

The Quality of North Dakota's 1971 Hard Red Spring Wheat

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The overall quality of North Dakota's 1971 hard red spring wheat crop is considered to be generally very good. The seeding, growing and harvesting conditions were ideal in North Dakota in 1971 and a bumper crop was produced. The average test weight is 61.3 pounds per bushel which is 2.0 pounds higher than last year or the five-year average. Moisture content of the grain is low with an average of 11.1 per cent reported. Average wheat protein content is 14.0 per cent expressed on an "as is" moisture basis or when expressed on a 14.0 per cent moisture basis it becomes 13.5 per cent which is somewhat lower than last year. However, the quality of the protein is excellent. Vitreous kernel content is 3.0 percentage points higher than last year. Shrunken and broken kernels, damaged kernels, total defects and wheat ash are all lower than last year. Foreign material is the same as last year. Flour yield is higher than last year and is coupled with a relatively low ash content.

Baking characteristics, in general, are very good to excellent. Dough handling properties are very elastic with no "buckiness" of the doughs observed. Loaves of large volume having very good crumb color were produced. Loaf volumes which were a little smaller than last year also tended to produce crumb grain and textures which were slightly open. Mixing time and tolerance, as measured by the Farinograph, are somewhat lower than last year's crop. Very good elastic properties, as indicated by the Extensograph, were obtained. The crop is quite uniform throughout the state and can be classed as being a little mellower than last year.

The USDA estimates the North Dakota hard red spring wheat crop at about 205 million bushels (5.6 million metric tons). This compares with the 1970 crop of 109 million bushels. An estimated average yield of 31 bushels per acre is eight bushels

above a year ago. A preponderance of the crop (96 per cent) should grade U.S. No. 2 Dark Northern Spring or better. The USDA also estimates the total U.S. production of Northern Spring Wheat at about 362 million bushels.

Samples and Methods

During the 1971 harvest, samples were collected and submitted by cooperating elevators from all of the counties producing substantial amounts of hard red spring wheat, with at least two elevators in each county participating. The number of collected samples reflected the anticipated crop production of each county. Elevator operators were requested to collect a sample from each truck load of hard red spring wheat delivered and place the sample in a suitable container. Twice a week, the samples were thoroughly mixed, a three-pound aliquot taken and placed in a moisture proof plastic bag, and sent to the Cereal Chemistry and Technology Department at North Dakota State University, Fargo, for a complete grade and ultimate quality evaluation. These samples were uncleaned and reflected the condition of the grain delivered to the elevator.

Each of the individual wheat samples was tested for test weight, dockage, moisture and protein in the Cereal Chemistry and Technology laboratory. Aliquots were taken and transmitted to the federally licensed Grain Inspection Department located on campus for a complete official grade.

To determine the milling, baking and other quality tests of this year's crop, measured aliquots of each sample were taken and composited for each county in the state.

QUALITY DATA FOR COMPOSITES

Wheat Data

Table 1 lists by county the averages for dockage, grades, and the various grading factors as well as the overall state average. Table 2 is presented to show the "Official" Grades and Grade Requirements for Hard Red Spring wheat produced in the United States.

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Test weight of this year's crop, as shown in Table 1, ranged from 59.0 to 62.5 with an average of 61.3 lbs. per bushel. Average test weight for each county sampled is presented in Fig. 1. Figure 2 is a bar graph showing the test weight distribution of the 1971 crop. This graph shows that about 93 per

cent of the crop would fall within 59.0 and 62.9 pounds per bushel. Average wheat moisture content for the state is 11.1 per cent. Vitreous kernels ranged from 80 to 95 per cent with an average of 90 per cent.

Shrunken and broken kernels averaged 1.7

Fig. 1. Average hard red spring wheat protein content and test weight for each county in North Dakota.

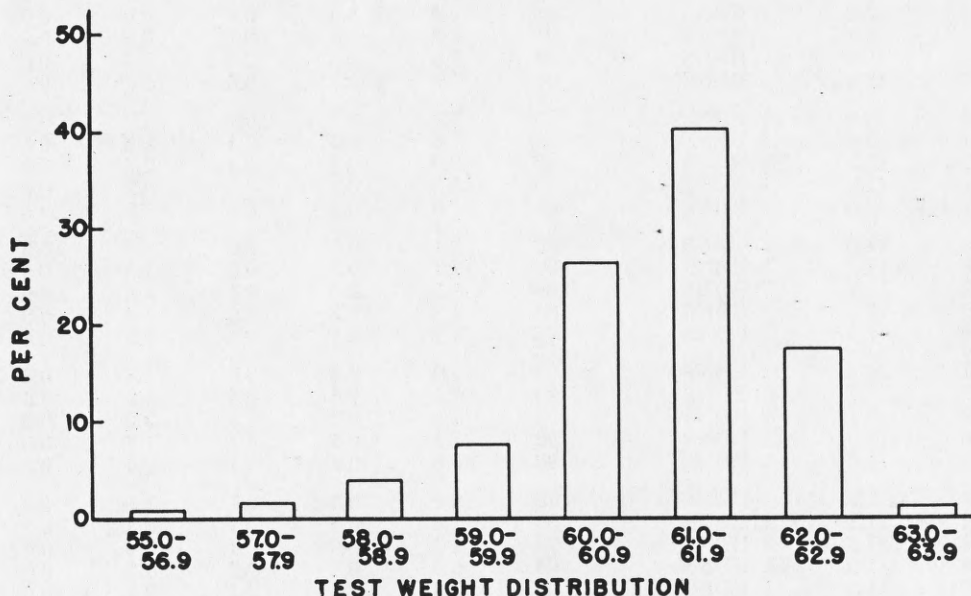
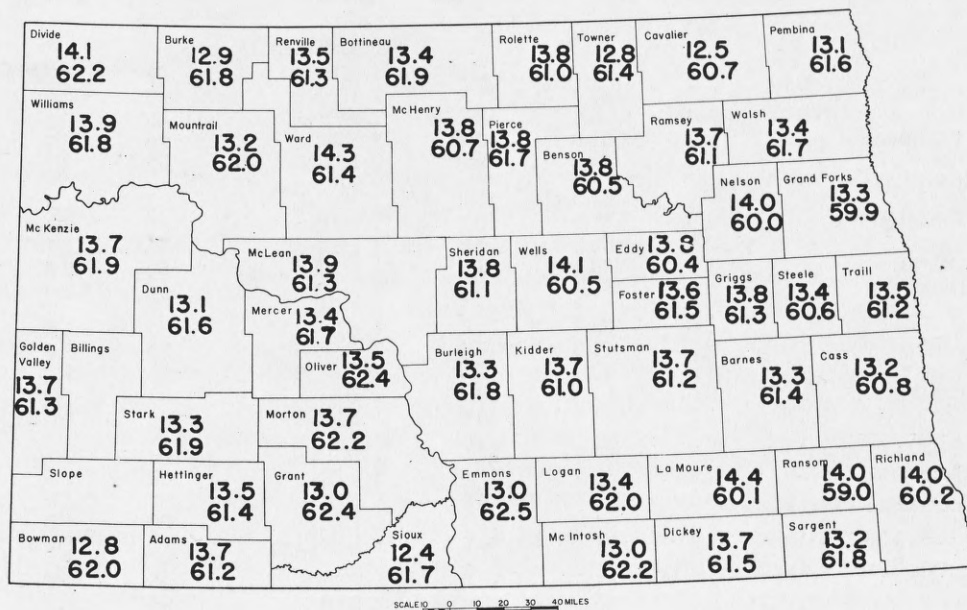


