The Quality of North Dakota's 1968 Hard Red Spring Wheat

L. D. Sibbitt and K. A. Gilles

The 1968 North Dakota hard red spring wheat crop is the second largest on record and is estimated by the USDA to be about 129 million bushels (3.5 million metric tons). This compares with the 1967 crop of 123 million bushels. An average yield of 26.5 bushels per acre is estimated which is four and one-half bushels above a year ago and nearly three and one-half bushels above the five-year average.

The overall quality of North Dakota's 1968 hard red spring wheat crop is considered to be generally good. The flour yield on a constant ash basis is quite high as is crumb color and the crumb grain and texture of the test loaves. The other quality factors are at satisfactory levels, although most of these characteristics are lower than reported for the 1967 crop. On the average, test weight (hectoliter weight), wheat protein, absorption and farinogram pattern are the principal quality factors that are lower.

With the exception of absorption, the baking characteristics in general are good. Loaf volume, however, is a little lower than would be expected from the fairly high protein level shown for this year's crop.

The general format used for the 1968 North Dakota quality survey was somewhat different from that used in previous years. Primarily, these changes involved the method imposed for sample selection and the procedure followed for preparing the milling and baking composites. In an attempt to avoid some duplication which existed last year, a cooperative effort was initiated by the North Dakota Department of Agriculture, the U. S. Department of Agriculture (Consumer and Marketing Service, Grain Division), the North Dakota Wheat Commission, the Cooperative Extension Service and the Experiment Station at North Dakota State University.

Samples and Methods

During the 1968 harvest, samples were collected and submitted by cooperating elevators from all of the counties producing substantial amounts of wheat, with at least two elevators in each county participating. The number of samples collected reflected the anticipated crop production of each county. The elevator operators were requested to collect and place in suitable containers a sample from each truck load of hard red spring wheat delivered to the elevator. Twice a week, the samples were thoroughly mixed and a 1½ quart aliquot taken, placed in a moisture proof plastic bag and transmitted to the Cereal Chemistry and Technology Department at North Dakota State University, Fargo, N. Dak. 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 the campus for a complete official grade. These data were transmitted on a weekly basis to the North Dakota Department of Agriculture, Bismarck, N. Dak. Various computations were made and reports issued on a weekly basis. The purpose of these reports is to publicize as early as possible some preliminary information on the general condition of the crop.

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. Unfortunately, in five of the counties an insufficient number of samples was submitted to permit the preparation of a proper sized composite; in addition, three counties failed to submit any samples.

Dr. Gilles is professor and chairman, Sibbitt is associate professor, Department of Cereal Chemistry and Technology.

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QUALITY DATA ON COMPOSITES

Wheat Tests

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.

The test weight of this year's crop, as shown

Table 1. HRS Wheat Survey — 1968 Crop: Grading Information (County Averages).

Counties	Dockage	Test Weight	Moisture	Grade	Vitreous Kernels	Shrunken and Broken	F. M.	Damage	Total Defects	Contrasting Classes
	%	lbs/bu	%		%	%	%	%	%	%
Adams	1.3	59.0	12.0	2 DNS	94	2.6	0.3	0.2	3.1	0.0
Barnes	0.8	59.6	12.3	1 DNS	92	1.7	0.3	0.2	2.2	0.3
Benson	1.3	58.2	12.6	1 DNS	84	1.4	0.3	0.9	2.6	0.1
Bottineau	1.1	59.0	13.2	1 DNS	84	0.7	0.2	0.9	1.8	0.2
Bowman	1.2	59.9	10.5	2 DNS	90	2.6	0.4	0.5	3.5	0.0
Burke	1.0	59.5	13.0	1 DNS	85	0.5	0.4	0.5	1.4	0.0
Cass	0.8	60.6	11.4	1 Hv DNS	91	1.9	0.3	0.2	2.4	0.1
Cavalier	1.2	58.3	13.6	1 DNS*	82	0.6	0.3	0.8	1.7	0.0
Dickey	1.2	58.6	12.3	2 DNS	88	2.7	0.4	0.4	3.5	0.0
Divide	1.1	58.6	13.6	1 DNS*	86	0.8	0.3	1.6	2.7	0.2
Dunn	1.0	58.0	13.0	1 DNS	90	1.7	0.3	0.4	2.4	0.1
Emmons	0.9	59.4	12.2	1 DNS	86	2.2	0.3	0.1	2.6	0.1
Golden Valley	0.2	58.7	12.8	1 DNS	86	1.2	0.2	0.2	1.6	0.0
Grand Forks	1.5	57.8	12.6	2 DNS	84	1.6	0.3	1.2	3.1	0.1
Grant	0.4	58.4	12.0	1 DNS	90	2.4	0.2	0.2	2.8	0.0
Griggs	0.2	59.3	12.4	1 DNS	88	0.7	0.2	0.4	1.3	0.0
Hettinger	2.0	57.8	12.6	2 DNS	92	2.6	0.3	0.3	3.2	0.0
Kidder	1.4	58.7	12.5	2 DNS	92	2.7	0.3	0.2	3.2	0.1
Logan	1.2	59.7	13.5	1 DNS	89	1.4	0.3	0.2	1.9	0.1
McHenry	0.9	58.0	13.1	1 DNS	83	1.1	0.3	1.1	2.5	0.1
McIntosh	1.2	59.9	12.3	1 DNS	83	2.1	0.3	0.2	2.6	0.1
McKenzie	0.4	58.4	11.6	1 DNS	79	1.6	0.1	0.7	2.4	0.0
McLean	1.5	57.2	13.0	2 DNS	91	2.3	0.3	0.7	3.3	0.1
Mercer	1.2	58.1	13.7	1 DNS*	87	1.8	0.3	0.4	2.5	0.0
Morton	1.7	58.9	13.2	1 DNS	90	1.9	0.3	0.2	2.4	0.0
Mountrail	1.1	57.6	12.7	2 DNS	88	1.8	0.3	0.4	2.5	0.0
Nelson	1.3	57.1	14.5	2 DNS*	83	1.2	0.4	1.5	3.1	0.1
Oliver	1.4	58.1	13.9	1 DNS*	87	1.3	0.3	0.4	2.0	0.0
Pembina	1.0	58.0	13.5	1 DNS	80	0.9	0.3	1.2	2.4	0.0
Pierce	0.1	57.5	12.8	2 DNS	84	0.9	0.2	0.9	2.0	0.1
Ramsey	0.9	58.3	13.0	1 DNS	86	1.0	0.2	0.5	1.7	0.0
Ransom	0.3	60.4	11.2	1 Hv DNS	91	1.6	0.3	0.2	2.1	0.0
Renville	1.1	58.7	13.2	1 DNS	84	0.8	0.2	0.7	1.7	0.1
Richland	0.6	61.8	11.5	1 Hv DNS	92	1.3	0.3	0.2	1.8	0.1
Sheridan	0.9	56.4	13.5	3 DNS	82	1.8	0.3	0.8	2.9	0.1
Sioux	1.3	57.9	12.1	2 DNS	86	2.2	0.3	0.2	2.7	0.1
Stark	1.7	58.7	13.2	1 DNS	90	2.1	0.3	0.3	2.7	0.1
Steele	0.5	58.6	12.9	1 DNS	83	1.3	0.2	0.6	2.1	0.1
Stutsman	1.2	59.5	12.8	1 DNS	90	1.6	0.4	0.2	2.2	0.0
Towner	0.8	58.5	13.3	1 DNS	82	0.8	0.2	0.9	1.9	0.1
Traill	1.2	59.2	12.4	1 DNS	85	1.5	0.4	0.3	2.2	0.1
Walsh	1.1	57.9	12.6	2 DNS	82	0.9	0.2	1.1	2.2	0.1
Ward	1.8	59.4	12.7	1 DNS	87	1.4	0.3	0.3	2.0	0.0
Wells	0.9	58.8	12.5	2 DNS	88	2.2	0.4	0.7	3.3	0.1
Williams	0.9	58.9	13.0	1 DNS	87	1.5	0.2	0.6	2.3	0.0
Average	1.0	58.7	12.7	1 DNS	87	1.6	0.3	0.5	2.4	0.1

