The Quality of North Dakota's 1969 Hard Red Spring Wheat

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The overall quality of North Dakota's 1969 hard red spring wheat crop is considered excellent. The test weight (hectoliter weight), flour yield and falling number are considerably better than the 1968 crop and the five-year average. The percentage of vitreous kernels and wet gluten are both higher than the 1968 crop. The average wheat protein content for the state is 14.1 per cent, about the same as the 1968 crop (14.0 per cent). The average moisture content of the wheat, 10.9 per cent, is almost 2.0 per cent lower than last year.

The baking characteristics in general are excellent. The dough handling properties are very elastic with no "buckiness" of the dough observed. Loaves of large volume with fine grain and silky textures were produced. Flour protein and baking absorption are both higher than the 1968 crop. The mixing properties, although very good, tend to be slightly mellower than last year.

The USDA estimates the North Dakota hard red spring wheat crop at about 109 million bushels (2.9 million metric tons). This compares with the 1968 crop of 129 million bushels. An estimated average yield of 28.0 bushels per acre is one and one-half bushels above a year ago. Ideal harvesting conditions in North Dakota resulted in a crop having low moisture, very low amounts of shrunken and broken kernels, damaged kernels and foreign material. Test weights are about 2.0 lbs. per bushel heavier than the 1968 crop. Vitreous kernel content is also quite high. The crop generally was very uniform throughout the entire state. A preponderance of the crop (95 per cent) should grade No. 2 Dark Northern Spring or better.

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Samples and Methods

During the 1969 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 and place in suitable containers a sample from each truck load of hard red spring wheat delivered. Twice a week, the samples were thoroughly mixed and a three-pound 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.

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 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 in Table 1, ranged from 58.6 to 61.4 with an average of 60.4 lbs. per bushel. The average moisture content for the state is 10.9 per cent. Vitreous kernels ranged from 80 to 94 per cent with an average of 89 per cent.