Fig. 2. Test weight distribution of the 1971 North Dakota hard red spring wheat crop.

per cent, well below the allowable limit for the two top grades. Foreign material (FM) is quite low, showing an average of 0.4 per cent with a range of 0.2 to 0.8 per cent. Damaged kernels are also low, ranging from zero per cent to 2.9 per cent with an

average of 0.2 per cent. Total defects, which is the sum of shrunken and broken kernels, foreign material and damaged kernels, including heat damaged kernels are, with the exception of two samples, within the limits listed for the two top

grades. None of the samples is in excess of 4.8 per cent and the average is considerably less. Contrasting classes in this year's crop are negligible. The

grades of the composites ranged from U.S. No. 2 Dark Northern Spring to U.S. No. 1 Heavy Dark Northern Spring.

Table 1. HRS Wheat Survey — 1971 Crop: Grading Information (County Averages).

Counties	Dockage %	Test Weight lbs/bu	Moisture %	Grade	Vitreous Kernels %	Shrunken and Broken %	F.M. %	Damage %	Total Defects %	Contrast- ing Classes %
Adams	1.8	61.2	9.7	1 HDNS	95	1.8	0.3	0.0	2.1	0.0
Barnes	1.2	61.4	11.2	2 HDNS	90	2.0	0.6	0.1	2.7	0.0
Benson	1.4	60.5	12.2	1 HDNS	85	0.6	0.5	0.3	1.4	0.0
Bottineau	0.9	61.9	11.5	1 HDNS	95	1.7	0.4	0.2	2.3	0.0
Bowman	2.3	62.0	9.8	2 HDNS	95	2.7	0.4	0.1	3.2	0.0
Burke	0.4	61.8	11.3	1 HDNS	90	1.6	0.3	0.2	2.1	0.0
Burleigh	1.9	61.8	10.3	1 HDNS	95	2.2	0.4	0.1	2.7	0.0
Cass	0.6	60.8	11.8	1 HDNS	85	1.1	0.5	0.1	1.7	0.0
Cavalier	1.5	60.7	13.4	1 HDNS	80	0.8	0.5	0.1	1.4	0.0
Dickey	0.8	61.5	10.6	2 HDNS	90	2.9	0.5	0.0	3.4	0.0
Divide	1.0	62.2	10.1	1 HDNS	95	1.0	0.4	0.0	1.4	0.0
Dunn	2.2	61.6	10.4	2 HDNS	95	2.6	0.5	0.1	3.2	0.0
Eddy	1.9	60.4	11.4	1 HDNS	90	2.4	0.4	0.2	3.0	0.0
Emmons	0.6	62.5	10.7	1 HDNS	90	1.9	0.3	0.2	2.4	0.0
Foster	1.0	61.5	10.9	1 HDNS	95	1.6	0.4	0.0	2.0	0.0
Golden Valley	0.6	61.3	10.0	1 HDNS	90	2.7	0.3	0.0	3.0	0.0
Grand Forks	2.0	59.9	11.9	2 DNS	85	2.5	0.5	0.2	3.2	0.0
Grant	0.6	62.4	10.7	1 HDNS	95	1.8	0.4	0.0	2.2	0.0
Griggs	1.2	61.3	11.1	1 HDNS	90	1.2	0.5	0.0	1.7	0.0
Hettinger	1.3	61.4	9.9	1 HDNS	95	1.9	0.4	0.0	2.3	0.0
Kidder	1.3	61.0	10.9	1 HDNS	95	1.7	0.4	0.0	2.1	0.0
LaMoure	1.4	60.1	10.8	2 HDNS	90	2.1	0.6	1.3	4.0	0.0
Logan	0.6	62.0	11.2	1 HDNS	90	1.2	0.3	0.1	1.6	0.0
McHenry	1.0	60.7	11.5	1 HDNS	90	1.4	0.5	0.4	2.3	0.3
McIntosh	1.6	62.2	10.5	2 HDNS	90	1.7	0.6	0.1	2.4	0.0
McKenzie	1.2	61.9	11.0	1 HDNS	95	2.5	0.2	0.0	2.7	0.0
McLean	1.5	61.3	10.5	1 HDNS	95	2.6	0.4	0.0	3.0	0.0
Mercer	0.8	61.7	10.1	1 HDNS	95	2.2	0.3	0.1	2.6	0.0
Morton	2.2	62.2	10.6	1 HDNS	95	1.9	0.3	0.2	2.4	0.0
Mountrail	1.3	62.0	10.6	1 HDNS	95	1.5	0.3	0.0	1.8	0.0
Nelson	1.3	60.0	11.9	1 HDNS	85	1.3	0.5	0.1	1.9	0.2
Oliver	1.5	62.4	10.1	1 HDNS	90	1.6	0.3	0.1	2.0	0.0
Pembina	1.4	61.6	12.5	1 HDNS	80	0.9	0.3	0.1	1.3	0.0
Pierce	0.4	61.7	11.3	1 HDNS	90	0.5	0.3	0.1	0.9	0.0
Ramsey	1.0	61.1	12.0	1 HDNS	90	1.0	0.3	0.0	1.3	0.0
Ransom	2.0	59.0	11.3	2 DNS	80	1.1	0.8	2.9	4.8	0.0
Renville	1.8	61.3	11.2	1 HDNS	90	1.1	0.3	0.0	1.4	0.0
Richland	1.4	60.2	12.7	1 HDNS	85	1.3	0.4	0.1	1.8	0.0
Rolette	1.2	61.0	12.6	1 HDNS	90	1.2	0.2	0.0	1.4	0.0
Sargent	1.6	61.8	11.7	1 HDNS	85	1.1	0.3	0.1	1.5	0.0
Sheridan	1.2	61.1	10.2	1 HDNS	95	1.9	0.4	0.0	2.3	0.0
Sioux	0.9	61.7	11.5	1 HDNS	90	1.0	0.4	0.4	1.8	0.0
Stark	2.5	61.9	10.1	1 HDNS	95	2.8	0.2	0.0	3.0	0.0
Steele	1.2	60.6	12.0	1 HDNS	85	1.1	0.5	0.1	1.7	0.0
Stutsman	1.7	61.2	11.4	1 HDNS	90	2.3	0.5	0.1	2.9	0.3
Towner	0.6	61.4	12.7	1 HDNS	85	0.6	0.3	0.1	1.0	0.0
Traill	0.4	61.2	11.2	1 HDNS	90	1.8	0.5	0.1	2.4	0.0
Walsh	1.4	61.7	11.8	2 HDNS	90	1.3	0.6	0.1	2.0	0.0
Ward	1.3	61.4	11.0	1 HDNS	95	0.6	0.4	0.2	1.2	0.0
Wells	1.4	60.5	11.3	1 HDNS	90	2.0	0.4	0.1	2.5	0.0
Williams	1.2	61.8	10.3	1 HDNS	95	2.6	0.2	0.2	3.0	0.0
Average	1.3	61.3	11.1	1 HDNS	90	1.7	0.4	0.2	2.3	0.016