*tough

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

Grade	Minimum Test Weight Per Bushel	Maximum limits of: Defects: Heat Damaged Kernels	Damaged Kernels (total)	Foreign Material	Shrunken and Broken Kernels	Defects (total)	Wheat of Other Classes: Contrasting Classes	Wheat of other classes (total)
	Pounds	percent	percent	percent	percent	percent	percent	percent
1	58.0	0.1	2.0	0.5	3.0	3.0	1.0	3.0
2	57.0	0.2	4.0	1.0	5.0	5.0	2.0	5.0
3	55.0	0.5	7.0	2.0	8.0	8.0	3.0	10.0
4	53.0	1.0	10.0	3.0	12.0	12.0	10.0	10.0
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.

in Table 1, ranged from 56.4 to 61.8 with an average of 58.7 lbs. per bushel. The moisture content was somewhat higher than a year ago and resulted in some of the samples grading "tough". The average moisture content for the state, however, was 12.7 per cent. Vitreous kernels ranged from 79 to 94 per cent with an average of 87 per cent.

Shrunken and broken kernels averaged out at 1.6 per cent which was well below the allowable limit for the top two grades. Foreign material (FM) was quite low showing an average of 0.3 per cent with a range of 0.1 to 0.4 per cent. Damaged kernels were also low with a range of 0.1 per cent to 1.6 per cent with an average of 0.5 per cent. Total defects, which is the sum of shrunken and broken kernels, foreign material and damaged kernels, including heat damaged kernels, were on the average within the limits listed for the two top grades. None of the samples was in excess of 0.3 per cent and the average was considerably less. The grades ranged from 3 Dark Northern Spring to 1 Heavy Dark Northern Spring.

The average test weight for each county sampled is presented in Fig. 1.

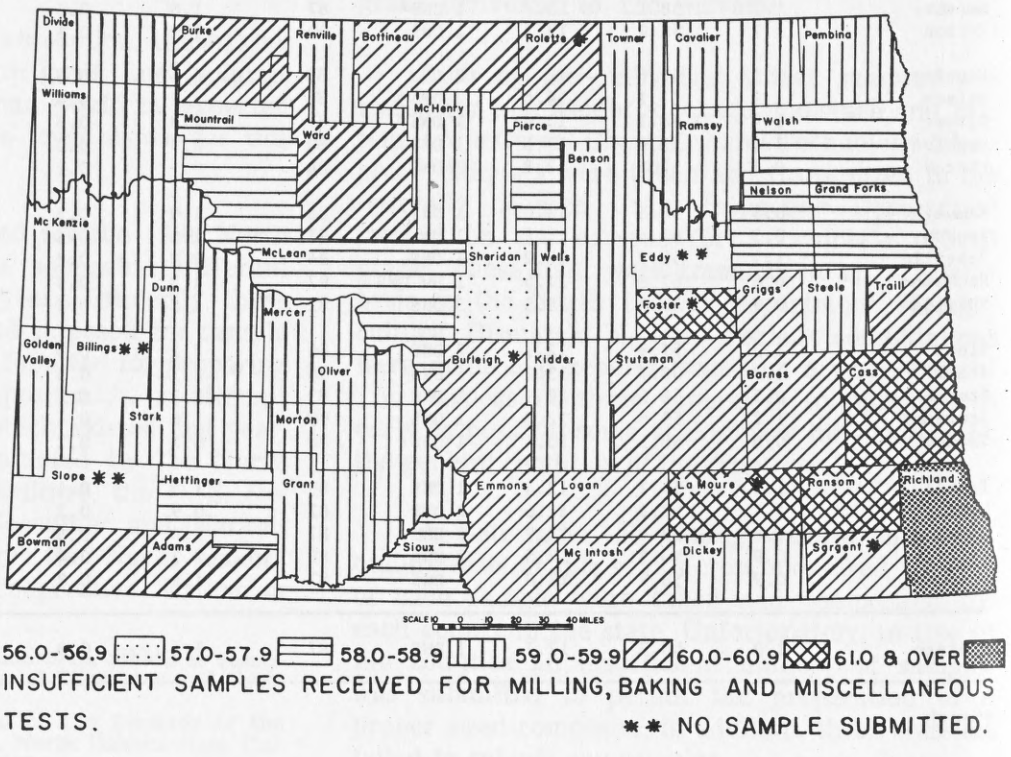

Fig. 1. The average test weight for each county in North Dakota.

Table 3. HRS Wheat Survey — 1968 Crop; Wheat Data (County Averages).