TABLE 1. HRS Wheat Survey - 1969 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	2.3	59.4	10.2	2 DNS	92	2.8	0.3	0.2	3.3	0.1
Barnes	1.8	60.5	11.2	2 Hv DNS	92	2.2	0.5	0.4	3.1	0.0
Benson	1.1	60.9	10.9	1 Hv DNS	87	0.9	0.2	0.2	1.3	0.0
Bottineau	0.8	60.8	11.3	1 Hv DNS	90	1.4	0.2	0.2	1.8	0.0
Bowman	2.1	59.0	9.7	2 DNS	89	3.2	0.4	0.3	3.9	0.1
Burke	0.7	61.0	10.8	1 Hv DNS	90	1.2	0.3	0.2	1.7	0.0
Burleigh	2.6	60.1	11.0	1 Hv DNS	91	2.3	0.3	0.2	2.8	0.0
Cass	0.5	60.5	10.9	1 Hv DNS	89	1.3	0.3	0.4	2.0	0.0
Cavalier	0.9	60.8	11.8	1 Hv DNS	86	1.2	0.2	0.3	1.7	0.0
Dickey	2.3	59.5	10.8	2 DNS	92	3.9	0.5	0.2	4.6	0.0
Divide	0.9	61.4	10.6	1 Hv DNS	94	1.4	0.3	0.4	2.1	0.0
Dunn	1.1	59.9	10.4	1 DNS	89	2.2	0.4	0.4	3.0	0.0
Eddy	0.7	60.4	11.1	1 Hv DNS	80	2.0	0.4	0.3	2.7	0.0
Emmons	1.1	60.0	10.5	1 Hv DNS	88	2.0	0.4	0.4	2.8	0.0
Foster	1.3	60.4	11.0	2 Hv DNS	93	2.0	0.6	0.2	2.8	0.0
Golden Valley	0.2	60.3	10.3	1 Hv DNS	90	1.0	0.4	0.3	1.7	0.0
Grand Forks	1.1	61.1	11.0	1 Hv DNS	85	1.8	0.3	0.4	2.5	0.0
Grant	1.5	58.8	10.2	2 DNS	82	4.0	0.4	0.3	4.7	0.2
Griggs	1.0	60.4	11.4	2 Hv DNS	89	2.5	0.4	0.3	3.2	0.1
Kidder	1.7	59.8	10.6	2 DNS	94	2.7	0.4	0.3	3.4	0.2
LaMoure	0.4	58.6	11.3	1 DNS	92	0.4	0.4	0.4	1.2	0.0
Logan	0.9	60.7	11.8	1 Hv DNS	87	1.6	0.4	0.2	2.2	0.0
McHenry	1.2	60.2	11.2	1 Hv DNS	87	1.7	0.4	0.4	2.5	0.0
McIntosh	1.9	59.8	12.0	2 DNS	86	2.6	0.4	0.3	3.3	0.0
McKenzie	1.8	59.3	10.4	2 DNS	90	3.3	0.4	0.5	4.2	0.0
McLean	1.6	60.2	11.0	1 Hv DNS	92	1.8	0.4	0.4	2.6	0.0
Mercer	2.4	60.1	10.5	1 Hv DNS	91	2.4	0.4	0.2	3.0	0.1
Morton	1.9	60.2	10.9	1 Hv DNS	89	2.0	0.5	0.2	2.7	0.2
Mountrail	1.4	60.2	11.0	1 Hv DNS	94	2.0	0.4	0.4	2.8	0.0
Nelson	0.8	61.4	11.5	1 Hv DNS	89	1.5	0.4	0.4	2.3	0.0
Oliver	0.2	60.4	10.5	1 Hv DNS	88	1.2	0.4	0.6	2.2	0.0
Pembina	0.9	61.3	11.6	1 Hv DNS	83	1.3	0.4	0.2	1.9	0.0
Pierce	1.0	61.1	11.2	1 Hv DNS	88	1.3	0.4	0.3	2.0	0.0
Ramsey	1.6	61.0	11.4	3 Hv DNS	86	4.6	0.4	0.2	5.2	0.0
Ransom	1.2	60.5	11.1	1 Hv DNS	90	1.0	0.4	0.5	1.9	0.0
Renville	0.4	61.0	11.0	1 Hv DNS	91	0.6	0.2	0.4	1.2	0.2
Richland	1.0	60.2	11.0	2 Hv DNS	88	2.4	0.5	0.3	3.2	0.0
Rolette	1.1	60.1	11.4	2 Hv DNS	92	2.0	0.6	0.6	3.2	0.0
Sargent	1.4	61.2	10.9	2 Hv DNS	90	1.0	0.6	0.3	1.9	0.3
Sheridan	0.4	60.8	11.2	1 Hv DNS	93	1.8	0.4	0.3	2.5	0.0
Sioux	3.4	60.0	8.9	1 Hv DNS	92	2.0	0.3	0.4	2.7	0.3
Stark	2.4	59.6	10.4	2 DNS	91	3.3	0.3	0.3	3.9	0.2
Steele	0.7	61.0	11.0	1 Hv DNS	89	1.8	0.3	0.3	2.4	0.0
Stutsman	1.8	59.9	11.2	1 DNS	91	1.9	0.5	0.3	2.7	0.1
Towner	0.9	59.8	12.5	1 DNS	84	1.0	0.3	0.3	1.6	0.0
Traill	0.7	60.3	10.8	1 Hv DNS	90	1.1	0.3	0.3	1.7	0.0
Walsh	1.4	61.4	11.2	1 Hv DNS	86	1.2	0.5	0.3	2.0	0.0
Ward	0.9	61.1	11.0	1 Hv DNS	80	0.5	0.3	0.3	1.1	0.0
Wells	1.8	60.7	11.2	1 Hv DNS	89	1.9	0.4	0.3	2.6	0.0
Williams	0.9	60.7	10.9	1 Hv DNS	89	1.9	0.4	0.7	3.0	0.1
Average	1.3	60.4	10.9	1 Hv DNS	89	1.9	0.4	0.3	2.6	0.04

Shrunken and broken kernels averaged 1.9 per cent, well below the allowable limit for the top two grades. Foreign material (FM) is quite low, showing an average of 0.4 per cent with a range of 0.2 to 0.6 per cent. Damaged kernels are also low, ranging from 0.2 per cent to 0.7 per cent with an average of 0.3 per cent. Total defects, which is the sum of shrunken and broken kernels, foreign material and damaged kernels, including heat damaged kernels, are on the average within the limits listed for the two top grades. None of the samples is in excess of 5.2 per cent and the average is considerably less. Contrasting classes in this year's crop are negligible. The grades ranged from 3 Heavy Dark Northern Spring to 1 Heavy Dark Northern Spring.

Table 2 lists the official grades and grade requirements for Hard Red Spring Wheat.

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

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	per cent	per cent	per cent	per cent	per cent	per cent	per cent
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.