Upon a casual examination of the samples it was observed that, in some instances, ergot bodies were present; a condition which is unusual. To obtain reliable information as to the extent and de-

gree of this problem, composite wheat samples from each county were examined by the Department of Plant Pathology at NDSU. It was found that only two samples had ergot slightly in excess

of 0.3 per cent by weight, a level which according to the Official U.S. Grain Standards would cause these samples to be graded as "ergoty." The other samples ranged from zero per cent to 0.248 per cent with a state average of 0.077 per cent by weight.

Table 3 shows the wheat quality factors determined. An appendix is included in this report

which lists the methods employed for the various quality factors determined. For comparative purposes only, test weight is repeated in this table. The hectoliter weight of this year's crop ranged from 75.9 to 80.4 with an average of 78.9 kilograms per hectoliter. Thousand-kernel weight ranged from 29.8 to 38.6 with an average of 33.4, which is considerably higher than last year.

Table 2. Grades and Grade Requirements for Hard Red Spring Wheat (Effective March 5, 1965).

Grade	Maximum Limits Of						Wheat of other Classes	
	Minimum Test Weight Per Bushel	Heat Damaged Kernels	Damaged Kernels (total)	Foreign Material	Shrunken and Broken Kernels	Defects (total)	Contrasting Classes	Wheat of other classes (total)
	pounds	per cent	per cent	per cent	per cent	per cent	per cent	per cent
U.S. No. 1	58.0	0.1	2.0	0.5	3.0	3.0	1.0	3.0
U.S. No. 2	57.0	0.2	4.0	1.0	5.0	5.0	2.0	5.0
U.S. No. 3	55.0	0.5	7.0	2.0	8.0	8.0	3.0	10.0
U.S. No. 4	53.0	1.0	10.0	3.0	12.0	12.0	10.0	10.0
U.S. No. 5	50.0	3.0	15.0	5.0	20.0	20.0	10.0	10.0

Sample Grade: Sample grade shall be wheat which does not meet the requirements for any of the grades from No. 1 to No. 5, inclusive; or which contains stones; or which is musty, or sour, or heating; or which has any commercially objectionable foreign odor except of smut or garlic; or which contains a quantity of smut so great that any one or more of the grade requirements cannot be applied accurately; or which is otherwise of distinctly low quality.

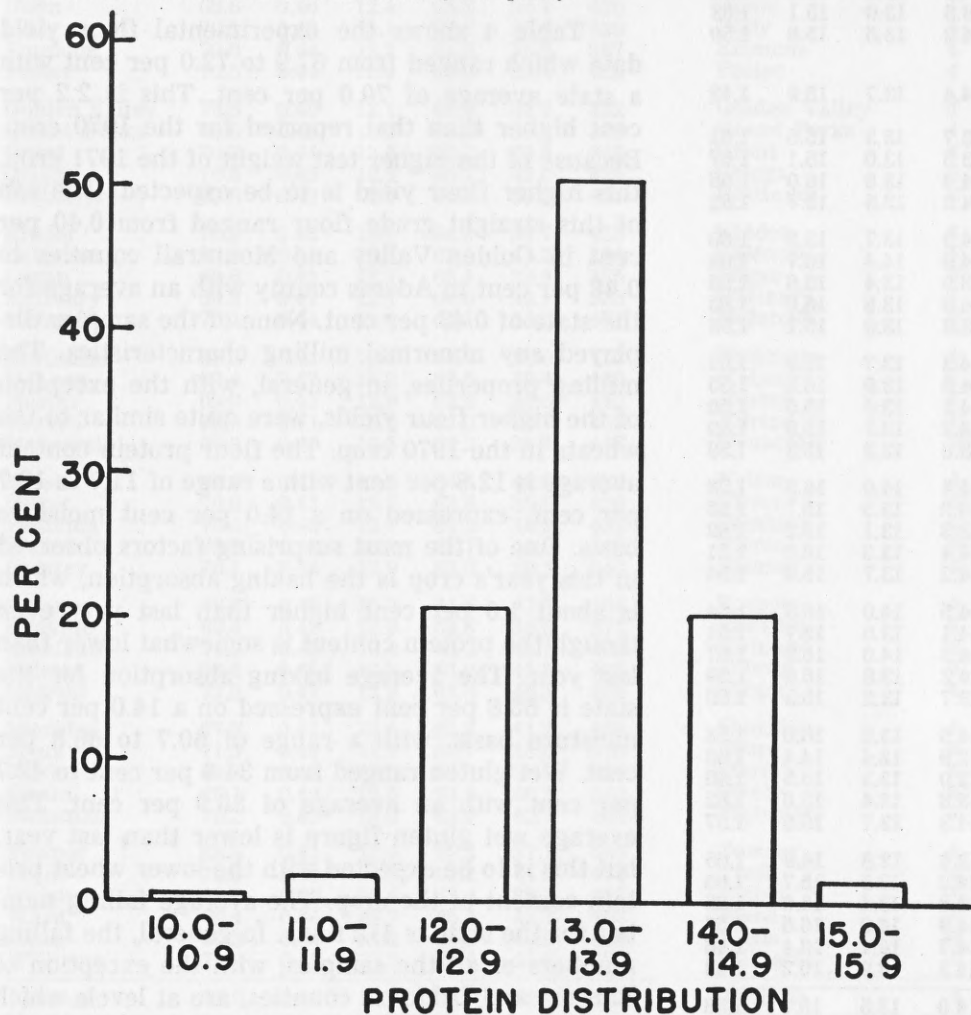


Fig. 3. Wheat protein distribution of the 1971 North Dakota hard red spring wheat crop.