Counties	Test Weight	Hectoliter Weight	1000 Kernel Weight	Kernel Size		Protein
				.064 x 3/8	2.10 x 20	
	lbs/bu	Kg.	g.	%	%	%
Adams	59.0	78.4	27.2	1.6	11.7	14.2
Barnes	59.6	79.2	27.6	0.3	4.7	14.1
Benson	58.2	77.3	27.1	0.3	4.8	14.2
Bottineau	59.0	78.4	29.2	0.1	2.5	14.3
Bowman	59.9	79.6	27.0	0.9	7.2	13.3
Burke	59.5	79.1	31.4	0.1	2.3	14.3
Cass	60.6	80.5	29.3	0.1	6.1	13.4
Cavalier	58.3	77.5	30.5	0.1	3.1	12.7
Dickey	58.6	77.9	26.3	0.2	7.2	13.3
Divide	58.6	77.9	28.9	0.1	4.0	14.9
Dunn	58.0	77.1	25.8	0.1	6.3	14.7
Emmons	59.4	78.9	27.5	0.4	4.7	13.0
Golden Valley	58.7	78.0	28.6	0.1	3.8	14.2
Grand Forks	57.8	76.8	27.1	0.1	5.1	13.7
Grant	58.4	77.6	24.0	0.9	8.7	14.0
Griggs	59.3	78.8	29.3	0.1	3.0	14.0
Hettinger	57.8	76.8	26.9	0.5	8.8	15.2
Kidder	58.7	78.0	26.8	0.3	9.0	14.2
Logan	59.7	79.3	27.7	0.1	4.9	13.5
McHenry	58.0	77.1	29.2	0.1	2.9	14.8
McIntosh	59.9	79.6	27.4	0.5	6.5	12.9
McKenzie	58.4	77.6	31.2	0.1	3.7	14.8
McLean	57.2	76.0	23.4	0.5	12.3	15.2
Mercer	58.1	77.2	25.1	0.5	6.0	14.2
Morton	58.9	78.3	27.2	0.3	5.5	13.6
Mountrail	57.6	76.5	27.7	0.2	8.0	14.6
Nelson	57.1	75.9	26.3	0.1	5.5	14.1
Oliver	58.1	77.2	28.7	0.1	3.9	15.0
Pembina	58.0	77.1	29.2	0.1	2.5	13.7
Pierce	57.5	76.4	27.0	0.1	4.1	14.7
Ramsey	58.3	77.5	27.6	0.1	5.0	14.8
Ransom	60.4	80.2	26.7	0.2	4.5	13.9
Renville	58.7	78.0	28.2	0.1	3.3	14.6
Richland	61.8	82.1	28.6	0.3	2.9	13.0
Sheridan	56.4	74.9	24.7	0.5	7.6	15.1
Sioux	57.9	76.9	24.8	0.6	6.7	13.2
Stark	58.7	78.0	26.7	0.4	6.4	14.1
Steele	58.6	77.9	25.6	0.5	3.8	13.8
Stutsman	59.5	79.1	27.8	0.2	4.0	13.8
Towner	58.5	77.7	28.7	0.1	3.8	13.8
Traill	59.2	78.7	28.4	0.3	4.0	14.0
Walsh	57.9	76.9	29.9	0.2	2.4	14.3
Ward	59.4	78.9	25.6	0.5	4.0	14.2
Wells	58.8	78.1	25.6	0.7	6.8	14.8
Williams	58.9	78.3	28.3	0.5	4.0	14.7
Average	58.7	78.0	27.5	0.3	5.3	14.0

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 74.9 to 82.1 with an average of 78.0 kilograms per hectoliter. Thousand kernel weight ranged from 23.4 to 31.4 with an average of 27.5 grams.

Kernel size was determined by two methods. The first set of data lists results obtained by a U.S. sieve used for determining shrunken and broken kernels. On the average, 0.3 per cent of the wheat passed through the sieve. The second set of data was obtained from an European sieve with openings 30 per cent wider and twice as long as the U.S. sieve. In this test, on the average, 5.3 per cent of the kernels passed through the sieve.

The wheat protein content ranged from 12.7 to 15.3 per cent with a state average of 14.0 per cent. This is 0.4 per cent lower than the 1967 crop average. Figure 2 shows the average protein for the various counties sampled.

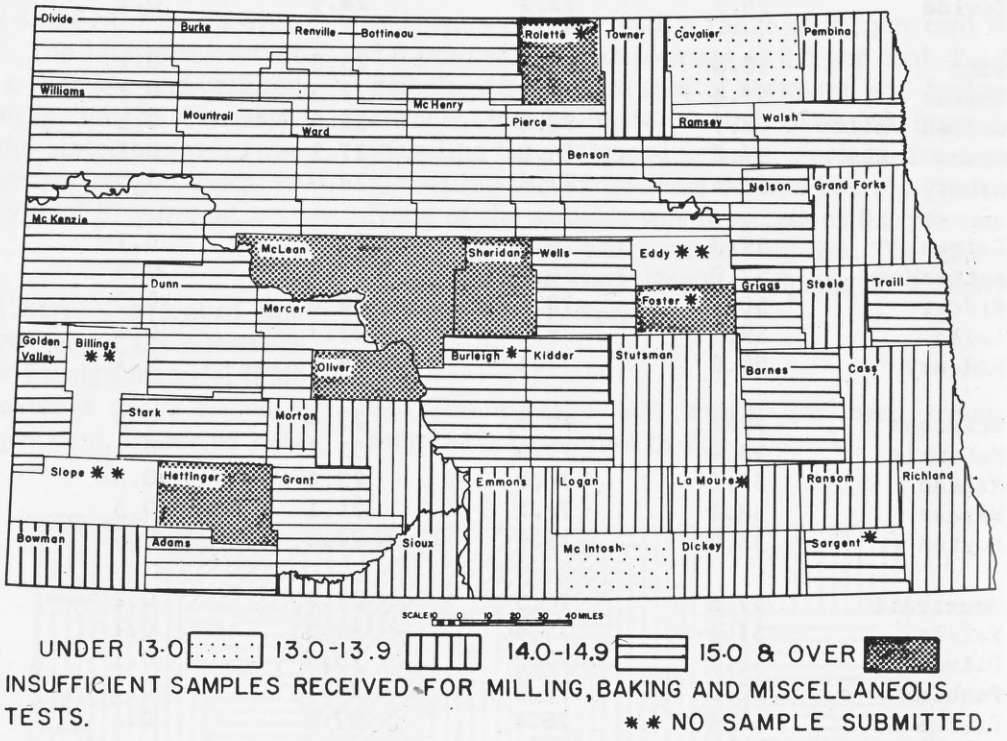

Fig. 2. The average protein content for each county in North Dakota.

Flour Tests

Table 4 shows the flour yield data which ranged from 67.0 to 73.1 per cent with a state average of 70.9 per cent. This is a little more than 4.0 per cent higher than last year at the same ash level. The ash of this straight grade flour ranged from 0.36 per cent in Sheridan county to 0.47 per cent in Kidder county with an average of 0.41 per cent. None of the samples displayed any abnormal milling characteristics. The protein content average was 13.2 per cent, with a range of 11.9 to 14.2 per cent. Flour water absorptions, as would be expected, were on the average 1.0 per cent lower than the 1967 crop. Wet gluten ranged from 32.1 to 49.0 with an average of 40.6 per cent. The diastatic activity and falling number are at levels which indicate the absence of excessive enzyme activity (sprout damage) in this year's crop.

Table 4. HRS Wheat Survey — 1968 Crop; Flour Data (County Averages).

