

Quality Factors of the 1971 Durum Crop

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The overall quality of the 1971 durum wheat crop is considered excellent. In the major quality factors (test weight, vitreous kernels, milling yield and spaghetti color) the crop is considerably better than the average durum from North Dakota in previous years. The crop is high in test weight and low in moisture content which is primarily due to the excellent growing conditions during the summer. As in 1969 and 1970, Leeds continues to be the predominant durum variety in the crop. Compared with the previously dominant varieties, Leeds has larger kernels and produces a brighter spaghetti color.

According to official USDA production estimates, the North Dakota durum crop is 78 million bushels (about 2.1 million metric tons), out of a total of 88 million bushels for the United States. This is an increase of 34 million bushels over last year's North Dakota crop. In average yield, the 1971 crop is estimated at 33 bushels per acre, which is eight bushels above last year and well above the five-year average for the state. It is anticipated that 67 per cent of the North Dakota crop will grade U.S. No. 1 Hard Amber Durum or better. In all, the crop has very good milling properties and produces top quality pasta products.

Samples and Methods

During the 1971 harvest, samples were collected 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 eight-week period reflected the anticipated crop

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production of each county. Elevator operators were requested to collect a sample from each truck load of durum wheat delivered to the elevator. Twice a week, the samples were thoroughly mixed and a three-pound aliquot was taken, placed in a moisture proof plastic bag, and mailed to the Department of Cereal Chemistry and Technology at North Dakota State University, Fargo, North Dakota, for grading and quality evaluation. These samples were uncleaned and reflected the condition of the grain delivered to the elevators.

Determinations were made on the individual samples for test weight, dockage, moisture, and protein in the Cereal Chemistry and Technology Laboratory. Randomly selected aliquots from one-fourth of the samples were submitted to the federally licensed Grain Inspection Department, located on the campus, for an official U.S. grade.

To determine the milling, spaghetti processing, and other quality data on this year's crop, measured aliquots of each sample were composited by counties. Samples were milled and processed into spaghetti using continuous laboratory procedures which were comparable to commercial practices.

QUALITY DATA FOR COMPOSITES

Wheat Data

Table 1 shows the average dockage, test weight, moisture and grading factors for the major durum producing counties of North Dakota. Dockage in this year's crop is low (average of 1.1 per cent) and reflects the efficiency of the harvesting operation. Test weight data shows that the crop is heavy and averages 62.4 pounds per bushel with a range from a low of 60.7 pounds per bushel to a high of 63.5 pounds per bushel. In grade, the crop is variable among the counties and ranges from a low of U.S. No. 3 Durum to the top grade of U.S. No. 1 Heavy Hard Amber Durum. However, the theoretical average grade for the state is high — U.S. No. 1 Heavy Hard Amber Durum.