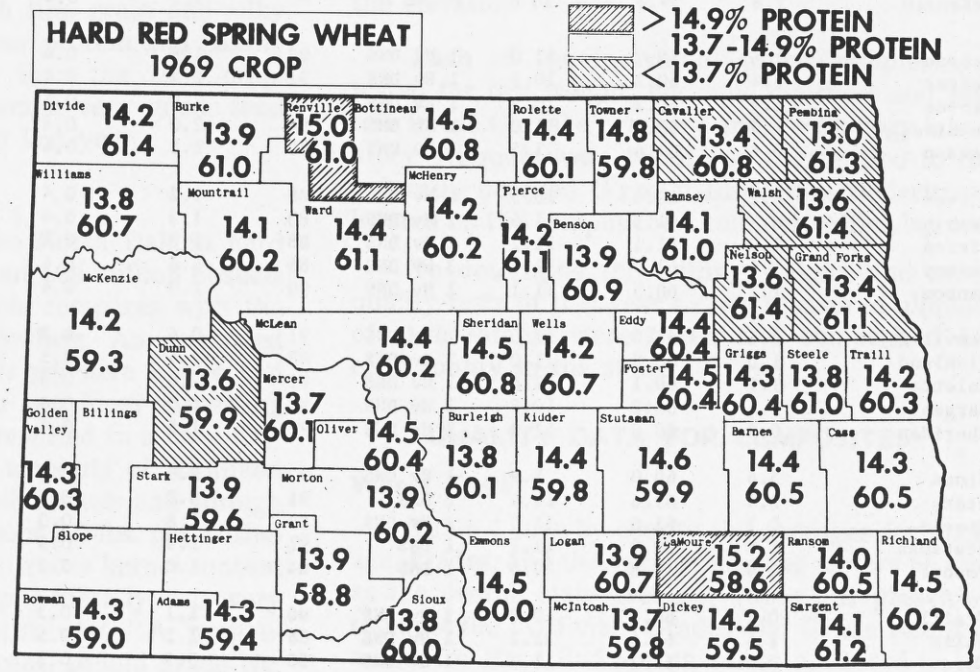

Fig. 1. The average protein content and test weight for each county in North Dakota.

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 77.8 to 81.5 with an average of 80.2 kilograms per hectoliter. Thousand-kernel weight ranged from 24.7 to 30.9 with an average of 27.6.

Table 3. HRS Wheat Survey — 1969 Crop: Wheat Data (County Averages).

Counties	Test Weight	Hectoliter Weight	1000 Kernel Weight	Protein	Ash
	lbs/bu	Kg.	g.	%	%
Adams	59.4	78.9	27.3	14.3	1.97
Barnes	60.5	80.3	26.2	14.4	1.61
Benson	60.9	80.8	29.2	13.9	1.55
Bottineau	60.8	80.7	27.2	14.5	1.62
Bowman	59.0	78.4	29.3	14.3	1.73
Burke	61.0	81.1	28.9	13.9	1.63
Burleigh	60.1	79.8	30.9	13.8	1.69
Cass	60.5	80.3	27.9	14.3	1.65
Cavalier	60.8	80.8	28.1	13.4	1.56
Dickey	59.5	79.0	25.2	14.2	1.68
Divide	61.4	81.5	30.2	14.2	1.55
Dunn	59.9	79.5	26.7	13.6	1.71
Eddy	60.4	80.2	25.4	14.4	1.57
Emmons	60.0	79.7	26.2	14.5	1.79
Foster	60.4	80.3	25.8	14.5	1.58
Golden Valley	60.3	80.1	29.4	14.3	1.53
Grand Forks	61.1	81.1	28.5	13.4	1.58
Grant	58.8	78.1	27.8	13.9	1.93
Griggs	60.4	80.2	25.8	14.3	1.61
Kidder	59.8	79.4	25.8	14.4	1.67
LaMoure	58.6	77.8	27.8	15.2	1.79
Logan	60.7	80.6	26.0	13.9	1.71
McHenry	60.2	80.0	27.3	14.2	1.94
McIntosh	59.8	79.5	24.7	13.8	1.75
McKenzie	59.3	78.8	27.8	14.2	1.62
McLean	60.2	79.9	28.5	14.4	1.71
Mercer	60.1	79.8	29.7	13.7	1.70
Morton	60.2	79.9	30.0	13.9	1.66
Mountrail	60.2	80.0	27.5	14.1	1.75
Nelson	61.4	81.5	28.6	13.6	1.53
Oliver	60.4	80.2	28.1	14.5	1.64
Pembina	61.3	81.4	29.4	13.0	1.60
Pierce	61.1	81.1	27.3	14.2	1.63
Ramsey	61.0	81.1	25.6	14.1	1.59
Ransom	60.5	80.4	27.8	14.0	1.66
Renville	61.0	81.0	27.2	15.0	1.66
Richland	60.2	79.9	26.5	14.5	1.60
Rolette	60.1	79.9	25.7	14.4	1.63
Sargent	61.2	81.3	25.1	14.1	1.68
Sheridan	60.8	80.7	29.1	14.5	1.76
Sioux	60.0	79.8	29.6	13.8	1.77
Stark	59.6	79.2	27.2	13.9	1.65
Steele	61.0	81.0	27.5	13.8	1.65
Stutsman	59.9	79.6	25.4	14.6	1.61
Towner	59.8	79.4	26.2	14.8	1.51
Traill	60.3	80.0	27.5	14.2	1.54
Walsh	61.4	81.6	29.0	13.6	1.60
Ward	61.1	81.2	28.8	14.4	1.72
Wells	60.7	80.7	27.4	14.2	1.64
Williams	60.7	80.7	30.3	13.8	1.63
Average	60.4	80.2	27.6	14.1	1.66

The wheat protein content ranged from 13.0 to 15.0 per cent with a state average of 14.1 per cent. Figure 1 shows the average protein for the various counties sampled. The average wheat ash for the state is 1.66 per cent with a range of 1.51 to 1.97 per cent.