Counties	Yield	Ash	Protein	Absorption	Wet Gluten	Diastatic Activity	Falling No.
	%	%	%	%	%	mg.	units
Adams	71.2	0.42	13.4	64.3	44.4	162	549
Barnes	70.5	0.43	13.5	63.4	45.9	192	542
Benson	72.1	0.40	13.4	63.5	43.6	129	443
Bottineau	69.2	0.39	13.3	64.5	49.0	214	304
Bowman	70.4	0.42	12.4	62.2	39.1	213	444
Burke	71.1	0.38	13.4	63.9	43.0	196	303
Cass	70.4	0.43	12.3	61.0	38.7	212	540
Cavalier	68.4	0.42	12.1	65.3	41.5	236	331
Dickey	72.2	0.43	13.0	62.3	39.3	187	493
Divide	69.4	0.40	13.7	65.5	39.5	291	211
Dunn	71.2	0.40	13.5	64.1	39.2	207	353
Emmons	72.0	0.41	11.9	61.6	32.1	225	524
Golden Valley	71.6	0.42	13.0	63.9	39.2	195	544
Grand Forks	70.4	0.42	12.9	63.9	45.6	268	270
Grant	72.5	0.44	13.1	63.0	37.7	213	310
Griggs	69.4	0.42	13.1	64.4	42.8	184	395
Hettinger	68.9	0.46	14.2	65.5	41.3	174	457
Kidder	69.7	0.47	13.7	63.8	45.0	182	513
Logan	73.0	0.44	12.8	63.6	39.3	188	467
McHenry	71.2	0.41	13.8	64.4	43.4	216	351
McIntosh	71.8	0.43	12.4	61.5	38.8	218	470
McKenzie	71.3	0.39	13.5	62.8	44.3	257	225
McLean	70.0	0.42	14.1	62.7	43.9	210	317
Mercer	73.0	0.40	13.1	61.8	40.3	216	389
Morton	72.0	0.44	12.8	61.8	39.8	190	480
Mountrail	71.4	0.40	13.7	61.2	40.5	194	362
Nelson	67.0	0.43	12.9	65.4	38.5	204	341
Oliver	72.5	0.40	13.6	65.2	46.0	222	334
Pembina	67.3	0.44	12.5	64.9	44.4	215	324
Pierce	70.3	0.41	13.5	63.9	38.6	221	315
Ramsey	71.4	0.41	13.5	64.7	39.0	178	401
Ransom	73.0	0.43	13.1	60.8	40.5	186	538
Renville	69.4	0.39	13.6	63.6	40.0	176	423
Richland	71.8	0.40	12.3	60.8	35.3	206	506
Sheridan	71.2	0.36	14.0	65.8	41.7	174	305
Sioux	72.5	0.43	12.5	62.4	33.7	190	528
Stark	70.8	0.43	12.8	62.6	38.6	197	449
Steele	71.0	0.41	13.0	64.0	38.1	174	346
Stutsman	72.4	0.42	13.2	64.7	38.6	188	563
Towner	67.0	0.39	12.9	66.4	38.8	181	441
Traill	72.7	0.40	13.0	64.4	37.5	218	411
Walsh	70.1	0.38	13.0	64.0	39.0	229	299
Ward	71.3	0.39	13.7	65.0	39.6	169	377
Wells	73.1	0.39	13.9	64.6	43.6	188	375
Williams	71.1	0.38	13.6	62.2	39.6	178	344
Average	70.9	0.41	13.2	63.6	40.6	201	405

Table 5. HRS Wheat Survey — 1968 Crop: Baking Data.

Counties	Dough char.	Loaf vol.	Gr. & tex.	Crumb color	Crust color	Symmetry
		cc.				
Adams	4	765	8.5	8.5	4	4.5
Barnes	4	790	9.0	8.5	4	4.5
Benson	4	815	9.0	8.5	4	4.5
Bottineau	4	850	9.0	8.5	4	4.5
Bowman	4	800	8.5	8.0	4	4.5
Burke	4	840	9.0	8.5	4	4.5
Cass	4	740	8.5	8.0	4	4.5
Cavalier	4	735	8.5	8.0	4	4.5
Dickey	4	740	9.0	8.5	4	4.5
Divide	4	885	8.5	8.5	4	4.5
Dunn	4	830	9.0	8.5	4	4.5
Emmons	3	740	9.0	8.5	4	4.5
Golden Valley	4	785	9.0	8.5	4	4.5
Grand Forks	4	790	9.0	8.5	4	4.5
Grant	4	760	9.0	8.5	4	4.5
Griggs	4	790	8.5	8.5	4	4.5
Hettinger	4	865	8.5	8.5	4	4.5
Kidder	4	795	9.0	8.5	4	4.5
Logan	4	790	8.5	8.0	4	4.5
McHenry	4	800	9.0	9.0	4	4.5
McIntosh	4	715	9.0	8.5	4	4.5
McKenzie	4	780	9.0	9.0	4	4.5
McLean	4	825	8.5	8.5	4	4.5
Mercer	4	785	8.5	8.5	4	4.5
Morton	4	740	9.0	8.5	4	4.5
Mountrail	4	850	9.0	8.5	4	4.5
Nelson	4	785	8.0	8.0	4	4.5
Oliver	4	875	8.5	8.5	4	4.5
Pembina	3	725	8.5	7.5	4	4.0
Pierce	4	905	8.5	8.5	4	4.5
Ramsey	4	855	8.5	8.5	4	4.5
Ransom	4	780	8.5	8.5	4	4.5
Renville	4	825	9.0	8.5	4	4.5
Richland	4	700	8.5	8.5	4	4.0
Sheridan	4	930	8.0	8.5	4	4.5
Sioux	3	730	9.0	8.5	4	4.0
Stark	3	745	9.0	8.5	4	4.5
Steele	4	740	9.0	8.5	4	4.0
Stutsman	4	780	9.0	8.5	4	4.5
Towner	3	725	9.0	8.5	4	4.0
Traill	4	740	8.5	8.0	4	4.5
Walsh	4	755	8.5	8.5	4	4.5
Ward	4	805	8.5	8.5	4	4.5
Wells	4	795	9.0	8.5	4	4.5
Williams	3	795	8.5	8.5	4	4.5
Average	4	791	8.7	8.4	4	4.5

Baking Tests

In general, the baking properties of the 1968 crop, as shown in Table 5, are good. The dough handling properties were very good in 39 of the counties tested; the remaining samples classed as good. Loaf volume, on the average, although a little lower than last year, was good. Crumb color and crumb grain and texture of the test loaves were quite high, in fact on the average, these scores were the highest obtained for the past seven years. Color of the loaf crust as well as the overall appearance (symmetry) were very good. Loaves of bread of large volume having a uniform grain and texture are desired; these characteristics indicate flour strength.

Table 6. HRS Wheat Survey — 1968 Crop: Physical Dough Properties.