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

Counties	Dockage	Test Weight	Moisture	Grade	Shrunken and Broken		F.M.	Damage	Total Contrasting	
					Vitreous Kernels	Broken			Defects	Classes
	%	lbs/bu	%		%	%	%	%	%	%
Barnes	1.64	63.0	10.8	2 Hv HAD	85	2.8	0.3	0.1	3.2	0.0
Benson	1.10	62.5	12.2	1 Hv HAD	80	1.2	0.4	0.5	2.1	0.0
Bottineau	0.90	62.2	12.0	1 Hv HAD	80	1.3	0.4	0.2	1.9	0.4
Burke	0.52	62.3	12.6	1 Hv AD	70	1.7	0.5	0.5	2.7	0.0
Cass	0.65	63.2	11.6	1 Hv HAD	80	1.5	0.5	1.0	3.0	0.3
Cavalier	0.98	61.5	13.2	1 HAD	95	1.7	0.4	0.3	2.4	0.0
Dickey	2.57	61.1	10.6	3 HAD	90	4.0	0.9	0.4	5.3	0.7
Divide	0.70	62.2	12.3	1 Hv AD	70	1.9	0.4	0.2	2.5	0.5
Eddy	1.45	62.3	11.7	1 Hv HAD	75	1.8	0.4	0.3	2.5	0.1
Foster	0.63	63.5	12.0	1 Hv HAD	85	1.0	0.4	0.2	1.6	0.6
Grand Forks	0.49	61.9	12.7	1 HAD	75	1.8	0.5	0.3	2.6	0.8
Griggs	1.62	61.1	13.5	1 D	50	1.7	0.5	0.4	2.6	0.6
LaMoure	1.05	61.9	10.8	3 D	55	1.6	1.2	1.5	4.3	1.3
McHenry	1.06	63.1	10.9	1 Hv HAD	95	2.0	0.3	0.1	2.4	0.0
McLean	0.64	63.2	10.5	1 Hv HAD	95	2.2	0.3	0.1	2.6	0.0
Mountrail	1.92	62.4	11.1	1 Hv HAD	90	1.6	0.5	0.2	2.3	0.3
Nelson	1.40	62.5	12.5	1 Hv HAD	80	1.2	0.3	0.3	1.8	0.0
Pierce	0.18	62.8	11.9	2 Hv HAD	80	0.8	0.7	0.3	1.8	0.0
Ramsey	1.23	62.3	12.5	1 Hv HAD	85	0.6	0.4	0.3	1.3	0.0
Renville	0.90	62.2	12.2	1 Hv HAD	90	0.5	0.2	0.2	0.9	0.0
Rolette	1.07	61.9	12.3	2 HAD	85	0.8	0.6	0.3	1.7	0.5
Stutsman	2.44	62.2	11.5	2 Hv HAD	90	1.0	0.5	0.3	1.8	0.8
Towner	1.22	62.6	12.9	1 Hv HAD	85	0.9	0.4	0.4	1.7	0.3
Traill	0.52	63.2	11.6	1 Hv HAD	75	1.2	0.5	0.7	2.4	0.4
Walsh	1.59	60.7	12.8	3 AD	65	1.3	0.4	0.3	2.0	1.2
Ward	0.71	63.4	11.2	1 Hv HAD	95	0.8	0.3	0.1	1.2	0.0
Wells	1.95	63.3	11.7	1 Hv HAD	95	1.4	0.5	0.2	2.1	0.2
Williams	0.71	63.5	9.6	1 Hv AD	70	1.4	0.5	0.3	2.2	0.0
Average	1.14	62.4	11.8	1 Hv HAD	81	1.5	0.5	0.4	2.3	0.3

In other grading factors (shrunken and broken kernels, foreign material, damage, total defects and wheat of contrasting classes) the 1971 durum crop is very good. On the average, shrunken and broken kernels are very low (1.5 per cent), foreign material is only 0.5 per cent while damaged kernels is only 0.4 per cent. Inasmuch as total defects is the sum of shrunken and broken kernels, foreign material and damaged kernels, it can be used as a general index

of wheat condition. In total defects, the crop ranges from 0.9 per cent to 5.3 per cent, and averages 2.3 per cent for the state, which indicates that the crop is generally in very good condition. Wheat of contrasting classes in the durum is negligible (0.3 per cent). Table 2 lists the Official Grades and Grade Requirements for Durum Wheat as set by the United States Government.

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

Grade	Maximum Limits Of						Wheat of other Classes		
	Defects					Shrunken and Broken Kernels	Defects (total)	Contrasting Classes	Wheat of other classes (total)
	Minimum Test Weight Per Bushel	Heat Damaged Kernels	Damaged Kernels (total)	Foreign Material	Defects (total)				
pounds	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	
U.S. No. 1	60.0	0.1	2.0	0.5	3.0	3.0	1.0	3.0	
U.S. No. 2	58.0	0.2	4.0	1.0	5.0	5.0	2.0	5.0	
U.S. No. 3	56.0	0.5	7.0	2.0	8.0	8.0	3.0	10.0	
U.S. No. 4	54.0	1.0	10.0	3.0	12.0	12.0	10.0	10.0	
U.S. No. 5	51.0	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.