Table 4. HRS Wheat Survey — 1969 Crop: Flour Data (County Averages).

Counties	Yield	Ash	Protein	Absorption	Wet Gluten	Falling No.
	%	%	%	%	%	Units
Adams	79.3	0.46	13.8	64.2	44.0	491
Barnes	74.1	0.42	13.8	64.3	45.8	489
Benson	71.2	0.42	13.3	65.1	42.7	459
Bottineau	71.8	0.43	13.7	65.7	48.0	449
Bowman	71.6	0.45	13.8	62.6	47.0	433
Burke	73.0	0.42	13.1	64.8	44.2	454
Burleigh	72.5	0.44	13.1	63.9	42.4	469
Cass	71.8	0.45	13.6	63.7	44.2	438
Cavalier	72.0	0.43	12.9	63.2	42.3	441
Dickey	71.5	0.46	13.7	63.3	44.2	482
Divide	72.0	0.43	13.5	64.5	45.1	457
Dunn	72.9	0.45	12.8	63.9	41.5	473
Eddy	72.1	0.42	13.9	65.6	43.9	446
Emmons	71.8	0.47	13.9	64.5	44.7	435
Foster	72.8	0.45	14.1	63.1	46.4	442
Golden Valley	72.9	0.42	13.9	63.0	48.5	435
Grand Forks	76.0	0.43	13.0	62.1	40.4	421
Grant	73.4	0.43	13.1	61.8	40.6	431
Griggs	71.7	0.43	13.6	63.7	41.8	537
Kidder	71.1	0.44	13.8	63.8	43.3	435
LaMoure	72.0	0.45	14.2	64.0	48.4	477
Logan	71.6	0.44	13.4	63.0	41.8	451
McHenry	71.9	0.46	13.7	65.7	41.5	449
McIntosh	72.9	0.49	13.4	64.8	45.3	470
McKenzie	72.3	0.47	13.8	64.2	45.9	468
McLean	71.7	0.45	13.9	64.0	43.9	468
Mercer	73.9	0.44	13.3	64.4	40.6	456
Morton	73.0	0.49	13.4	63.5	41.6	463
Mountrail	71.6	0.46	13.5	62.6	41.0	465
Nelson	72.4	0.42	13.2	63.3	40.8	444
Oliver	71.9	0.42	13.7	63.5	44.7	404
Pembina	71.2	0.45	12.6	63.1	39.3	458
Pierce	71.9	0.42	13.9	65.4	46.3	455
Ramsey	73.3	0.42	13.4	63.3	42.0	548
Ransom	72.0	0.44	13.5	64.2	44.7	444
Renville	71.0	0.43	14.1	64.2	48.8	439
Richland	74.0	0.45	14.2	65.8	49.6	450
Rolette	70.5	0.44	13.9	66.1	43.5	458
Sargent	72.6	0.42	13.5	63.4	39.3	512
Sheridan	70.7	0.42	13.9	64.1	43.0	546
Sioux	78.4	0.49	13.4	64.7	43.6	423
Stark	70.5	0.46	13.4	63.4	42.1	422
Steele	71.2	0.42	13.5	63.8	44.6	437
Stutsman	73.2	0.44	13.5	63.6	44.2	483
Towner	72.5	0.40	14.1	64.1	47.4	455
Traill	73.4	0.43	13.5	65.7	45.6	458
Walsh	71.2	0.45	12.9	64.8	43.2	448
Ward	73.3	0.46	14.1	65.8	47.9	469
Wells	73.7	0.45	13.8	65.0	47.8	418
Williams	75.0	0.49	13.4	64.8	45.7	429
Average	72.6	0.44	13.7	64.1	42.3	458

Flour Tests

Table 4 shows the flour yield data which ranged from 70.5 to 79.3 per cent with a state average of 72.6 per cent. This is 1.7 per cent higher than the 1968 crop. The ash of this straight grade

flour ranged from 0.40 per cent in Towner county to 0.49 per cent in four other counties with an average for the state of 0.44 per cent. None of the samples displayed any abnormal milling characteristics. The protein content average is 13.7 per cent, with a range of 12.6 to 14.2 per cent. Flour water absorptions are on the average a little higher than the 1968 crop. Wet gluten ranged from 39.3 to 49.6 with an average of 42.3 per cent. The falling numbers of all the samples are at levels which indicate the absence of excessive enzyme activity (sprout damage) in this year's crop.

Table 5. HRS Wheat Survey — 1969 Crop: Baking Data (County Averages).