Counties	Farinogram					Extensogram					
		Mixing			Classification	Extensibility		Resistance			Classification
	Absorption	Time	Tolerance	MTI		45 min.	180 min.	45 min.	180 min.	Area	
	%	min.	min.			cm.	cm.	cm.	cm.	sq. cm.	
Adams	63.3	6.5	7.0	25	6	22.3	20.5	8.3	9.0	145	7
Barnes	62.1	5.0	5.5	30	5	16.9	20.9	6.6	6.9	126	5
Benson	62.7	6.5	7.0	25	5	22.2	23.8	8.3	9.1	174	7
Bottineau	63.7	5.0	5.5	60	4	24.8	22.0	7.1	7.5	140	5
Bowman	61.6	5.0	6.0	40	5	23.3	18.9	6.9	8.1	120	6
Burke	63.0	5.0	6.0	35	5	25.1	22.0	7.8	9.1	160	7
Cass	60.2	4.0	5.5	40	5	18.3	19.9	8.2	9.1	150	7
Cavalier	64.3	4.5	5.5	40	4	18.1	18.1	5.3	5.8	90	4
Dickey	61.3	6.0	9.5	20	6	22.3	20.3	5.0	9.2	140	7
Divide	64.7	5.5	6.5	35	5	23.4	21.5	6.2	8.3	135	6
Dunn	63.3	8.0	11.5	10	7	21.6	21.8	8.1	11.7	198	8
Emmons	60.9	5.0	9.0	20	6	20.8	17.7	6.4	9.7	140	7
Golden Valley	63.4	8.5	9.5	30	7	23.3	21.8	8.8	13.4	235	9
Grand Forks	63.3	5.0	5.5	55	4	21.7	23.7	5.8	7.9	160	6
Grant	62.7	6.5	13.0	15	7	21.7	22.0	8.0	11.6	210	8
Griggs	63.7	5.0	6.0	45	4	19.2	18.4	5.2	7.6	115	6
Hettinger	64.9	6.5	5.5	35	5	22.8	20.4	5.0	8.3	140	6
Kidder	63.3	7.0	8.0	20	6	21.8	20.7	5.3	8.8	150	7
Logan	63.0	5.5	6.5	25	5	19.5	17.8	5.6	8.6	130	6
McHenry	63.7	6.0	6.5	30	5	24.2	23.3	7.2	11.3	220	8
McIntosh	61.0	5.0	6.0	35	5	21.4	19.3	7.3	9.8	155	7
McKenzie	62.3	5.0	6.5	40	5	19.9	22.0	7.8	11.0	200	8
McLean	62.0	6.5	7.5	30	6	23.3	21.0	9.0	12.4	205	9
Mercer	61.0	5.5	8.0	35	6	21.0	19.2	8.0	12.7	190	9
Morton	61.0	5.0	8.0	35	6	19.0	18.2	8.3	13.7	160	8
Mountrail	61.0	4.5	7.5	40	5	22.5	19.1	8.1	10.9	165	8
Nelson	65.1	5.0	5.5	50	4	17.8	16.9	4.4	6.7	100	5
Oliver	65.0	8.0	8.0	35	6	23.5	23.0	7.0	10.4	200	8
Pembina	64.7	4.0	5.0	40	4	19.4	17.0	5.9	7.3	100	6
Pierce	63.9	4.5	6.0	35	5	21.1	22.3	6.5	10.1	190	8
Ramsey	64.6	5.5	6.0	55	4	22.5	20.8	5.9	8.0	145	6
Ransom	60.3	5.0	6.5	40	5	20.0	19.3	7.0	9.3	150	7
Renville	63.0	5.0	5.0	45	5	23.8	24.0	6.5	10.2	200	8
Richland	60.5	4.0	5.0	50	5	19.3	21.5	6.8	9.8	180	7
Sheridan	65.3	9.0	10.0	20	7	26.7	22.3	7.1	11.7	200	8
Sioux	62.1	8.0	10.0	20	7	23.0	20.2	8.2	11.9	190	8
Stark	62.6	5.5	8.5	30	6	20.7	21.5	7.4	10.8	190	8
Steele	63.4	4.5	5.5	40	5	21.0	20.8	6.0	8.4	140	6
Stutsman	64.1	7.0	8.0	20	6	22.5	19.5	6.0	8.6	130	7
Towner	65.7	6.0	7.0	50	5	19.9	20.3	5.7	8.4	140	7
Traill	63.7	5.5	7.0	35	5	18.8	17.8	5.7	7.6	110	6
Walsh	63.3	5.0	6.5	30	5	21.7	21.3	6.2	8.3	150	6
Ward	64.4	6.5	6.5	35	5	23.8	24.7	5.8	8.8	190	7
Wells	64.3	4.5	4.0	50	4	23.2	22.6	6.0	8.9	170	7
Williams	61.6	5.5	7.5	30	5	24.0	22.2	8.0	11.1	200	8
Average	63.0	5.7	7.0	34	5.3	21.6	20.7	6.8	9.5	161	7.0

Physical Dough Properties

Table 6 shows farinogram and extensogram data.

The mixing characteristics of this year's crop, as indicated by the farinogram pattern, are classified as having medium strength. Farinogram absorption averaged 1.3 per cent lower than last year. However, the actual baking absorption averaged 0.6 per cent higher than the Farinograph absorption. Mixing time ranged from 4.0 to 9.0

minutes with an average of 5.7 minutes. The mixing tolerance average was 7.0 minutes with a range of 4.0 to 13.0 minutes. On the average, both mixing time and tolerance are somewhat lower than last year. A partial explanation of this is attributed to the increased production of the better agronomic varieties Chris and Manitou which took over acreage formerly occupied by the very strong variety Justin. The MTI value (mixing tolerance index) depicts the characteristics of a medium strength curve. The average overall empirical classification was 5.3. This is below the very strong type curve of the 1967 crop. Figure 3 shows an average farinogram for the 1968 crop.

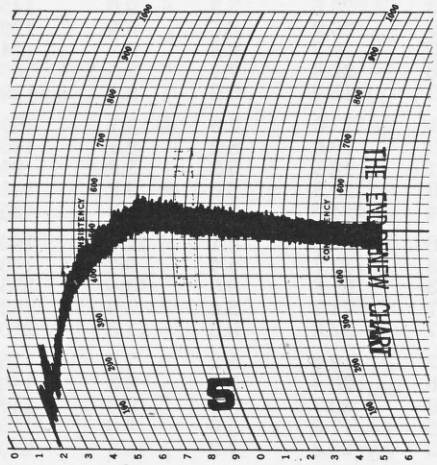

Fig. 3. Farinogram showing average mixing strength of the 1968 crop.

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 only a little lower than those obtained for the 1967 crop, which indicates in general that the 1968 crop has very good elastic properties. An average extensogram is shown in Fig. 4.

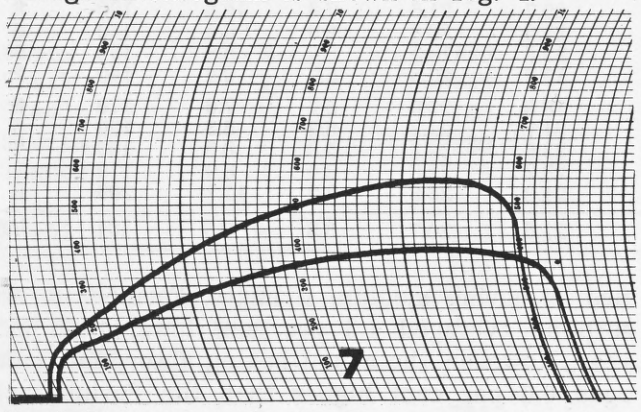

Fig. 4. Extensogram showing average properties of the 1968 crop.

Table 7 compares some of the pertinent average quality factors for the 1962, 1963, 1964, 1965, 1966, 1967 and 1968 hard red spring wheat crops. Also, the five-year (1963-1967) average is shown. The data from this year's crop, when compared with the 1967 crop, are higher in flour yield, crumb color and crumb grain and texture. The other quality characteristics are either equal to last year or a little lower.

When compared with the five-year average, the 1968 crop is better in test weight (hectoliter weight) flour yield, flour ash, crumb color and crumb grain and texture. Dough handling properties and the general appearance of the test loaves were about the same as that shown for the five-year average. Percentage of vitreous kernels, wheat protein, absorption, loaf volume and the empirical classification of the farinogram and extensogram were a little lower.