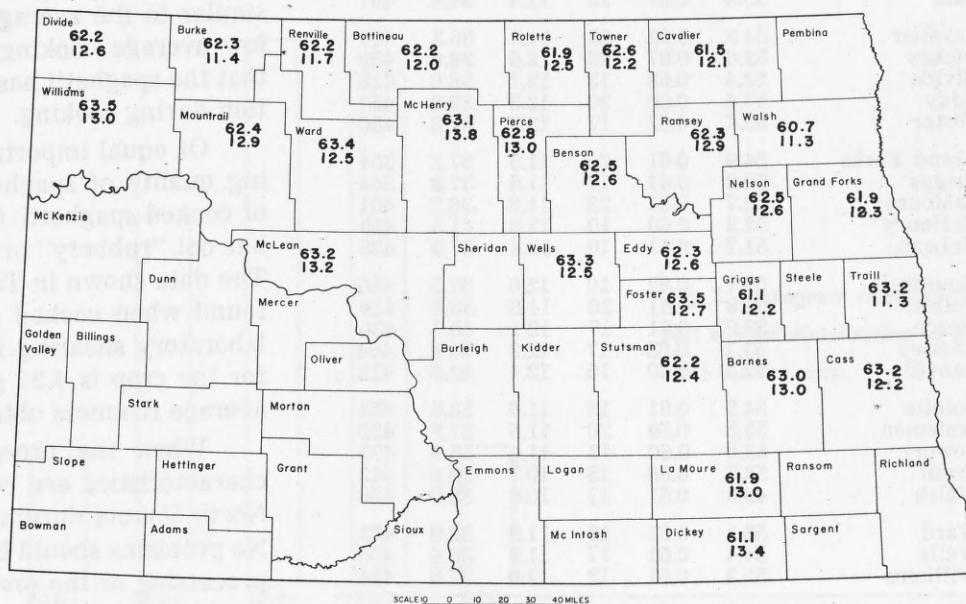
Other important factors used for assessing the quality of the 1971 durum wheat are shown in Table 3. Included are test weight, hectoliter weight, 1000 kernel weight, kernel size distribution, mineral content (ash), and wheat protein content. For a description of the methods used in these determin-

ations, an appendix is included at the end of this report. The hectoliter weight of this year's crop is high and ranges from 78.1 to 81.7 with an average of 80.3 kilograms per hectoliter. Moreover, the thousand kernel weight is quite high and averages 35.2 grams.

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

Counties	Test	Hectoliter	1000	Kernel Distribution			Mineral	
	Weight	Weight	Kernel Weight	Large	Medium	Small	Protein	Content (ash)
	lbs/bu	kg.	g.	%	%	%	%	%
Barnes	63.0	81.1	35.3	32	62	6	13.0	1.58
Benson	62.5	80.4	35.7	32	61	7	12.6	1.56
Bottineau	62.2	80.1	33.2	26	68	6	12.0	1.53
Burke	62.3	80.2	32.4	28	63	9	11.4	1.56
Cass	63.2	81.4	37.3	36	59	5	12.2	1.69
Cavalier	61.5	79.2	39.1	39	55	6	12.1	1.55
Dickey	61.1	78.6	32.7	26	64	10	13.4	1.71
Divide	62.2	80.1	34.5	29	64	7	12.6	1.57
Eddy	62.3	80.2	35.6	35	60	5	12.6	1.55
Foster	63.5	81.7	37.0	35	62	3	12.7	1.54
Grand Forks	61.9	79.7	37.0	39	55	6	12.3	1.51
Griggs	61.1	78.6	37.0	34	58	8	12.2	1.58
LaMoure	61.9	79.7	27.7	50	46	4	13.0	1.65
McHenry	63.1	81.2	35.5	24	69	7	13.8	1.48
McLean	63.2	81.4	33.1	18	75	7	13.2	1.54
Mountrail	62.4	80.3	33.8	23	70	7	12.9	1.57
Nelson	62.5	80.4	36.1	33	59	8	12.6	1.56
Pierce	62.8	80.8	35.6	29	65	6	13.0	1.50
Ramsey	62.3	80.2	35.8	29	65	6	12.9	1.56
Renville	62.2	80.1	35.6	33	60	7	13.2	1.36
Rolette	61.9	79.7	33.1	24	69	7	12.5	1.61
Stutsman	62.2	80.1	36.4	39	55	6	12.4	1.59
Towner	62.6	80.2	36.9	41	55	4	12.2	1.48
Traill	63.2	81.4	38.9	43	53	4	11.3	1.57
Walsh	60.7	78.1	33.1	28	63	9	11.3	1.59
Ward	63.4	81.6	36.1	29	65	6	12.5	1.53
Wells	63.3	81.5	36.4	37	55	8	12.5	1.54
Williams	63.5	81.7	34.4	25	70	5	13.0	1.55
Average	62.4	80.3	35.2	32	62	6	12.6	1.56