Table 3 shows wheat protein contents expressed on a dry matter basis (DMB), on a 14.0 per cent

Table 3. HRS Wheat Survey — 1971 Crop: Wheat Data (County Averages).

Counties	Test Weight	Hectoliter Weight	1000 Kernel Weight	Protein ¹	Protein ²	Protein ³	Ash
	lbs/bu	kg.	g.	%	%	%	%
Adams	61.2	78.8	30.3	14.4	13.7	15.9	1.57
Barnes	61.4	79.0	33.9	13.8	13.3	15.5	1.58
Benson	60.5	77.9	36.0	14.2	13.8	16.0	1.51
Bottineau	61.9	79.7	34.4	13.8	13.4	15.6	1.53
Bowman	62.0	79.8	31.6	13.5	12.8	14.9	1.59
Burke	61.8	79.5	31.2	13.5	12.9	15.0	1.50
Burleigh	61.8	79.5	33.0	13.9	13.3	15.5	1.60
Cass	60.8	78.3	34.7	13.6	13.2	15.3	1.63
Cavalier	60.7	78.1	34.6	12.7	12.5	14.5	1.60
Dickey	61.5	79.2	29.8	14.3	13.7	15.9	1.63
Divide	62.2	80.1	35.1	14.8	14.1	16.4	1.49
Dunn	61.6	79.3	32.1	13.7	13.1	15.2	1.55
Eddy	60.4	77.7	34.6	14.3	13.8	16.0	1.50
Emmons	62.5	80.4	32.2	13.5	13.0	15.1	1.63
Foster	61.5	79.2	34.7	14.2	13.6	15.8	1.59
Golden Valley	61.3	78.9	34.2	14.4	13.7	15.9	1.43
Grand Forks	59.9	77.1	35.7	13.7	13.3	15.5	1.61
Grant	62.4	80.3	34.5	13.6	13.0	15.1	1.67
Griggs	61.3	78.9	34.8	14.4	13.8	16.0	1.66
Hettinger	61.4	79.0	31.8	14.2	13.5	15.7	1.62
Kidder	61.0	78.5	30.5	14.3	13.7	15.9	1.60
LaMoure	60.1	77.4	36.9	14.9	14.4	16.7	1.64
Logan	62.0	79.8	31.9	13.9	13.4	15.6	1.55
McHenry	60.7	78.1	32.4	14.3	13.8	16.0	1.55
McIntosh	62.2	80.1	32.5	13.6	13.0	15.1	1.63
McKenzie	61.9	79.7	30.5	14.3	13.7	15.9	1.51
McLean	61.3	78.9	30.2	14.5	13.9	16.2	1.55
Mercer	61.7	79.4	31.2	14.1	13.4	15.6	1.50
Morton	62.2	80.1	33.3	14.2	13.7	15.9	1.59
Mountrail	62.0	79.8	30.6	13.8	13.2	15.3	1.59
Nelson	60.0	77.2	36.8	14.4	14.0	16.3	1.53
Oliver	62.4	80.3	34.2	14.2	13.5	15.7	1.55
Pembina	61.6	79.3	38.6	13.3	13.1	15.2	1.62
Pierce	61.7	79.4	34.2	14.4	13.8	16.0	1.51
Ramsey	61.1	78.6	36.0	14.2	13.7	15.9	1.54
Ransom	59.0	75.9	35.0	14.5	14.0	16.3	1.64
Renville	61.3	78.9	35.6	14.1	13.5	15.7	1.51
Richland	60.2	77.5	34.2	14.3	14.0	16.3	1.67
Rolette	61.0	78.5	33.2	14.2	13.8	16.0	1.59
Sargent	61.8	79.5	33.1	13.7	13.2	15.3	1.69
Sheridan	61.1	78.6	30.5	14.5	13.8	16.0	1.53
Sioux	61.7	79.4	38.5	12.9	12.4	14.4	1.63
Stark	61.9	79.7	30.8	13.9	13.3	15.5	1.68
Steele	60.6	78.0	34.5	13.8	13.4	15.6	1.62
Stutsman	61.2	78.8	34.1	14.3	13.7	15.9	1.57
Towner	61.4	79.0	30.5	13.4	12.8	14.9	1.65
Traill	61.2	78.8	34.0	14.0	13.5	15.7	1.65
Walsh	61.7	79.4	36.5	13.8	13.4	15.6	1.65
Ward	61.4	79.0	31.7	14.9	14.3	16.6	1.59
Wells	60.5	77.9	32.1	14.7	14.1	16.4	1.46
Williams	61.8	79.5	32.1	14.5	13.9	16.2	1.53
Average	61.3	78.9	33.4	14.0	13.5	15.7	1.58

¹As is Moisture Basis.

²14.0% Moisture Basis.

³Dry Matter Basis

moisture basis, and on an "as is" moisture basis. The wheat protein content, expressed on a 14.0 per cent moisture basis, ranged from 12.4 to 14.4 with a state average of 13.5 per cent, which is 1.3 per cent lower than last year. However, when the average wheat protein content for the state is expressed on an "as is" moisture basis, it becomes 14.0 per cent, and on a dry matter basis, it is reported at 15.7 per cent. Figure 1 shows the average protein content (14.0 per cent moisture basis) for the various counties sampled. Figure 3 is a bar graph showing the wheat protein distribution (14.0 per cent moisture basis) of the 1971 crop. These data show that about 75 per cent of the crop would fall within 13.0 and 14.9 per cent, or if expressed on a DMB it becomes 15.1 to 17.3 per cent. The average wheat ash for the state is 1.58 with a range of 1.43 to 1.69 per cent. This is the lowest ash level reported for the past three crop years.

Flour Data

Table 4 shows the experimental flour yield data which ranged from 67.9 to 72.0 per cent with a state average of 70.0 per cent. This is 2.2 per cent higher than that reported for the 1970 crop. Because of the higher test weight of the 1971 crop, this higher flour yield is to be expected. The ash of this straight grade flour ranged from 0.40 per cent in Golden Valley and Mountrail counties to 0.48 per cent in Adams county with an average for the state of 0.43 per cent. None of the samples displayed any abnormal milling characteristics. The milling properties, in general, with the exception of the higher flour yields, were quite similar to the wheats in the 1970 crop. The flour protein content average is 12.8 per cent with a range of 11.7 to 13.7 per cent, expressed on a 14.0 per cent moisture basis. One of the most surprising factors observed in this year's crop is the baking absorption, which is about 1.0 per cent higher than last year even though the protein content is somewhat lower than last year. The average baking absorption for the state is 63.8 per cent expressed on a 14.0 per cent moisture basis, with a range of 60.7 to 66.8 per cent. Wet gluten ranged from 34.6 per cent to 42.7 per cent with an average of 38.9 per cent. This average wet gluten figure is lower than last year, but this is to be expected with the lower wheat protein content of the crop. The average falling number for the state is 412 units. In general, the falling numbers of all the samples, with the exception of Ransom and LaMoure counties, are at levels which indicate the absence of excessive enzyme activity

Baking Data

In general, the baking characteristics of this year's crop are considered very good to excellent. Dough handling properties are excellent with no

Table 4. HRS Wheat Survey — 1971 Crop: Flour Data (County Averages).

