

## THE QUALITY PICTURE OF NORTH DAKOTA HARD RED SPRING WHEAT VARIETIES

by  
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Questions arise after the expenditure of a considerable sum of money on investigational work, such as, "What has actually been accomplished by this expenditure over a term of years? Is the present picture substantially different from that of, say, ten years ago? If so, what has caused the change?" Some of the results of hard red spring wheat quality investigations at this Station are summarized in this report with the object of answering these questions. The data cover eight crop years and the samples were grown at Dickinson and Fargo.

Progress in the development of new wheat varieties depends primarily upon the application of the laws governing heredity in plant breeding. To secure improvement in quality, however, the wheat breeder must know the factors which denote or characterize quality in the material with which he works. This knowledge should include data on varieties which are accepted as standard, parent individuals, used in the breeding program, and the new wheats produced by crossing and selection. The breeder must

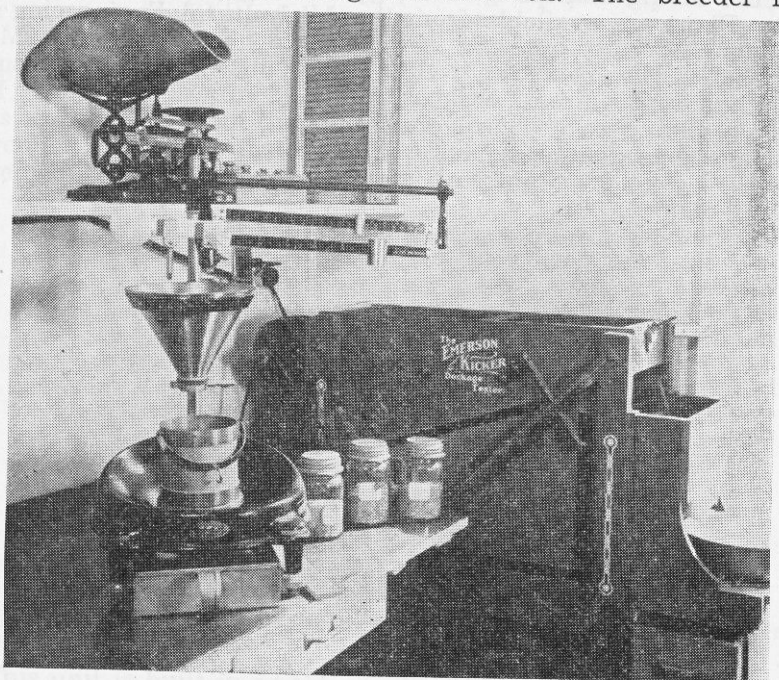


Figure 1. In the foreground is the apparatus used for the determination of test weight. A wheat cleaner is shown in the background.

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Note: No seniority in authorship is implied.

rely upon the cereal technologist and his specialized equipment to obtain data on milling and baking quality.

Probably the quality test most important to the farmer is test weight since this factor largely sets the grade, and therefore the price. It is directly related to flour yield within varieties. Test weight is determined on equipment which is not at all complex, and is pretty well standardized. The latest design of this equipment is used at the Experiment Station at Fargo, and is shown in Fig. 1.

Protein content is another factor of interest to both farmer and miller; high protein wheat is desirable and commands a premium on the market. Protein content is highly related to baking quality. It is ascertained by use of specialized apparatus, and the test is a strictly chemical one. It is known as the Kjeldahl test, in memory of the Danish chemist who developed it. It is one of the most widely used and important determinations employed in cereal chemistry. Fig. 2 illustrates the apparatus employed in the Department of Cereal Technology for this test.

Milling quality is a third significant attribute in the utilization of hard red spring wheat. This term embraces both the ease with which the wheat is milled by standard techniques and the proportion or yield of flour secured from the wheat. Wheats which do not respond to the usual milling system are not regarded favorably by the miller. Easy milling and high flour yield are desirable in a bread wheat.

Flour ash, or the quantity of inorganic material remaining after burning the flour in a suitable laboratory furnace, is another and probably rather minor quality attribute. Ash is to some extent a varietal characteristic of wheat, and those varieties which produce a relatively low ash flour are favored for milling bread flour. The ash determination is relied on by commercial mills to furnish information regarding the efficiency of their milling operation.

The most important test made on a wheat or its flour is the baking test. Technologists have found no test to replace it in evaluating quality. This determination is conducted under strictly controlled conditions. Constant temperature levels are used during the mixing of the dough, while it is fermenting or "rising" and during the baking in the oven. Mixing is done by an electric laboratory mixer, while fermentation cabinets and an electric oven are utilized for fermenting and baking the doughs. The size, or volume, of the baked loaf is measured in a device called a "volumeter," in which the loaf volume can be read in cubic centimeters. The loaf volume is the most important single factor of quality, and wheats which produce large loaves of bread are very desirable.

A good crumb color of the loaf is required, since dark bread is not pleasing to most Americans. The color is judged the morn-

ing after the bread is baked, using a fluorescent light. The crumb texture is also examined at this time; coarse, open textured loaves are undesirable.