Fig. 1. The test weight and average protein content for wheat from the major durum producing counties of North Dakota. In each county, the upper number indicates the test weight; the lower shows the protein content.



Still another means of measuring kernel size is distribution. In the test, wheat is separated into three sizes (large, medium, and small), according to kernel diameter. For best milling performance, the wheat should have a minimum of small kernels. According to the average data, the crop has a kernel distribution of 32, 62, and 6 per cent, large, medium, and small kernels, respectively, which is a better distribution than that of the 1970 crop.

The average protein content of the crop is 12.6 per cent which is considered adequate for processing good quality pasta products. For illustrative purposes, Fig. 1 shows a map of North Dakota which lists the average test weight and protein contents for the major durum producing counties.

Semolina Data

To characterize the quality of the 1971 durum crop, composite samples of wheat from each county were milled and purified into semolina. Included were tests for milling yield, bran specks, protein and wet gluten contents, falling number, and mineral content (ash) of the semolina (Table 4). The

Table 4. Durum Wheat Survey — 1971 Crop: Semolina Data (County Averages).

Counties	Semolina Yield	Mineral Content (ash)	Bran Specks	Protein	Wet Gluten	Falling No.
	%	%	No./10 in ²	%	%	units
Barnes	53.3	0.62	13	12.1	37.3	489
Benson	54.4	0.67	17	11.7	37.1	453
Bottineau	53.4	0.63	17	11.2	35.5	469
Burke	52.4	0.59	23	10.7	34.5	436
Cass	55.3	0.67	23	11.4	34.4	467
Cavalier	54.9	0.62	23	11.2	36.3	466
Dickey	53.6	0.67	23	12.6	38.6	459
Divide	52.4	0.62	13	12.1	38.0	428
Eddy	57.4	0.66	20	12.3	39.8	459
Foster	55.4	0.62	17	12.2	37.8	436
Grand Forks	54.9	0.61	20	11.5	37.2	354
Griggs	50.9	0.64	17	11.6	37.8	344
LaMoure	52.7	0.61	23	11.8	38.2	401
McHenry	52.2	0.60	10	12.8	41.3	459
McLean	51.7	0.61	10	12.4	37.9	435
Mountrail	53.7	0.62	10	12.0	37.5	480
Nelson	52.8	0.61	20	11.8	38.3	410
Pierce	53.9	0.61	17	12.1	40.1	430
Ramsey	53.1	0.63	17	12.3	43.6	464
Renville	52.5	0.60	10	12.4	42.6	432
Rolette	54.3	0.61	13	11.6	38.6	453
Stutsman	53.5	0.59	20	11.6	37.5	439
Towner	53.0	0.60	13	11.4	35.8	475
Trail	53.7	0.58	13	10.7	33.6	443
Walsh	49.3	0.61	17	10.6	36.0	400
Ward	53.1	0.61	13	11.9	38.0	483
Wells	54.4	0.61	17	11.9	36.4	456
Williams	55.3	0.61	13	12.0	37.8	454
Average	53.5	0.62	17	11.8	37.7	469

semolina yield of the 1971 crop averaged 53.5 per cent. The speck count, a measure of the number of bran particles remaining after purification, averaged 17 per 10 square inches. Compared with the milling data for last year's crop, the 1971 crop has a slightly higher milling yield with considerably fewer bran specks in the semolina.