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; in fact, 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, with Chris, a better wheat agronomically but displaying more mellow quality characteristics, occupying about 33 per cent of the acreage. In 1968, it was estimated that Justin was seeded on only 18 per cent of the wheat acreage, Chris, 40 per cent and Manitou, 28 per cent. Manitou is similar to Chris in general dough properties. These figures show that in three 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 mellow types to 20 per cent very strong and 80 per cent mellow wheats in 1968.

GRADE AND MARKET QUALITY FACTORS

The percentage of the crop falling into the various grades is depicted in the diagram shown in Fig. 5. The figures shown on the outside of the circle are an accumulative percentage of the grades. For example, the number 86 on this figure indicates that 86 per cent of the 1968 hard

Table 7. HRS Wheat Survey: Comparison of Average Quality Factors for North Dakota 1962, 1963, 1964, 1965, 1966, 1967 and 1968 Crops.

(Milling and analytical data)

Crop Year	Test weight	Hectoliter weight	Vit. kernels	Wheat protein	Flour yield	Flour ash	Falling No.	Diastatic activity
	lbs/bu	kg.	%	%	%	%	units	mg.
1962	59.6	79.2	87	13.3	68.5	0.46	—	—
1963	55.7	74.0	87	14.4	67.6	0.45	—	—
1964	57.9	76.9	96	14.7	67.1	0.44	—	206
1965*	58.4	77.6	96	14.4	67.3	0.42	349	212
1966	58.4	77.6	94	15.2	66.9	0.43	343	181
1967	59.9	79.6	95	14.4	66.8	0.41	493	178
1968	58.7	78.0	87	14.0	70.9	0.41	405	201
5-year Ave.	58.1	77.2	94	14.6	67.1	0.43	—	—

(Baking data)

Crop Year	Absorption	Dough char.	Loaf vol.	Gr. & tex.	Crumb color	Crust color	Symmetry
	%		cc.				
1962	66.0	4	819	8.0	8.0	4	4.5
1963	65.0	4	810	8.0	8.0	4	4.5
1964	64.3	4	830	8.3	8.1	4	4.5
1965*	64.2	4	845	8.6	8.0	4	4.5
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
5-year Ave.	64.9	4	835	8.4	8.1	4	4.5

(Physical dough properties)

	Farinogram				Extensogram					
Crop	Mixing				Extensibility		Resistance			
Year	time	tolerance	Classification		45	180	45	180	Classification	
	min.	min.			cm.	cm.	cm.	cm.		
1962	5.9	8.2	M. Strong	5.9	23.3	22.3	5.2	7.7	M. Strong	5.7
1963	7.3	15.2	Strong	6.8	23.5	22.0	6.5	9.4	Strong	7.2
1964	6.9	13.8	Strong	7.2	23.6	22.5	5.9	8.8	Strong	7.1
1965*	9.0	22.0	Strong	7.5	23.7	22.9	7.3	10.4	V. Strong	7.7
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
5-year Ave.	8.7	18.8	Strong	7.4	23.3	22.4	7.1	10.3	V. Strong	7.6

*Calculated weighted average for the "pre" and "post" rain crops of 1965. 5-year Average — 1963-1967.

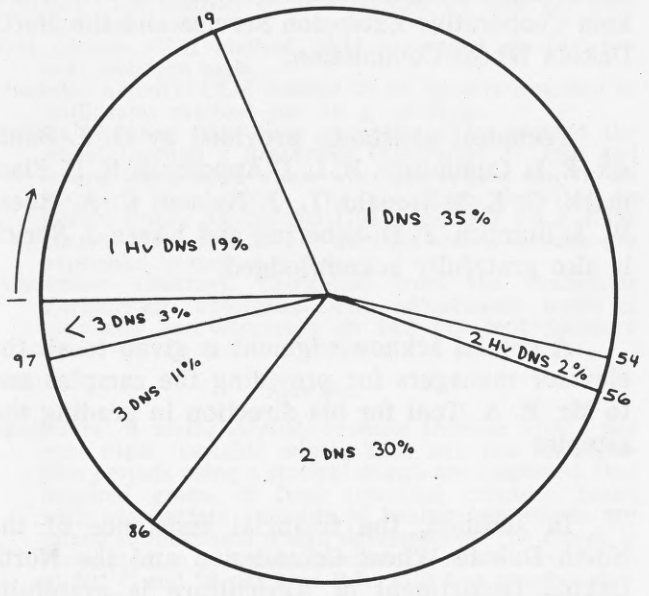

Fig. 5. Diagram showing grade distribution of the 1968 Crop.

red spring wheat crop (approximately 111 million bushels) should grade 2 Dark Northern Spring or better. This compares quite favorably with the 1967 crop report which estimated that 95 per cent of the crop would grade 2 Dark Northern Spring or better. Almost all of the samples received in this year's survey fall within six grade classifications.

WEATHER AND HARVEST

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

The seeding of hard red spring wheat in North Dakota was in progress in some of the southern counties as early as mid-March. By mid-April, about 19 per cent was planted, and by the end of the month, 70 per cent of the state was completed. By May 15, 92 per cent was planted; this compared with only 35 per cent last year and 79 per cent for the ten-year average. The seeding

of hard red spring wheat was virtually completed by the end of May according to the "North Dakota Weekly Weather and Crop Report".

Excellent growing conditions prevailed during June, July and up to mid-August. Toward the end of August, rains and heavy dew hampered the harvest and this continued for some time. By September 10, only 44 per cent of the HRS wheat was in the bin; this compared with 99 per cent for last year. In general, the 1968 harvest was very slow, particularly in the northeastern sections of the State. However, by October 8, HRS wheat combining was 98 per cent completed. In a wet year such as was experienced in 1968, sprouting, bleaching and low vitreous kernel content are damage factors of concern to the grain industry. Although the vitreous kernel content was down somewhat from last year, this lower value did not markedly affect the quality. The enzyme activity, associated with sprouting, was low also. In general, the prolonged rainy spell during harvest did not affect the quality of the crop to the extent that was expected.

Subsequently, the 1968 North Dakota hard red spring wheat crop was estimated by the USDA to be about 129.3 million bushels with an average yield per acre of 26.5 bushels. This is a near record HRS crop, being 5 per cent over the 1967 crop and 33 per cent over the five-year average. The record was 129.4 million bushels produced in 1944.

Summary

In spite of adverse weather conditions during harvest, North Dakota farmers produced a near record crop of hard red spring wheat. The heavy rains which came during harvest time did not seriously affect the quality of the major portion of the crop. In isolated areas where sprouting had occurred, farmers and grain merchants were urged not to blend sound wheat with sprouted wheat, as this practice would most certainly lower the quality and thereby alter the reputation that North Dakota has gained over the years for supplying both the domestic and export markets with hard red spring wheat of high quality.

It is estimated that 54 per cent of the crop graded Number 1 and that 86 per cent graded Number 2 or better. The average dockage for the state was 1.0 per cent with a range of 0.2 to 2.0 per cent. The average moisture and protein contents were 12.7 and 14.0 per cent, respectively. Test weights ranged from 56.4 to 61.8 with a state average of 58.7 pounds per bushel.