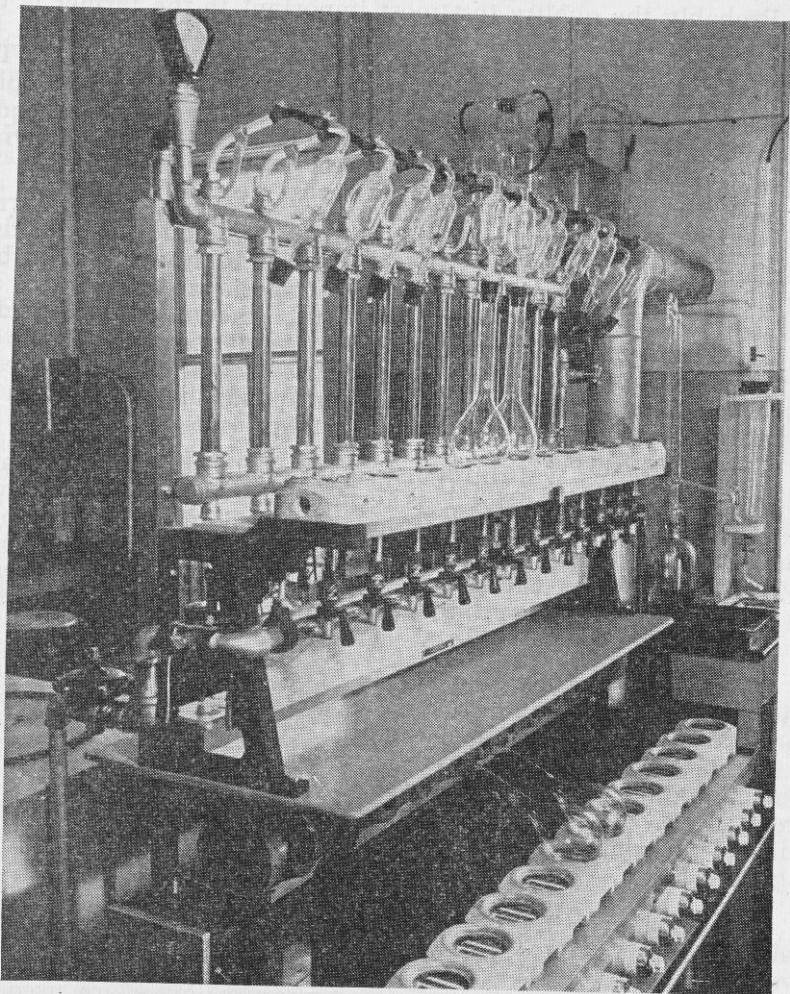


Figure 2. Kjeldahl digestion and distillation unit used in the determination of wheat protein.

The absorption, or proportion of water necessary to form a dough of optimum consistency, is always determined and recorded. The commercial baker prefers high absorption flours since the yield of bread per sack of flour will be greater; and also high absorption flour tends to perform satisfactorily through the production operation.

The program of wheat improvement at the Station requires that new varieties under consideration for release possess distinct superiority in one or more characteristics over varieties already

grown in the state. This means that each wheat must be tested for each quality factor, and the results compared with standard varieties which have found general acceptance, such as Thatcher or Rival.

Moisture content must be known before the wheat can be properly "tempered" by the addition of sufficient water the day before milling to bring the moisture content to 13.5%. One-half hour before milling the moisture content is increased to 15.0%. Wheat cannot be satisfactorily milled as it is received, due to the dryness of the bran, and other factors. It is also necessary to know the moisture content so that all samples milled contain the same quantity of dry matter; then the flour yields of different samples will not be influenced by the original wheat moisture content. Wheat protein content, weight and absorption of flour used for baking, and other quantitative factors, are expressed on a uniform wheat and flour moisture content to increase the precision of the results.

Table 1 shows the data secured from seven varieties of hard red spring wheat which have been released in North Dakota in different years and which were included in this investigation.

**Table 1.—Quality Comparisons Among Seven Hard Red Spring Wheat Varieties Grown at Fargo and Dickinson in 1941 to 1948 inclusive.**

(Five newer varieties arranged in order of decreasing loaf volume)

Variety	Wheat protein	Test weight	Approx. vitreous kernels	Flour yield	Ash	Absorption	Loaf volume	Crumb color score
	%	lbs./bu.	%	%	%	%	cc.	
Marquis	12.5	60.1	88	68.0	0.42	58.7	593	6.8
Ceres	13.2	61.2	89	69.6	0.41	60.1	605	6.8
Cadet	13.7	59.7	92	70.3	0.43	60.9	698	8.2
Rival	13.7	61.2	89	72.9	0.44	60.6	642	7.5
Thatcher	13.5	60.5	93	71.4	0.43	59.7	638	6.9
Mida	13.8	62.4	88	72.7	0.40	59.6	625	8.0
Pilot	13.2	60.4	89	68.5	0.38	59.8	591	7.2
Means of five newer varieties	13.6	60.8	90	71.2	0.42	60.1	639	7.6

Marquis originated in Canada in 1903 and was later introduced in North Dakota. Ceres was first distributed in 1926. This variety as shown later tended to increase the wheat protein content, test weight, flour yield and absorption of wheat grown in the state. Thatcher was released by the Minnesota station in 1934 and tended to increase flour yield and loaf volume. In 1939 Rival and Pilot were introduced and these two varieties, especially Rival, eventually replaced Thatcher to a large extent in the eastern section of the state. Mida was distributed in 1944 and showed an increase in wheat protein, test weight, flour yield and crumb color over the other varieties. Cadet was released in 1946

and tended to improve the quality picture with respect to loaf volume and crumb color.