The 1971 semolina was high in gluten content and averaged 37.9 per cent wet gluten compared with 36.4 for the 1970 crop. The average semolina protein content was 11.8 per cent. Falling number, a test for detecting sprout damage, showed that the 1971 durum crop was essentially free of sprouting. Finally, the mineral content of the crop averaged 0.62 per cent throughout the state which is an acceptable value for good quality durum semolina.

Spaghetti Processing Data

To evaluate the semolina, a semi-commercial scale continuous extrusion press was used. In processing, ingredients were mixed under vacuum, automatically extruded through a Teflon spaghetti die, and dried. Furthermore, the extrusion conditions were controlled precisely to follow moderate processing conditions. All samples tested showed excellent extrusion properties and no cracking or checking was found in the dry spaghetti.

The color and appearance of the finished spaghetti is excellent (Table 5). The samples have a deep yellow color with color scores which range from 10.5 to 11.0 with a state average of 10.8 which is the second highest average spaghetti color score ever recorded for a North Dakota durum crop. Also shown in Table 5 are spaghetti cooking data for the crop. Cooked weight averages 36.9 grams which is similar to the average for last year. In addition, a low average cooking loss (7.6 per cent) indicates that the spaghetti has good resistance to disintegration during cooking.

Of equal importance in determining the cooking quality of spaghetti is the firmness or "bite" of cooked spaghetti. Good spaghetti should be firm but not "rubbery" or "mushy" in the cooked form. The data shown in Table 5 are the firmness values found when cooked spaghetti is measured with a laboratory shearing instrument. Average firmness for the crop is 4.25 g. cm. which is similar to the average firmness obtained for last year's crop.

When the processing and spaghetti quality characteristics are considered together, the 1971 North Dakota durum crop appears to be excellent. No problems should be encountered with either the processing or the preparation of high quality pasta products from this year's crop.

Table 5. Durum Wheat Survey - 1971 Crop: Spaghetti Processing Data (County Averages).

Counties	Color	Spaghetti Processing		
		Cooked Weight	Cooking Loss	Firmness
		g.	%	g.cm.
Barnes	10.5	36.5	7.0	4.96
Benson	10.5	36.2	7.0	4.14
Bottineau	10.5	36.0	7.0	4.18
Burke	10.5	37.3	8.0	3.91
Cass	10.5	37.5	8.0	3.92
Cavalier	10.5	36.3	8.0	4.13
Dickey	10.5	37.6	7.0	4.34
Divide	10.5	36.7	7.0	4.59
Eddy	11.0	36.6	6.0	4.22
Foster	11.0	36.5	8.0	4.46
Grand Forks	10.5	37.8	8.0	3.63
Griggs	10.5	36.5	8.0	4.28
LaMoure	10.5	37.8	8.0	3.65
McHenry	11.0	35.8	7.0	4.63
McLean	11.0	36.7	8.0	4.77
Mountrail	11.0	36.7	7.0	4.61
Nelson	11.0	36.8	7.0	4.71
Pierce	11.0	36.9	7.0	4.48
Ramsey	11.0	35.6	7.0	4.86
Renville	11.0	37.1	7.0	4.37
Rolette	11.0	36.9	8.0	4.48
Stutsman	10.5	37.3	8.0	3.78
Towner	11.0	36.1	7.0	4.45
Traill	10.5	38.3	9.0	3.52
Walsh	10.5	37.8	8.0	3.63
Ward	11.0	38.5	9.0	3.70
Wells	11.0	35.9	8.0	4.61
Williams	11.0	37.1	8.0	4.02
Average	10.8	36.9	7.6	4.25

major grades. Approximately 56 per cent of the wheat falls in the top grade, U.S. No. 1 Heavy Hard Amber Durum (Hv HAD), 11 per cent is classed as