The wheat milled in a normal manner and produced flour of a good color, high yield and low ash. The baking absorption, loaf volume, farinogram and extensogram patterns were all a little lower than the 1967 crop. Crumb color and crumb grain and texture were higher than last year. In general, however, the overall baking properties were good, but not quite equal to the 1967 crop.

When the 1968 crop is compared with the five-year average, it is better in test weight, flour yield, flour ash, crumb color and crumb grain and texture of the bread. It is a little lower in percentage of vitreous kernels, wheat protein content, absorption and loaf volume. The mixing characteristics and gluten properties as measured by the Farinograph and Extensograph appear to indicate a more mellow dough. These dough characteristics can be explained by the fact that the predominating varieties and environmental conditions are subject to yearly changes.

Acknowledgment

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Technical assistance provided by O. J. Banasik, E. L. Cummings, B. L. D'Appolonia, R. P. Fladmark, C. E. McDonald, L. J. Nelson, C. A. Roen, W. J. Rumpca, F. D. Sobering and Karen J. Sprick is also gratefully acknowledged.

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In addition, the financial assistance of the North Dakota Wheat Commission and the North Dakota Department of Agriculture is gratefully acknowledged.

WHEAT

Test Weight per Bushel: Cereal Laboratory Methods (CLM)*; method 84-10.

Hectoliter Weight: Calculated from the test weight per bushel.

Thousand Kernel Weight: Ten grams of cleaned wheat (free from foreign material and broken kernels) are counted, using an electronic seed counter. The calculated weight for 1,000 kernels is reported.

Kernel Size (0.064 x 3/8 sieve): A 0.064 x 3/8 sieve is a metal sieve 0.0319 inch thick perforated with oblong holes 0.064 inch by 0.375 (3/8) inch which are 1/8 (0.1250) inch from center to center and with 0.0525 inch end bridges. The perforations are staggered in relation to the adjacent rows. One hundred grams of wheat are placed on the sieve, which is rotated 30 times. The material passing through the sieve is reported.

Kernel Size (2-10 x 20 sieve): This sieve, which is used extensively in Europe, is a metal sieve with slotted holes 2.1 mm wide by 20 mm long with 84 perforations per 10 sq. cm. One hundred grams of wheat are placed on the sieve which is rotated 30 times. The material passing through the sieve is reported.

Grade: The grade is determined by a United States licensed inspector using the Official Grain Standards of the United States (SRA-AMS-177) as revised May, 1964.

Vitreous Kernels (Vit. Kernels): The vitreous kernels from 50 grams of wheat are hand picked, weighed and reported.

Protein: CLM; method 46-10, expressed on 14.0 per cent moisture basis.

FLOUR

Yield: Thoroughly cleaned wheat is tempered to 16.0 per cent moisture for 16 hours; scoured, and an additional temper of 0.5 per cent made 5 minutes prior to milling. The milling laboratory is controlled at 68 per cent relative humidity and 72° to 74° F. Milling is performed in a Buhler laboratory mill (Type MLU-202). All six flour streams are blended and reported as "flour yield". The blended flour is rebolted through 60 SS and 80 SS sieves to remove any foreign material. This product is used for the other flour quality determinations.

Ash: CLM method 08-01 expressed on 14.0 per cent moisture basis.

Protein: CLM method 46-10 expressed on 14.0 per cent moisture basis.

Wet Gluten: CLM method 38-11 expressed on 14.0 per cent moisture basis.

Diastatic Activity: CLM method 22-15. Results reported as milligrams maltose per 10 g. of flour.

Falling Number: The flour is obtained by passing the wheat through a Brabender Quadramat Jr. mill and sifting the ground whole wheat through a No. 70 US standard sieve (200u). The procedure, described in Cereal Chem. 38, 202-203 (1961) requires 7.0 g. flour (15.0% M.B.) and 25 ml. distilled water. Results are expressed in units (seconds).

Absorption (Baking): Calculated from the Brabender Farinograph absorption with adjustments made if necessary and expressed on 14.0 per cent moisture basis.

BAKING

Procedure: A malt-phosphate-bromate formula with 5 per cent sugar, variable mixing time and two fermentation periods using a straight dough are employed. One hundred grams of flour (constant moisture basis) with appropriate amounts of baking ingredients are mixed to maximum dough development. The dough is fermented in porcelain bowls in a cabinet controlled at 30° C and 78 per cent R.H. with two punches during a 3-hour fermentation, a proof period of 55 minutes then baked at 230° C. for 25 minutes.

Dough Characteristics (Dough Char.): Handling qualities of the fermented dough; assessed at panning time. (4 equals very good; 3 equals good; 2 equals fair; 1 equals poor).

Loaf Volume (Loaf Vol.); Rape seed displacement measurment made 30 minutes after bread removed from oven.

Grain and Texture (Gr. & Tex.): Visual comparison with a standard, using a constant illumination source. Perfect score is 10.0.

Crumb color: Visual comparison with a standard, using a constant illumination source. Perfect score is 10.0,

Crust Color: Visual comparison with a standard, using a constant illumination source. (4 equals very good, 3 equals good; 2 equals fair; 1 equals poor).

Symmetry: Visual comparison with a standard, using a constant illumination source. Perfect score is 5.0.

PHYSICAL DOUGH PROPERTIES

FARINOGRAM:

Procedure: Fifty grams of flour on a constant moisture basis are mixed in a small stainless steel Farinograph bowl with sufficient distilled water to give a maximum dough consistency centered on the 540 Brabender unit line.

Absorption: Amount of water (cc x 2) required to center curve peak on the 540 Brabender unit line.

Mixing Time (Mix Time): Time in minutes required for the center portion of the farinogram to reach the 540 Brabender unit line.

Mixing Tolerance (Mix. Tol.): Time in minutes that the curve remains horizontal on the 540 Brabender unit line.

Mixing Tolerance Index (M.T.I.): CLM method 54-21.

Classification: An overall empirical classification incorporating mixing time, mixing tolerance, and general curve characteristics is assigned.

EXTENSOGRAM:

Procedure: One hundred grams of flour, on a constant moisture basis, are mixed with 1.0 per cent sodium chloride U.S.P.; 0.003 per cent potassium bromate and a quantity of water as pre-determined by the Farinograph. Mixing is performed using a Standard National Dough Mixer with variable mixing times in accordance with data obtained from the farinogram. Doughs are scaled, after mixing to 150 grams, rounded, moulded, placed in extensogram holders, and rested in a cabinet controlled at 30° C. + 78 per cent R.H. After 45 minutes, the dough is stretched in the Extensograph and a curve drawn. The dough is then gathered together, placed in a fermentation bowl and returned to the cabinet for an additional rest period. After 90 minutes, the dough is removed, rounded, moulded, placed in the Extensograph holder, and returned to the cabinet. After 45 minutes, a second curve is obtained which is super-imposed over the first curve. The lower tracing is the 45 minute curve and the upper, the 180 minute one.

Extensibility, 45 min: The length of the lower curve is measured and reported.

Extensibility, 180 min: The length of the upper curve is measured and reported.

Resistance, 45 min: The maximum height of the lower curve is measured and reported.

Resistance, 180 min: The maximum height of the upper curve is measured and reported.