Counties	Dough char.	Loaf vol.	Gr. & tex.	Crumb color	Crust color	Symmetry
		cc.				
Adams	4	875	9.0	8.5	4	4.5
Barnes	4	855	8.5	8.5	4	4.5
Benson	4	855	8.5	8.5	4	4.5
Bottineau	4	840	9.0	8.5	4	4.5
Bowman	4	840	8.5	8.5	4	4.5
Burke	4	810	8.5	9.0	4	4.5
Burleigh	4	850	8.5	8.5	4	4.5
Cass	4	890	8.5	9.0	4	4.5
Cavalier	4	860	9.0	8.5	4	4.5
Dickey	4	865	8.5	9.0	4	4.5
Divide	4	800	9.0	8.5	4	4.5
Dunn	4	810	9.0	8.5	4	4.5
Eddy	4	880	8.5	8.5	4	4.5
Emmons	4	845	8.5	9.0	4	4.5
Foster	4	840	9.0	8.5	4	4.5
Golden Valley	4	875	8.5	8.5	4	4.5
Grand Forks	4	810	8.5	8.5	4	4.5
Grant	4	805	9.0	8.5	4	4.5
Griggs	4	840	9.0	8.5	4	4.5
Kidder	4	850	8.5	8.0	4	4.5
LaMoure	4	960	8.5	8.5	4	4.5
Logan	4	815	8.5	8.5	4	4.5
McHenry	4	830	9.0	8.5	4	4.5
McIntosh	4	850	8.5	8.5	4	4.5
McKenzie	4	850	8.5	8.5	4	4.5
McLean	4	860	8.5	8.5	4	4.5
Mercer	4	815	9.0	8.5	4	4.5
Morton	4	825	8.5	8.5	4	4.5
Mountrail	4	845	8.5	8.5	4	4.5
Nelson	4	810	8.5	8.5	4	4.5
Oliver	4	840	9.0	9.0	4	4.5
Pembina	4	790	8.5	9.0	4	4.5
Pierce	4	860	8.5	9.0	4	4.5
Ramsey	4	835	8.5	9.0	4	4.5
Ransom	4	850	8.5	8.5	4	4.5
Renville	4	870	8.5	9.0	4	4.5
Richland	4	820	8.5	9.0	4	4.5
Rolette	4	860	9.0	9.0	4	4.5
Sargent	4	810	9.0	9.0	4	4.5
Sheridan	4	815	9.0	9.0	4	4.5
Sioux	4	875	8.5	9.0	4	4.5
Stark	4	790	9.0	8.5	4	4.5
Steele	4	755	9.0	9.0	4	4.5
Stutsman	4	825	8.5	9.0	4	4.5
Towner	4	895	8.5	9.0	4	4.5
Traill	4	815	9.0	9.0	4	4.5
Walsh	4	795	9.0	8.5	4	4.5
Ward	4	815	8.5	9.0	4	4.5
Wells	4	860	8.5	8.5	4	4.5
Williams	4	820	9.0	8.5	4	4.5
Average	4	839	8.7	8.7	4	4.5

Baking Tests

The overall baking properties of the 1969 crop, as shown in Table 5, are excellent. The dough handling properties were excellent with no "buckiness" of the doughs observed. The flour produced loaves of large volume with fine grain and silky textures. Crumb colors were also very good. On the average, these scores were the highest obtained for the past five years. Color of the crust, as well as the overall appearance (symmetry) of the loaves, was excellent. In general, the baking performance of the 1969 crop composites is very uniform. Dough handling characteristics, loaf crust colors and symmetry were scored the same for all of the samples. Individual loaf volumes were within 15 per cent of the mean loaf volume. Crumb grain and texture gave a range of less than 4 per cent and crumb color, a range of about 7 per cent from the mean.

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 0.3 per cent higher than last year. However, the actual baking absorption averaged 0.8 per cent higher than the Farinograph absorption. Mixing time ranged from 4.0 to 7.5 minutes with an average of 5.4 minutes. The mixing tolerance average is 6.1 minutes with a range of 4.0 to 9.0 minutes. On the average, both mixing time and tolerance are slightly lower than last year. This is attributed partially 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 is 5.4. This is similar to the 1968 crop but is below the very strong type curve of the 1967 crop. Figure 2 shows an average farinogram for the 1969 crop.

Table 6. HRS Wheat Survey - 1969 Crop: Physical Dough Properties (County Averages)