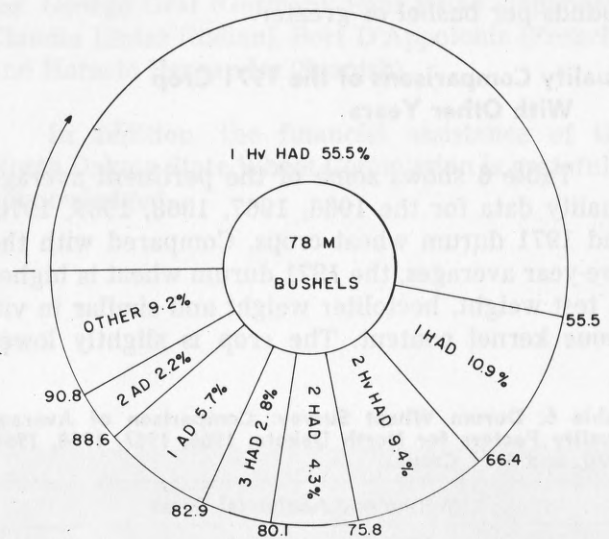


Fig. 2. Diagram showing the durum wheat grade distribution of the 1971 crop.

U.S. No. 1 Hard Amber Durum (1 HAD) and another 9 per cent grades U.S. No. 2 Heavy Hard Amber Durum (2 Hv HAD). Of the total North Dakota crop, approximately 43 million bushels of wheat should grade U.S. No. 1 Heavy Hard Amber Durum. To fall into this classification, the grain must contain more than 75 per cent vitreous kernels, have a test weight of at least 62 pounds per bushel and, as shown in Table 2, be within the limits listed for defects.

Grade and Market Quality Factors

Figure 2 depicts the distribution of the crop within the various wheat grades (U.S. Official). For the most part, the 1971 crop is divided into three

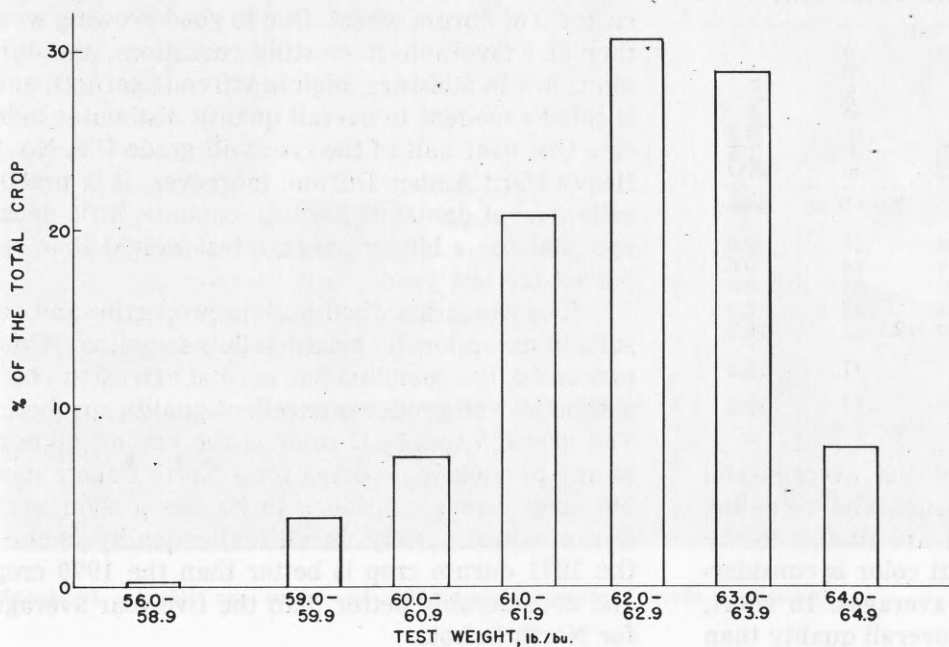


Fig. 3. Histogram showing the test weight distribution of the 1971 durum crop.