Counties	Yield	Ash	Protein	Baking Absorption	Wet Gluten	Falling No.
	%	%	%	%	%	units
Adams	71.4	0.48	13.3	64.4	38.0	437
Barnes	71.5	0.47	12.8	64.6	37.9	455
Benson	69.0	0.42	13.1	63.2	38.4	420
Bottineau	69.2	0.47	13.0	66.8	37.0	437
Bowman	70.0	0.46	12.3	66.3	34.9	414
Burke	70.0	0.43	12.4	66.5	34.6	396
Burleigh	69.8	0.45	12.7	65.8	39.4	403
Cass	71.8	0.48	12.5	64.2	36.8	435
Cavalier	68.5	0.45	12.2	62.3	35.1	401
Dickey	71.4	0.47	13.2	63.4	38.2	461
Divide	68.6	0.43	13.4	66.4	40.1	455
Dunn	69.8	0.46	12.4	65.8	35.1	420
Eddy	70.1	0.43	13.1	62.6	38.0	328
Emmons	70.0	0.44	12.3	61.2	36.2	367
Foster	70.5	0.44	12.9	64.5	39.4	423
Golden Valley	70.6	0.40	13.1	62.9	38.2	422
Grand Forks	69.6	0.43	12.5	63.4	37.4	389
Grant	70.8	0.44	12.5	63.2	39.5	445
Griggs	70.5	0.43	13.1	65.1	42.0	425
Hettinger	69.8	0.43	12.9	64.1	39.8	401
Kidder	70.3	0.43	13.1	64.2	39.7	433
LaMoure	69.8	0.41	13.3	63.5	41.2	214
Logan	69.6	0.41	12.7	65.1	38.4	395
McHenry	69.3	0.41	13.1	64.6	38.1	388
McIntosh	70.4	0.44	12.6	63.1	36.6	471
McKenzie	68.4	0.41	13.0	64.4	38.0	412
McLean	69.4	0.42	13.2	62.5	38.4	445
Mercer	69.9	0.41	12.9	63.2	39.6	442
Morton	70.6	0.41	12.8	62.6	38.1	465
Mountrail	69.0	0.40	12.5	62.9	35.7	448
Nelson	69.6	0.41	12.9	64.5	40.2	382
Oliver	70.6	0.41	12.7	63.8	39.6	420
Pembina	70.4	0.45	12.7	64.2	38.1	462
Pierce	69.5	0.41	12.9	65.1	39.6	443
Ramsey	70.1	0.42	12.9	63.8	39.1	340
Ransom	69.5	0.43	13.2	61.6	41.7	134
Renville	69.4	0.43	12.9	64.6	38.8	371
Richland	71.2	0.45	13.0	61.3	41.1	408
Rolette	69.4	0.43	13.3	64.2	41.1	426
Sargent	72.0	0.47	12.2	61.8	40.3	456
Sheridan	67.9	0.41	13.4	62.2	41.2	453
Sioux	71.5	0.43	11.7	60.7	35.0	370
Stark	69.2	0.42	12.6	62.8	39.4	454
Steele	69.1	0.42	12.5	63.4	40.1	340
Stutsman	70.2	0.42	13.0	63.9	42.7	462
Towner	68.8	0.41	12.4	62.3	37.1	440
Traill	70.8	0.43	12.9	63.2	41.6	451
Walsh	69.8	0.46	12.6	63.4	39.5	451
Ward	69.4	0.44	13.7	65.4	42.7	456
Wells	70.3	0.43	13.4	65.3	41.9	407
Williams	70.0	0.42	13.2	64.4	41.5	425
Average	70.0	0.43	12.8	63.8	38.9	412

“buckiness” of the doughs observed. The flour produced loaves of relatively large volume having very good crumb color. Loaf volumes, which are somewhat smaller than last year, also tended to produce crumb grain and textures which are a little open.

Table 5. HRS Wheat Survey — 1971 Crop: Baking Data (County Averages).

Counties	Dough Char.	Loaf Volume	Grain & Texture	Crumb Color	Crust Color	Symm.
		cc.				
Adams	4	890	8.0	8.0	4	4.5
Barnes	4	870	8.5	8.5	4	4.5
Benson	4	850	8.0	8.5	4	4.5
Bottineau	4	840	8.0	8.5	4	4.5
Bowman	4	790	8.5	8.5	4	4.5
Burke	4	750	8.5	8.5	4	4.5
Burleigh	4	845	8.5	8.5	4	4.5
Cass	4	875	8.5	8.5	4	4.5
Cavalier	4	790	8.5	8.5	4	4.5
Dickey	4	865	8.0	8.0	4	4.5
Divide	4	845	8.5	8.5	4	4.5
Dunn	4	810	8.5	8.5	4	4.5
Eddy	4	840	8.5	8.5	4	4.5
Emmons	4	820	9.0	8.5	4	4.5
Foster	4	890	8.5	8.5	4	4.5
Golden Valley	4	805	8.5	8.5	4	4.5
Grand Forks	4	910	8.5	8.5	4	4.5
Grant	4	850	9.0	8.5	4	4.5
Griggs	4	875	9.0	8.0	4	4.5
Hettinger	4	855	8.5	8.5	4	4.5
Kidder	4	890	9.0	8.5	4	4.5
LaMoure	4	910	8.0	8.0	4	4.5
Logan	4	880	8.5	8.5	4	4.5
McHenry	4	860	9.0	8.5	4	4.5
McIntosh	4	850	8.5	8.0	4	4.5
McKenzie	4	795	8.0	8.0	4	4.5
McLean	4	905	8.0	8.0	4	4.5
Mercer	4	845	9.0	8.0	4	4.5
Morton	4	840	8.5	8.0	4	4.5
Mountrail	4	785	8.5	8.5	4	4.5
Nelson	4	855	8.5	8.5	4	4.5
Oliver	4	785	8.5	8.5	4	4.5
Pembina	4	820	8.5	8.5	4	4.5
Pierce	4	840	8.5	8.5	4	4.5
Ramsey	4	825	8.5	8.5	4	4.5
Ransom	4	900	8.5	8.5	4	4.5
Renville	4	825	8.5	8.5	4	4.5
Richland	4	890	8.0	8.0	4	4.5
Rolette	4	840	8.5	8.5	4	4.5
Sargent	4	855	8.5	8.5	4	4.5
Sheridan	4	885	8.5	8.5	4	4.5
Sioux	4	810	8.5	8.5	4	4.5
Stark	4	835	8.5	8.5	4	4.5
Steele	4	865	8.5	8.5	4	4.5
Stutsman	4	885	8.5	8.5	4	4.5
Towner	4	790	8.5	8.5	4	4.5
Traill	4	850	9.0	8.5	4	4.5
Walsh	4	850	8.5	8.5	4	4.5
Ward	4	880	8.0	8.5	4	4.5
Wells	4	875	8.5	8.5	4	4.5
Williams	4	765	8.5	8.5	4	4.5
Average	4	846	8.5	8.4	4	4.5