Area: The area under the 180 min. curve is measured and reported.

Classification: An overall empirical classification of the 180 min. curve is assigned.

*American Association of Cereal Chemists, Cereal Laboratory Methods (7th Edition), St. Paul, Minn. (1962).

Fig. 6. The latest addition to the Cereal Chemistry and Technology building at North Dakota State University. New varieties are evaluated here for quality. North Dakota is famous for its high quality wheat. Much of the work done here is aimed at guarding and preserving this quality.

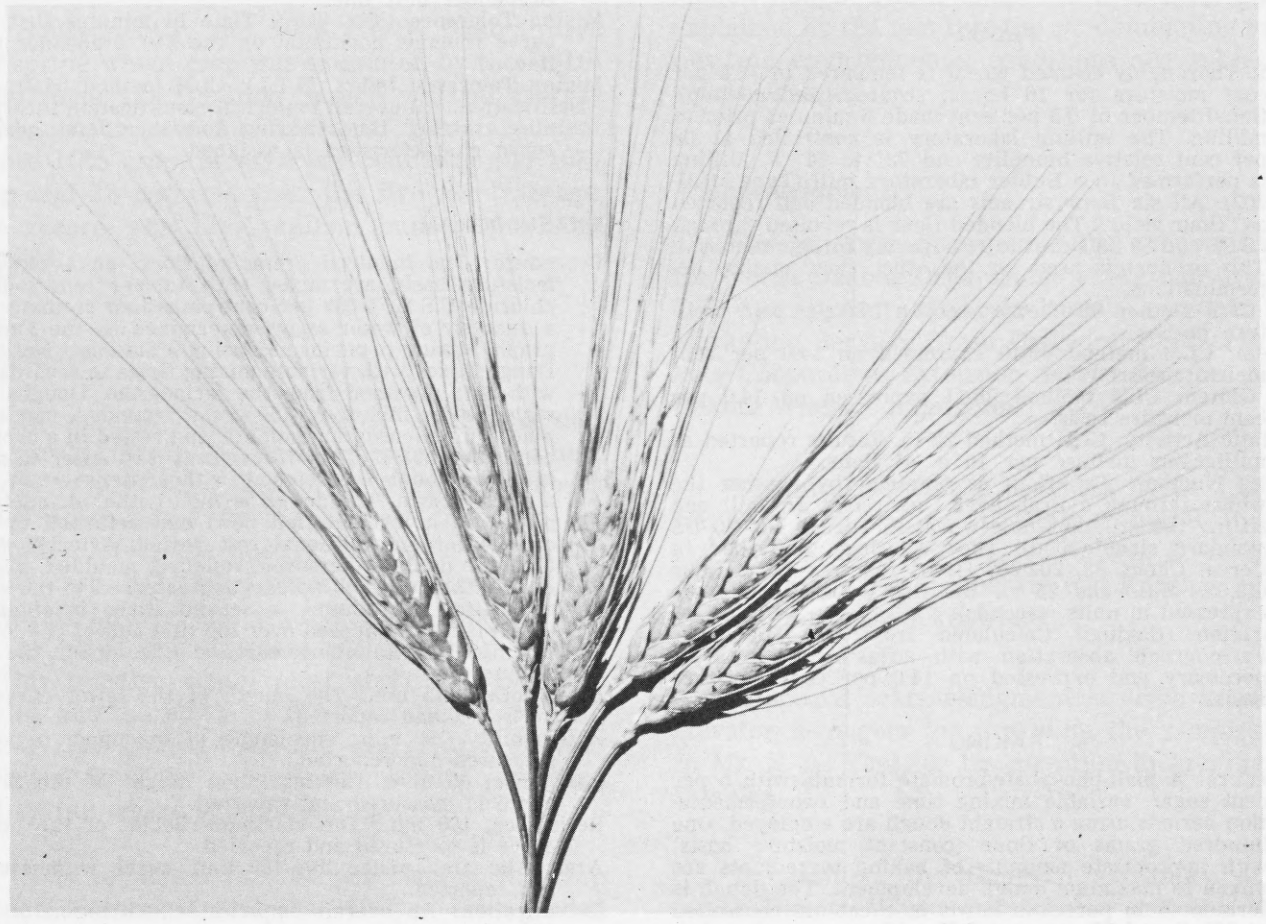

Fig. 7. North Dakota is a prime durum producing state. North Dakota field crops fill unique market demands, and great attention is given to the factors the market desires.

Quality Factors of the 1968 Durum Crop

L. D. Sibbitt and K. A. Gilles

The 1968 North Dakota durum wheat crop is estimated by the USDA to be about 82 million bushels (2.4 million metric tons), the largest on record for production of this specialty crop. The 1968 yield is almost 50 per cent larger than last year and the 5-year average. An average yield of 28.0 bushels per acre is estimated. This is 4.0 bushels above a year ago but a little below the 5-year average.

In general the 1968 North Dakota durum wheat crop is of fair to good quality, and is somewhat similar to that produced in 1966. It is, however, below the excellent quality of the durum wheat crop produced last year. All of the major factors examined are lower than the 1967 crop, with the exception of weight per 1000 kernels. This increase in kernel weight can be attributed to the new variety Leeds which was grown extensively in North Dakota for the first time. The color of the spaghetti is bright, but the score is a little lower than that produced last year.

In an attempt to avoid some duplication which existed last year, the general format was changed for the 1968 North Dakota wheat quality survey. A cooperative effort was initiated which involved to varying degrees the North Dakota Department of Agriculture, the U.S. Department of Agriculture (Consumer and Marketing Service, Grain Division), the North Dakota Wheat Commission, the Cooperative Extension Service and the Experiment Station at North Dakota State University. These changes involved primarily the procedure imposed for the selection of samples.

Samples and Methods

During the 1968 harvest, samples were collected and submitted by cooperating elevators from all of the counties producing substantial amounts of durum wheat, with at least two elevators in each county participating. The number of samples collected during an 8-week period reflected the anticipated crop production of each county. The elevator operators were requested to collect and place in suitable containers a sample from each truck load of durum wheat delivered to the elevator. Twice a week the samples were thoroughly mixed and a 2½ pound aliquot was taken, placed in a moisture proof plastic bag and transmitted to the Department of Cereal Chemistry and Technology at North Dakota State University, Fargo, N. Dak., for a complete grade and quality evaluation. These samples were uncleaned and reflected the condition of the grain delivered to the elevator.

Determinations were made on the individual samples 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 the campus, for a complete official grade. These data were transmitted on a weekly basis to the North Dakota Department of Agriculture, Bismarck, N. Dak. Weekly reports publicized, as early as possible, some preliminary information on the general condition of the crop.

To determine the milling, spaghetti processing and other quality tests on this year's crop, measured aliquots of each sample were composited by counties. Unfortunately, for certain counties a limited number of samples precluded preparation of an adequately sized composite for complete quality evaluation.

QUALITY DATA ON COMPOSITES

Wheat Tests

Table 1 lists by county the averages for dockage, grades and the various grading factors as

Dr. Gilles is professor and chairman, Sibbitt is associate professor, Department of Cereal Chemistry and Technology.

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