Figure 3 shows the test weight distribution for the 1971 crop. A preponderance of the wheat is in the test weight range from 61 to 64 pounds per bushel. According to the data, approximately 88 per cent of the crop will have a test weight of 61 pounds per bushel or greater.

Quality Comparisons of the 1971 Crop With Other Years

Table 6 shows some of the pertinent average quality data for the 1966, 1967, 1968, 1969, 1970, and 1971 durum wheat crops. Compared with the five-year averages, the 1971 durum wheat is higher in test weight, hectoliter weight and similar in vitreous kernel content. The crop is slightly lower

Table 6. Durum 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	Hectoliter Weight	1000 Kernel Weight	Vit. Kernels	Wheat Protein	Falling Number	Sprout Damage
	lbs/bu	kg.	g.	%	%	units	%
1966	59.6	76.7	28.2	74	13.6	272	4.0
1967	61.3	78.9	31.1	85	13.5	431	0.0
1968	59.5	76.6	32.0	74	13.3	260	3.5
1969	62.3	80.2	34.7	89	13.3	471	0.0
1970	61.3	78.9	36.7	80	13.9	451	0.0
1971	62.4	80.3	35.2	81	12.5	469	0.0
5-year Ave.	60.8	78.3	32.5	80.4	13.5	377	1.5

(Semolina, Macaroni and Physical Dough Data)					
Crop Year	Semolina Yield	Semolina Protein	Mineral Content (ash)	Bran Specks	Spaghetti Color
	%	%	%	No./10in ²	Score
1966	56.3	12.5	0.68	16	9.6
1967	54.8	12.6	0.61	14	9.8
1968	51.5	12.4	0.62	21	9.3
1969	55.8	12.3	0.63	15	10.9
1970	53.0	13.0	0.66	22	10.2
1971	53.5	11.8	0.61	17	10.8
5-yr. Ave.	54.3	12.6	0.64	18	10.0

in protein content than the five-year average and has no detectable sprout damage. The semolina yield and the bran speck count are similar to the five-year averages. The spaghetti color is considerably better than the five-year averages. In short, the 1971 crop appears better in overall quality than

the average durum from North Dakota over the past five years.

WEATHER AND HARVEST

To acquaint the readers with seeding, growing, and harvesting conditions which influenced the 1971 durum crop, a brief resumé is presented.

Due to favorable weather in May and June and a normal spring thaw, durum wheat seeding in the major counties was earlier than last year, but somewhat later than usual. By May 4, 13 per cent of the crop was planted. For the next two weeks, seeding proceeded rapidly so that over 60 per cent of the crop was seeded by May 18. By June 8, seeding was essentially completed, even in the northern counties.

Prevailing weather during the remainder of June, July, and August was quite good. Top soil moisture supplies were adequate over most of the durum growing area for the entire growing season. By mid July, it became evident that earlier predictions of a large durum crop were correct. Furthermore, as the harvest began in August, it was apparent that the crop was of excellent quality. Good drying weather continued throughout August. By September 14, 76 per cent of the crop was in the bin compared with 65 per cent last year. Late in September and early October, cool, wet weather set in. Fortunately, however, only a few fields were left to harvest.

SUMMARY

In 1971, North Dakota farmers produced an estimated 78 million bushels (about 2.1 million metric tons) of durum wheat. Due to good growing weather and favorable harvesting conditions, the durum is low in moisture, high in vitreous kernels, and is rated excellent in overall quality. Estimates indicate that over half of the crop will grade U.S. No. 1 Heavy Hard Amber Durum; moreover, it is practically free of damaged kernels, contains little dockage, and has a higher average test weight than reported for last year.

The wheat has good milling properties and results in exceptionally bright yellow semolina. When processed, the semolina has normal extrusion characteristics and produces excellent quality spaghetti. The average spaghetti color is the second highest of any previously reported for a North Dakota durum crop. Leeds continues to be the predominant durum wheat variety. In all major quality factors, the 1971 durum crop is better than the 1970 crop and considerably better than the five-year average for North Dakota.