Color of the crust, as well as the overall appearance (symmetry) of the loaves, is excellent. In general, the baking performance of the 1971 crop is very uniform. Dough handling characteristics, loaf crust colors and symmetry are scored the same for all samples. Individual loaf volumes are all within 10 per cent of the mean loaf volume with the ex-

ception of the sample from Burke county. Crumb grain and texture showed a range of about 5 per cent from the mean. Crumb color gave a range of about 3 per cent from the mean. This year's flours required very little, if any oxidizing agents. This was rather unusual as in previous years 10 ppm of potassium bromate on flours produced from North

Table 6. HRS Wheat Survey — 1971 Crop: Physical Dough Properties (County Averages).

Counties	Farinogram					Extensogram					
	Absorption	Mixing		MTI	Classification	Extensibility		Resistance		Area	Classification
		Time	Tolerance			45 min.	180 min.	45 min.	180 min.		
%	min.	min.			cm.	cm.	cm.	cm.	sq. cm.		
Adams	66.8	5.5	6.7	30	5	22.5	22.8	5.4	8.3	138	6
Barnes	66.6	6.0	6.7	45	5	22.7	21.8	5.2	6.6	104	5
Benson	64.7	7.0	8.2	30	5	21.9	24.1	5.7	7.3	130	5
Bottineau	69.3	6.5	6.0	50	5	23.0	20.4	5.7	7.3	111	5
Bowman	68.5	6.0	7.2	35	5	21.3	19.0	6.3	8.0	105	6
Burke	68.6	6.0	6.7	45	5	25.8	17.8	6.0	8.8	117	7
Burleigh	67.7	6.5	7.1	45	5	22.7	21.2	6.5	8.3	124	6
Cass	66.3	6.0	7.5	40	6	22.6	21.6	6.3	7.8	125	6
Cavalier	63.7	5.5	7.2	35	6	22.5	20.8	6.5	8.1	125	6
Dickey	66.1	5.0	7.6	35	6	21.8	20.2	6.1	8.4	126	6
Divide	68.9	7.5	6.5	35	5	21.8	21.2	6.3	8.3	124	6
Dunn	68.3	7.0	7.6	45	5	20.8	17.9	5.8	9.8	124	7
Eddy	64.4	7.0	7.8	40	5	21.8	21.7	6.7	8.9	143	7
Emmons	63.1	6.5	9.2	30	5	21.5	20.8	6.0	8.2	121	6
Foster	66.4	6.0	6.7	40	5	23.4	22.8	4.9	6.5	100	5
Golden Valley	64.7	7.0	5.9	35	5	22.2	18.3	6.5	8.1	107	6
Grand Forks	65.0	4.5	5.6	50	4	20.2	21.9	5.5	7.0	100	5
Grant	64.7	6.0	7.0	45	5	22.7	22.3	6.2	7.4	126	6
Griggs	66.9	6.0	5.8	55	5	22.4	21.4	5.5	6.0	100	4
Hettinger	66.3	6.0	7.5	40	5	20.9	20.3	6.1	7.9	125	6
Kidder	66.4	6.0	8.5	35	5	21.8	19.5	6.0	8.1	119	6
LaMoure	65.5	4.5	4.3	70	3	26.5	25.9	4.3	4.5	90	3
Logan	67.3	6.0	6.5	35	5	24.1	24.7	5.2	7.4	133	5
McHenry	67.0	6.0	7.6	30	5	22.5	21.6	5.1	7.9	121	6
McIntosh	65.3	5.5	7.4	35	5	22.7	22.0	5.9	8.3	139	6
McKenzie	66.5	7.0	8.9	30	6	21.2	19.2	6.0	8.6	114	7
McLean	64.6	8.0	9.5	30	6	22.3	20.0	6.8	10.6	149	8
Mercer	65.0	7.0	8.0	30	5	23.6	22.0	5.7	7.9	127	6
Morton	64.1	6.0	7.4	40	5	25.6	20.0	6.4	7.7	119	7
Mountrail	64.5	6.0	8.0	30	5	23.2	18.9	6.9	8.2	111	6
Nelson	66.4	5.0	5.6	50	4	23.6	23.1	5.0	6.0	109	4
Oliver	65.8	6.0	6.2	40	5	25.5	23.6	5.2	6.9	121	5
Pembina	66.0	6.0	9.5	30	6	23.2	20.9	5.8	7.8	120	6
Pierce	66.7	6.0	9.1	25	6	23.6	20.8	6.5	7.4	110	5
Ramsey	65.8	6.0	6.9	30	5	22.3	22.0	4.9	7.7	123	6
Ransom	63.5	5.0	4.7	75	3	24.3	22.6	4.9	5.3	98	3
Renville	66.7	6.0	8.2	35	5	24.5	22.3	5.4	7.7	127	6
Richland	63.3	6.0	9.3	35	5	24.2	21.6	6.6	8.5	137	6
Rolette	66.3	7.0	7.5	40	5	21.5	20.0	5.7	8.1	126	6
Sargent	63.9	6.0	7.1	40	5	23.5	17.8	6.5	7.7	105	6
Sheridan	64.2	8.5	11.7	30	6	22.5	22.0	7.4	10.2	155	8
Sioux	62.7	6.0	6.1	45	5	24.3	19.0	6.6	7.7	107	6
Stark	64.6	7.5	6.3	45	5	23.5	20.2	6.0	8.4	120	6
Steele	65.0	6.0	5.4	60	4	23.5	22.0	4.6	6.0	100	4
Stutsman	65.7	6.0	6.8	35	5	23.0	20.8	4.9	5.3	88	3
Towner	63.7	6.5	7.6	30	5	21.0	20.0	5.9	7.9	118	6
Trail	64.7	6.5	7.0	35	5	22.3	23.6	5.6	6.9	122	5
Walsh	65.2	6.0	9.1	40	5	21.6	22.1	5.4	7.8	129	6
Ward	67.4	7.0	7.5	25	5	22.3	19.5	5.3	7.7	114	6
Wells	66.9	7.0	6.0	30	5	20.1	21.5	6.2	8.1	141	6
Williams	66.3	7.0	8.5	30	5	23.0	18.7	6.9	8.5	115	6
Average	65.8	6.2	7.3	39	5.0	22.8	21.1	5.9	7.7	119	5.7

Dakota wheats were required to obtain optimum baking results when using a relatively lean formula. This, of course, is a plus factor for this year's Northern Spring Wheat crop, particularly in countries that do not permit the addition of oxidizing agents to the dough.