Counties	Farinogram					Extensogram					
	Absorption	Mixing Time	Mixing Tolerance	MTI	Classification	Extensibility 45 min.	Extensibility 180 min.	Resistance 45 min.	Resistance 180 min.	Area	Classification
	%	min.	min.			cm.	cm.	cm.	cm.	sq.cm.	
Adams	63.7	5.0	5.5	40	5	23.4	20.9	5.8	7.0	115	5
Barnes	63.1	5.0	6.0	40	5	22.4	19.5	5.3	7.2	105	5
Benson	64.1	5.0	4.0	45	4	20.5	22.0	5.2	5.6	103	4
Bottineau	64.7	5.0	5.5	35	5	22.9	21.5	5.4	5.9	107	4
Bowman	61.6	7.5	7.5	20	6	20.4	21.4	7.6	8.8	140	7
Burke	63.9	6.5	7.0	30	6	21.7	24.0	6.3	6.9	132	5
Burleigh	63.3	6.0	9.0	20	7	24.5	22.7	6.9	8.4	150	7
Cass	62.9	5.0	8.0	25	6	21.1	21.5	5.9	7.2	115	5
Cavalier	62.7	4.5	4.5	40	4	22.0	21.0	5.7	6.8	115	5
Dickey	63.2	5.0	7.5	30	5	22.0	21.0	6.6	8.3	140	6
Divide	64.2	5.0	4.5	30	5	22.6	21.0	5.7	6.9	105	5
Dunn	63.9	5.5	4.0	40	4	22.5	20.8	5.4	6.8	110	5
Eddy	65.3	5.0	5.0	30	5	21.7	20.1	6.4	7.5	116	6
Emmons	64.5	6.0	7.5	25	6	26.6	17.7	5.6	7.6	110	6
Foster	62.6	4.5	5.5	30	5	20.0	19.5	5.1	6.6	100	5
Golden Valley	62.7	7.0	7.5	25	6	24.3	23.2	6.8	8.7	158	7
Grand Forks	61.9	4.0	4.5	45	4	20.4	21.6	5.2	7.3	132	5
Grant	61.9	6.0	5.0	40	5	21.2	20.4	7.5	8.5	142	7
Griggs	63.4	5.0	5.0	40	5	21.5	19.5	6.0	7.3	110	5
Kidder	62.5	6.0	7.5	20	6	21.5	23.5	6.9	9.4	168	7
LaMoure	63.1	6.0	6.5	25	6	22.0	22.5	6.8	8.7	152	7
Logan	62.1	5.5	6.5	30	6	22.7	22.0	6.9	8.4	145	6
McHenry	64.5	6.0	8.0	35	7	24.2	22.2	6.4	8.6	145	7
McIntosh	63.1	6.5	8.0	35	6	23.0	21.8	5.7	7.7	132	7
McKenzie	63.3	6.0	5.5	30	6	23.5	22.8	5.4	7.2	125	5
McLean	63.1	6.0	7.0	25	7	26.9	20.9	6.1	7.9	125	6
Mercer	63.7	5.5	6.0	35	6	25.8	21.8	5.5	7.2	122	5
Morton	62.8	5.5	6.0	35	6	21.5	20.0	5.8	6.8	105	5
Mountrail	61.9	6.5	8.0	30	6	23.8	19.5	6.6	8.1	119	6
Nelson	62.4	4.5	4.5	40	4	23.5	16.4	5.3	5.6	72	4
Oliver	62.6	6.5	6.5	40	5	23.0	21.8	6.2	7.5	130	6
Pembina	62.1	5.0	6.0	40	5	21.0	18.5	5.8	8.0	112	6
Pierce	64.1	5.5	6.0	40	5	21.7	20.4	5.5	7.4	114	6
Ramsey	62.5	5.5	6.5	35	6	22.6	18.5	5.4	7.5	104	6
Ransom	63.6	4.0	6.0	30	6	18.9	19.2	6.2	7.7	115	6
Renville	63.4	5.5	7.0	25	6	23.0	18.5	6.0	7.5	110	6
Richland	64.8	5.5	6.5	30	6	25.3	20.9	5.4	6.5	108	5
Rolette	64.9	5.5	6.5	30	6	24.3	21.5	5.1	6.7	117	5
Sargent	61.9	4.5	6.5	30	6	22.0	21.0	6.0	8.4	138	6
Sheridan	62.4	5.5	9.0	30	7	23.3	21.3	6.4	7.5	128	6
Sioux	65.3	5.0	4.0	45	4	24.6	22.9	4.3	6.5	115	5
Stark	61.9	5.5	5.5	40	5	23.5	20.5	5.9	7.2	120	5
Steele	62.7	5.0	4.5	40	5	20.0	21.0	5.2	7.3	120	5
Stutsman	62.2	6.5	6.5	40	5	21.8	19.0	6.5	8.0	115	6
Towner	62.5	4.5	4.0	40	5	21.0	23.5	4.2	7.0	133	5
Traill	64.1	5.5	6.0	30	5	22.1	20.4	5.1	6.1	110	5
Walsh	63.6	4.5	6.0	40	5	21.5	21.3	4.6	6.9	115	5
Ward	64.9	5.5	5.0	30	5	19.5	22.5	4.2	6.4	120	5
Wells	64.3	5.5	6.0	40	5	18.5	20.7	6.0	7.4	120	6
Williams	64.3	4.5	6.0	40	5	19.5	22.0	5.1	7.0	121	5
Average	63.3	5.4	6.1	34	5.4	22.3	21.0	5.8	7.4	122	5.6

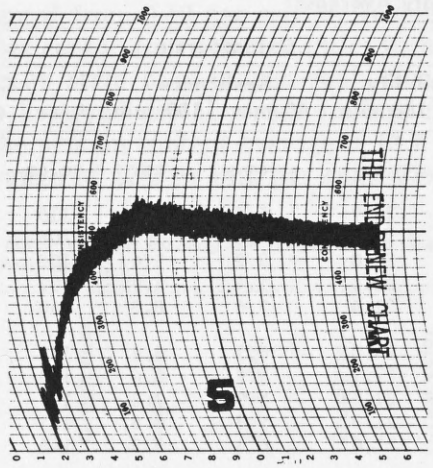

Fig. 2. Farinogram showing average mixing strength of the 1969 crop.

