	57.9	100	13.11	13.97	10
71.5	2,500	61.2	99	11.80	12.88	11
69.2	2,620	57.4	100	12.83	13.51	12
73.1	2,580	61.2	100	13.00	13.91	13
75.5	2,510	60.6	98	11.54	12.54	14
71.0	2,520	56.5	100	10.72	11.69	15
69.9	2,530	58.8	100	10.29	11.17	16
68.6	2,620	56.8	102	11.60	12.91	17
70.8	2,580	58.8	100	10.83	12.26	18
66.9	2,510	57.1	98	10.26	11.46	19
68.8	2,530	59.4	99	11.51	11.97	20
72.9	2,520	58.8	99	11.23	11.60	21
73.0	2,600	58.8	100	11.37	12.40	22
72.2	2,570	61.8	102	11.77	12.83	23
72.5	2,640	60.6	104	12.31	13.79	24
70.0	2,600	57.6	99	11.20	12.28	25
72.6	2,580	59.1	99	13.11	14.45	26
68.9	2,540	59.7	97	13.97	15.73	27
69.5	2,600	57.6	97	11.71	12.88	28

quently the protein deposited there largely during the earlier stages of growth is not diluted by starch to so great an extent. This must be made a matter of study through several seasons before it can be stated to be the rule in this particular case, but the results this season indicate that the Marquis variety is at least equal, and possibly superior, to the fife and bluestem varieties so far as milling and baking qualities and gluten content are concerned. This is evidenced by the data given.

The results of the tests of the fife and bluestem and those on the Marquis wheat samples grown in the same localities were averaged, and these averages are given below:

AVERAGES OF THE RESULTS OF TESTS OF THE FIFE AND BLUESTEM SAMPLES, AND OF THE MARQUIS SAMPLES GROWN IN THE SAME LOCALITIES

VARIETY	NO. OF SAMPLES	TOTAL FLOUR	TESTS OF MIDDLINGS FLOUR				CRUDE PROTEIN
			Loaf Volume	Water Used	Color Score	Crude Protein (Nx5.7)	IN WHEAT (Nx5.7)
		Per ct.	cc.	Per ct.		Per ct.	Per ct.
Fife and bluestem	9	71.14	2,537	58.6	99.3	11.34	12.24
Marquis ...	13	72.00	2,559	59.4	99.1	12.08	13.35

SUMMARY

The Marquis wheat samples tested were slightly superior in most respects to the fife and bluestem samples raised under the same conditions. A higher yield of total flour was obtained from the Marquis samples and the high-grade or "middlings flour" contained a higher percentage of protein, absorbed more water in making the dough, and produced loaves of somewhat greater volume. There was comparatively little difference in the color of flour obtained from the two groups of wheat.