Physical Dough Properties

Table 6 shows farinogram and extensogram data. Mixing characteristics of this year's crop as indicated by the farinogram pattern are classified as medium. Farinogram absorption averaged 65.8 per cent which is 2.0 percentage units higher than the actual average baking absorption. Mixing time ranged from 4.5 to 8.5 minutes with an average of 6.2 minutes. Mixing tolerance average is 7.3 minutes with a range of 4.3 to 11.7 minutes. On the average, both mixing time and tolerance are lower than last year. These slightly lower mixing characteristics are probably attributed to the lower wheat protein content of this year's crop. The MTI value (mixing tolerance index) depicts the characteristics of a medium type curve. Average overall empirical farinogram classification is 5.0. This is a little lower than either the 1970 or 1969 crops. Figure 4 shows an average farinogram for the 1971 crop.

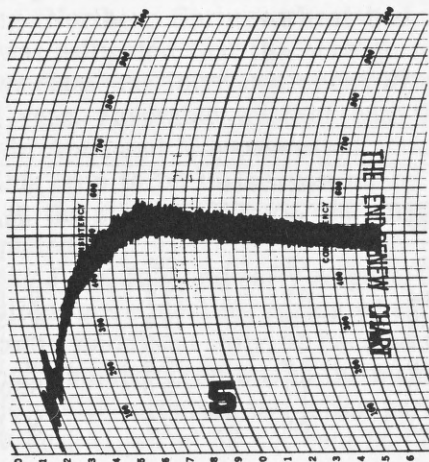


Fig. 4. Farinogram showing average mixing strength of the 1971 North Dakota hard red spring wheat crop.

The Extensograph measures the extensibility and resistance to extension of doughs after various periods of rest time. Measurements are made to determine extensibility (curve length), the resistance (curve height) and general dough strength (area of curve). These data also presented in Table 6 are, on the average, a little lower than those obtained for the 1970 crop. In general, the 1971 crop produced doughs with excellent elastic properties.

An average extensogram is shown in Fig. 5. In general, the doughs can be classed as a little mel- lower than last year.

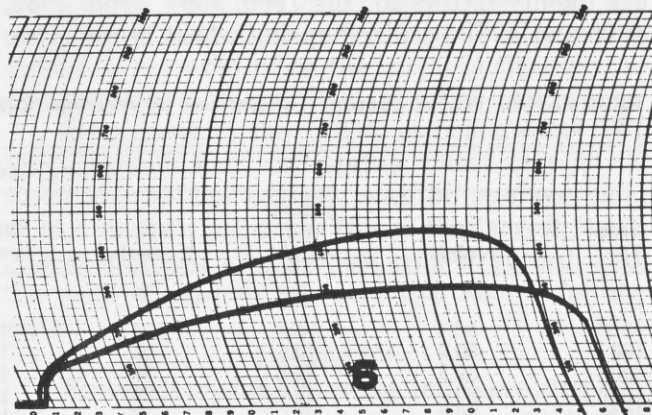


Fig. 5. Extensogram showing average properties of the 1971 North Dakota hard red spring wheat crop.

Grade and Market Quality Factors

The percentage of the crop falling into the various grades is depicted in the diagram shown in Fig. 6. The figures shown on the outside of the circle are an accumulative percentage of the grades. For example, the number 96 on this figure indicates that 96 per cent of the 1971 hard red spring wheat crop (approximately 191 million bushels) should grade U.S. No. 2 Dark Northern Spring or better. This is much higher than the 1970 crop, which

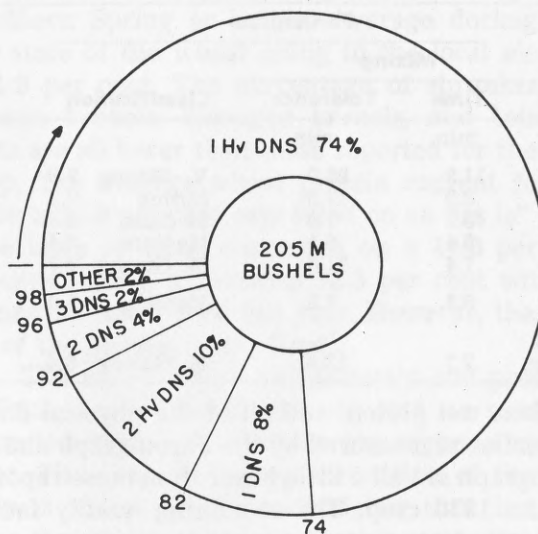


Fig. 6. Diagram showing grade distribution of the 1971 North Dakota hard red spring wheat crop.

estimated that 83 per cent (90 million bushels) should grade U.S. No. 2 Dark Northern Spring or better.

Quality Comparisons of the 1971 Crop With Other Years

Table 7 compares some of the pertinent average quality factors for the 1966, 1967, 1968, 1969, 1970 and 1971 hard red spring wheat crops. Also,

the five-year (1966-1970) average is shown. The data from this year's crop, when compared with the 1970 crop, shows a much higher test weight and hectoliter weight, higher percentage of vitreous kernels, flour yield and baking absorption. Wheat protein, loaf volume, crumb color scores, falling

Table 7. HRS Wheat Survey: Comparison of Average Quality Factors for North Dakota 1966, 1967, 1968, 1969, 1970, and 1971 Crops.