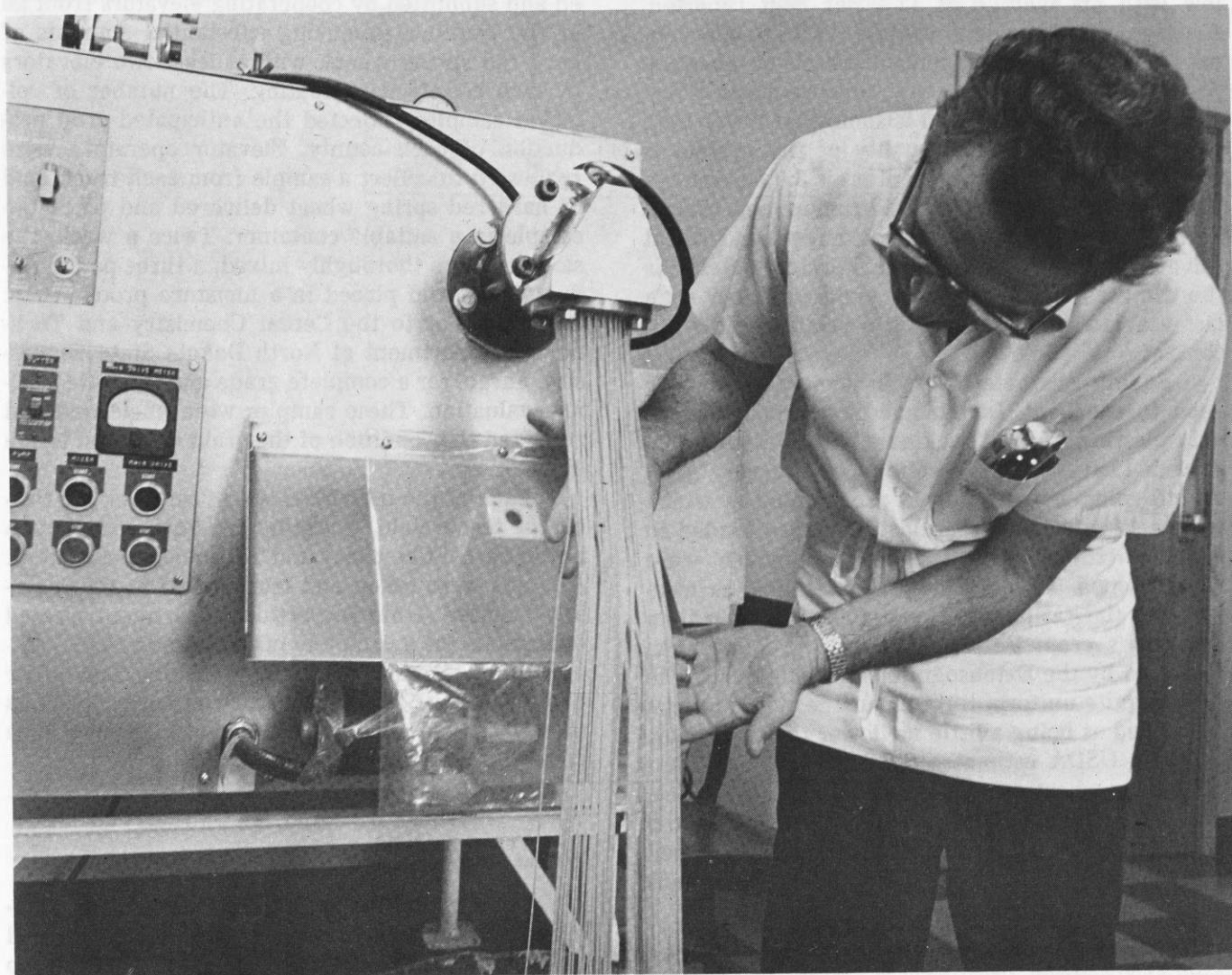
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Spaghetti samples are processed using semi-commercial scale equipment.