Comparing Marquis and the mean of the five varieties which were recently released, an increase in wheat protein content from 12.5% to 13.6% is evident. Ceres is slightly higher than Marquis (0.7%). This is an important point in the improvement of the wheat quality picture because North Dakota wheats are chiefly utilized for their high protein content, particularly for blending with lower protein wheats. When the housewife was the big consumer of flour, protein content was not as important a factor as it is today, when commercial bakeries produce most of the nation's bread. Little can be done to alter the proportions of the ingredients once machine mixing has commenced, and it is therefore exceedingly important that flours be uniform in quality, particularly in protein content. The increase obtained by a carefully directed breeding program is good insurance that the demand for North Dakota wheats will continue.

For test weight and vitreous kernel content there have been no significant changes. The situation remains the same as when Marquis was generally grown. Flour yield, the percent of flour secured from the wheat, however, has been significantly increased by the later wheats (commencing with Ceres) and especially by Thatcher, Rival and Mida. This enables the manufacturer to produce more flour from a given quantity, say a car lot, of wheat. While the yield of flour has been increased there has been no accompanying rise in flour ash content. As mentioned previously high ash flours are not desired.

In water absorption there is a trend toward a higher level, also beginning with Ceres. This increased absorption is another favorable factor in the present picture; bakers prefer "thirsty" flours.

In loaf volume, or size of loaf, the increase over Marquis is about 7%; little change was brought about in this factor by the release of Ceres. This gain is evidence of increased baking strength in wheats and is another favorable item flowing from the breeding and wheat improvement program.

Finally, we come to crumb color. Here again there has been a very significant improvement (approximately 12%) since the days of Marquis. If Mida and Cadet alone were considered, the improvement would be larger (about 19%). This means that bread of better color can be produced from the newer wheat flours.

Although the quality factors which have been improved may not be *directly* reflected to the grower in dollars and cents with the exception of protein content, it must be realized that North Dakota is noted for the production of high protein, strong quality wheats, and if this picture is allowed to change and inferior quality varieties enter the production field the demand for our wheats may decrease because of competition from other wheat producing

areas. This would soon be reflected in the price received by the grower. This fact is very pertinent at this time when a wheat surplus danger is looming on the horizon. It may also be pointed out that the newer wheats carry stem rust resistance, are higher yielding and have other characteristics superior to Marquis and Ceres which are directly related to cash returns per acre.

This investigation included the cooperation of a number of workers consisting of superintendents in charge of the various stations, plant breeders, agronomists, and student workers.

#### **Acknowledgment**

The authors wish to acknowledge the careful, painstaking work of G. M. Scott, Experimental Miller, who milled these wheats and assisted in other phases of the work.

### **Group Life in Wells County, North Dakota**

Wells County, North Dakota, centrally located in North Dakota, is a typical Northern Great Plains County highly representative of the spring wheat area, both hard red spring wheat and durum wheat being grown. Bulletin 351 "Rural Communities and Organizations—A study of Group Life in Wells County, North Dakota" of the North Dakota Agricultural Experiment Station is a report upon a field study conducted by Glen V. Vergeront, Rural Sociologist of the North Dakota Agricultural Experiment Station, and A. H. Anderson, Social Science Analyst of the Bureau of Agricultural Economics, U. S. Department of Agriculture. The field work was done in July and September, 1947; hence the picture presented is relatively up-to-date.

After listing and describing the many types of rural organizations the authors consider the participation of farm families in group life and each of the following general conclusions:

1. Small Villages Are Becoming Stable Centers of Simple Business Enterprises to Meet Primary Needs of Rural People
2. Open Country Institutions and Social Activities Show a Tendency to Shift to Town or Village Centers
3. The Traditional Informal Cooperation is Increasingly Expressed in Formally Organized Cooperatives and Other Associations
4. Physical Isolation Resulting from Widely Dispersed Farmsteads has Largely Been Counterbalanced Socially Through Modern Communication
5. The Trend to Farm Family Residence in Village or Town (Dual residence or single) Seems to be in Response to Higher Standards of Living Among Farm People
6. Identification with Primary Communities is Strong; It Seems More Important in Social Behavior than the Larger Trade Area or Governmental Unit
7. Economic Status is Not a Significant Factor in Social Groupings
8. Despite Relative Physical Isolation the General Awareness of the Larger World is Self Evident

Copies of Bulletin 351 will be sent free upon application to the Information Service, State College Station, Fargo, North Dakota.