(Milling and analytical data)								
Crop Year	Test Weight	Hecto-liter weight	Vit. Kernels	Wheat Protein	Flour Yield	Flour Ash	Falling No.	Wet Gluten
	lbs/bu	kg.	%	%	%	%	units	gm.
1966	58.4	75.2	94	15.2	66.9	0.43	343	51.6
1967	59.9	77.1	95	14.4	66.8	0.41	493	47.6
1968	58.7	75.6	87	14.0	70.9	0.41	405	40.6
1969	60.4	77.7	89	14.1	72.6	0.44	458	42.3
1970	59.3	76.3	87	14.8	67.8	0.42	453	42.3
1971	61.3	78.9	90	13.5	70.0	0.43	412	38.9
5-year Ave.	59.3	76.3	90	14.5	69.0	0.42	430	44.9

(Baking data)							
Crop year	Absorption	Dough Char.	Loaf Vol.	Gr. & Tex.	Crumb Color	Crust Color	Symmetry
	%		cc.				
1966	66.4	4	850	8.4	8.1	4	4.5
1967	64.6	4	840	8.5	8.2	4	4.5
1968	63.6	4	791	8.7	8.4	4	4.5
1969	64.1	4	839	8.7	8.7	4	4.5
1970	62.9	4	865	8.5	9.0	4	4.5
1971	63.8	4	846	8.5	8.4	4	4.5
5-year Ave.	64.3	4	837	8.6	8.5	4	4.5

(Physical dough properties)										
Crop Year	Farinogram				Extensogram					
	Mixing		Classification		Extensibility		Resistance		Classification	
	Time	Tolerance			45	180	45	180		
min.	min.	cm.	cm.	cm.	cm.	cm.	cm.			
1966	11.2	25.9	V. Strong	7.9	23.8	23.4	8.2	11.7	V. Strong	8.1
1967	8.9	17.0	Strong	7.7	21.8	21.4	7.8	11.4	V. Strong	8.1
1968	5.7	7.0	Medium	5.3	21.6	20.7	6.8	9.5	Strong	7.0
1969	5.4	6.1	Medium	5.4	22.3	21.0	5.8	7.4	M. Strong	5.6
1970	7.4	11.0	M. Strong	5.7	23.4	22.0	7.1	9.6	Strong	7.1
1971	6.2	7.3	Medium	5.0	22.8	21.1	5.9	7.7	M. Strong	5.7
5-year Ave.	7.7	13.4	M. Strong	6.4	22.6	21.7	7.1	9.9	Strong	7.2

number, wet gluten, and all of the physical dough properties as measured by the Farinograph and Extensograph are all a little lower than those reported for the 1970 crop. The remaining quality factors determined are quite similar to last year.

When compared with the five-year average, the 1971 crop is better in test weight, hectoliter weight, flour yield and loaf volume. Percentage of vitreous kernels, flour ash, dough handling properties, crumb grain and texture, crumb color, crust color and general shape of the loaf (symmetry) are

all about the same as that shown for the five-year average. Wheat protein content, falling number, wet gluten and absorption are all a little lower than the five-year average.

These yearly quality differences are to be expected and are attributed to both the changing environmental conditions and the wheat varieties grown. For example, in 1966, 75 per cent of the acreage was devoted to Justin which is a very strong hard red spring wheat variety. It is possibly the strongest hard red spring wheat released and

grown extensively in North Dakota. In 1967, the acreage for Justin dropped to about 47 per cent while Chris, a better wheat agronomically but displaying mellower quality characteristics, occupied about 33 per cent of the acreage. In 1969, Justin was seeded on about 15 per cent of the wheat acreage; Chris, 40 per cent; and Manitou, 30 per cent. Manitou is somewhat similar to Chris in general dough properties. In 1970, Justin was seeded on about 8 per cent of the acreage; Chris, 17 per cent; Manitou, 24 per cent; and Waldron, a new hard red spring wheat release, 27 per cent. It has been estimated that the 1971 acreage seeded to Waldron in North Dakota is about 62 per cent, Chris 10 per cent, with Manitou 8 and Justin 4 per cent. These figures show that in six years, the North Dakota bread wheat crop changed from 85 per cent very strong type wheats (Pembina, also a very strong wheat, represented 10 per cent of the 1966 crop) and 15 per cent mellower types to about 5 per cent very strong and 95 per cent mellower wheats in 1971.

WEATHER AND HARVEST

For the purpose of historic interest, a summary of the seeding, growing and harvesting conditions is presented.

Seeding of the 1971 North Dakota crop of hard red spring (Northern Spring) wheat had an early start. It was estimated that the acreage seeded to this wheat class was increased about 37 per cent over last year. Favorable weather with adequate moisture in April and May permitted about 80 per cent of this crop to be in the ground by May 18. By June 8, the seeding of hard red spring wheat was completed.

During June, July and early August, the growing conditions were ideal for spring wheat growth. By about the middle of July, it became fully apparent that a bumper crop was in the making. Harvest made a little progress the latter part of July and by August 11, about 33 per cent had been cut, including 10 per cent combined. On August 30, the North Dakota Weather-Crop Report stated that 71 per cent of the hard red spring wheat had been harvested. Harvest was slowed somewhat for the next two weeks, but by September 14, it had picked up again and was estimated to be 87 per cent completed. By September 21 the combining of hard red spring wheat was 94 per cent completed, with an additional 5 per cent swathed so within a week most of this class of wheat was in the bin.

As the wheat samples began to arrive in the laboratory it became apparent that an excellent crop was being harvested. The wheat had an excel-

lent appearance, was high in test weight, and low in moisture. It was relatively free of diseased or damaged kernels and had no visible sprout damage. It was observed, however, that in some instances the samples contained ergot. In general, with the exception of a small amount of ergot bodies, which should be removed when the wheat is cleaned, the crop possessed an excellent physical appearance.

Subsequently, the USDA estimated the 1971 North Dakota hard red spring wheat crop to be about 205 million bushels, with an average yield of 31.0 bushels per acre. This is the largest North Dakota hard red spring wheat crop on record; also, the yield of bushels per acre is a record for the state.

SUMMARY

Excellent seeding, growing and harvesting conditions prevailed in North Dakota during 1971. This resulted in a record crop of hard red spring wheat estimated by USDA to be about 205 million bushels (5.6 million metric tons). This bumper crop was produced on an acreage about 37 per cent larger than last year, but the production represented an increase of about 90 per cent over last year.

The physical appearance, with the exception of an occasional ergot body, is excellent. It possesses, on the average, a high test weight (61.3 lbs./bu.), a high vitreous kernel content (90 per cent), and a low moisture (11.1 per cent). The wheat is relatively free of diseased or damaged kernels with no visible sprout damage. It is estimated that 96 per cent of the crop should grade U.S. No. 2 Dark Northern Spring or better. Average dockage for the state of the wheat going to the local elevator is 1.3 per cent. The percentage of shrunken and broken kernels, damaged kernels, and total defects are all lower than those reported for the 1970 crop. The average wheat protein content for the state is 14.0 per cent expressed on an "as is" moisture basis or when expressed on a 14.0 per cent moisture basis, it becomes 13.5 per cent which is somewhat lower than last year. However, the quality of the protein is excellent.

The wheat milled satisfactorily and produced a flour of good color, low ash and, as would be expected, the yield of flour was higher than last year. The average baking absorption of the 1971 crop is about 1.0 per cent higher than last year even though the protein content is somewhat lower than last year. The loaf volumes, although a little smaller than last year, are satisfactory. Color of the crust, as well as the external appearance of the loaves, is excellent. In general, the overall baking performance of the 1971 crop is considered to be very good to excellent.

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A view of the Cereal Chemistry and Technology Building at North Dakota State University, Fargo