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 1968 crop. In general, the 1969 crop produced doughs with good elastic properties. An average extensogram is shown in Fig. 3.

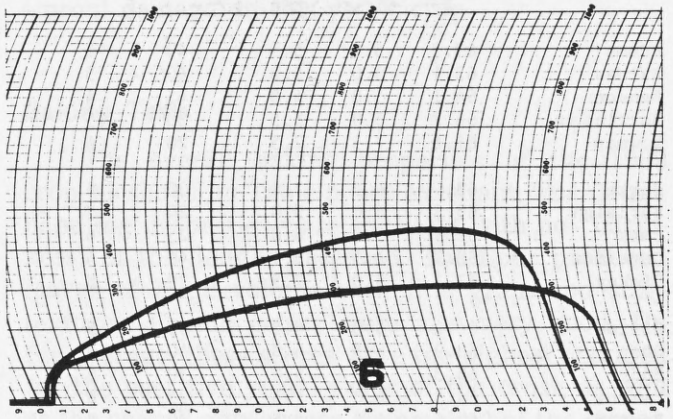

Fig. 3. Extensogram showing average properties of the 1969 crop.

Table 7 compares some of the pertinent average quality factors for the 1964, 1965, 1966, 1967,

Table 7. HRS Wheat Survey: Comparison of Average Quality Factors for North Dakota 1964, 1965, 1966, 1967, 1968 and 1969 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.
1964	57.9	76.9	96	14.7	67.1	0.44	—	46.0
1965*	58.4	77.6	96	14.4	67.3	0.42	349	48.0
1966	58.4	77.6	94	15.2	66.9	0.43	343	51.6
1967	59.9	79.6	95	14.4	66.8	0.41	493	47.6
1968	58.7	78.0	87	14.0	70.9	0.41	405	40.6
1969	60.4	80.2	89	14.1	72.6	0.44	458	42.3
5-year Ave.	58.7	77.9	94	14.5	67.8	0.42	—	46.8

(Baking data)

Crop Year	Absorption	Dough char.	Loaf vol.	Gr. and tex.	Crumb color	Crust color	Symmetry
	%		cc.				
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
1969	64.1	4	839	8.7	8.7	4	4.5
5-year Ave.	64.6	4	831	8.5	8.2	4	4.5

(Physical dough properties)

Crop Year	Farinogram Mixing time	Farinogram Mixing tolerance	Farinogram Classification		Extensogram Extensibility 45	Extensogram Extensibility 180	Extensogram Resistance 45	Extensogram Resistance 180	Extensogram Classification	
	min.	min.			cm.	cm.	cm.	cm.		
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
1969	5.4	6.1	Medium	5.4	22.3	21.0	5.8	7.4	M. Strong	5.6
5 Year Ave.	8.3	17.1	Strong	7.1	22.9	22.2	7.2	10.4	V. Strong	7.6

*Calculated weighted average for the "pre" and "post" rain crops of 1965. 5-year average — 1964-1968.

1968 and 1969 hard red spring wheat crops. Also, the five-year (1964-1968) average is shown. The data from this year's crop, when compared with the 1968 crop, are either equal to or higher in all of the major quality factors examined. The dough properties as determined by the Extensograph show the 1969 crop to be a little mellower than the 1968 crop.

When compared with the five-year average, the 1969 crop is equal to or better than all of the major quality factors listed, with the exception of the farinogram and extensogram data. Although these data indicate that the 1969 crop is a little mellower in physical dough properties, all of the doughs are classified within the category of strong type wheats.

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. 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 mellower quality characteristics, occupying 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 similar to Chris in general dough properties. These figures show that in four 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 about 16 per cent very strong and 84 per cent mellow wheats in 1969.

GRADE AND MARKET QUALITY FACTORS

The percentage of the crop falling into the various grades is depicted in the diagram shown in Fig. 4. The figures shown on the outside of the circle are an accumulative percentage of the grades. For example, the number 95 on this figure indicates that 95 per cent of the 1969 hard red spring wheat crop (approximately 104 million bushels) should grade No. 2 Dark Northern Spring or better. This compares very favorably with the 1968 crop report which estimated that 86 per cent of the crop would grade No. 2 Dark Northern Spring or better. Practically all of the samples received in this survey would fall within six grade classifications.

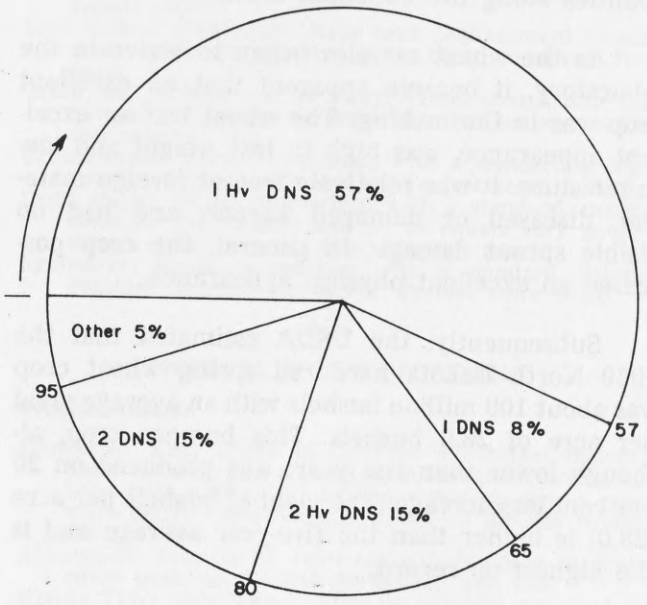

Fig. 4. Diagram showing grade distribution of the 1969 crop.

WEATHER AND HARVEST

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

Due to excessive snow in the winter of 1968-69 and the spring rains, much of the state was too wet to seed during March and the first part of April. By April 22 about 7 per cent of the hard red spring wheat was planted, largely in the southwestern, south central and west central counties where up to half of the acreage had been seeded. Last year, approximately 44 per cent of the hard red spring wheat was in the ground, compared with 22 per cent for the average. By about the middle of May, 78 per cent of this crop was planted and by the end of May, it was virtually completed, according to the "North Dakota Weekly Weather and Crop Report."

Excellent growing weather prevailed during June, July and mid-August. An adequate supply of moisture was maintained as well as warm temperatures which provided these ideal growing conditions. Harvesting conditions were excellent during the latter part of August and early September and proceeded rapidly. By September 2, 77 per cent of the crop was in the bin; this compared with 39 per cent a year ago and the ten-year average of 81 per

cent. By September 16, the combining of hard red spring wheat was 97 per cent completed. Most of the remaining acreage to be combined was in a few counties along the Canadian border.

As the wheat samples began to arrive in the laboratory, it became apparent that an excellent crop was in the making. The wheat had an excellent appearance, was high in test weight and low in moisture. It was relatively free of foreign material, diseased or damaged kernels and had no visible sprout damage. In general, the crop possessed an excellent physical appearance.

Subsequently, the USDA estimated that the 1969 North Dakota hard red spring wheat crop was about 109 million bushels with an average yield per acre of 28.0 bushels. This bumper crop, although lower than last year, was produced on 20 per cent less acreage. The yield of bushels per acre (28.0) is higher than the five-year average and is the highest on record.

Summary

Excellent seeding, growing and harvesting conditions prevailed in North Dakota during 1969. This resulted in a hard red spring wheat crop of 109 million bushels, which was produced on an acreage 20 per cent smaller than that seeded in 1968. The average yield of 28.0 bushels per acre exceeds the five-year average and is a record for the state.

The physical appearance of this crop is excellent. It possesses a high test weight, a high vitreous kernel content, and a low moisture. The wheat is relatively free of foreign material, diseased or damaged kernels with no visible sprout damage. It is estimated that 95 per cent of the crop will grade No. 2 Dark Northern Spring or better. The average dockage for the state is 1.3 per cent with a range of 0.2 to 3.4 per cent. The average moisture and protein content are 10.9 and 14.1 per cent, respectively. Test weights are quite uniform showing a range from 58.6 to 61.4 with an average of 60.4 pounds per bushel. As would be expected, hectoliter weight is also quite uniform and showed a range from 77.8 to 81.5 with an average of 80.2 kilograms per hectoliter. Weight per 1000 kernels is about the same as reported last year. The state average for wheat ash is 1.66 and showed a range of 0.46 per cent.

The wheat milled in a normal manner and produced flour of a good color, high yield and low ash. The falling number, wet glutten, baking absorption, loaf volume and crumb color are all higher than the data presented for the 1968 crop. The mixing time, mixing tolerance and the overall extensogram data indicate doughs which are a little mellower than those produced by last year's crop. In general, the milling and baking properties of the 1969 crop are excellent, and are considerably better than the 1968 crop.

When the 1969 crop is compared with the five-year average, it is better in test weight, hectoliter weight, flour yield, loaf volume, crumb color and crumb grain and texture of the bread. It is a little lower in percentage of vitreous kernels, wheat protein and wet gluten. The mixing characteristics and gluten properties, as measured by the Farinograph and Extensograph, appear to indicate a mellower dough.

These yearly quality differences are to be expected because the predominating varieties and environmental conditions are subject to yearly changes.

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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.

Moisture: Official USDA procedure, using Motomco Moisture Meter.

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

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).