

Quality Factors of the 1970 Durum Crop

D. E. Walsh and L. D. Sibbitt

The overall quality of the 1970 durum wheat crop is considered very good. 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. Because of good weather during the summer, the crop is high in test weight and low in moisture content. Leeds is the predominant durum variety in the crop. Compared with the previously dominant variety, Wells, Leeds has larger kernels and a brighter spaghetti color.

According to official USDA production estimates, the North Dakota durum crop is 44 million bushels (1.2 million metric tons). This is a decrease in production of 48 million bushels below last year's record crop and is the result of farmers shifting their acreage from durum to hard red spring wheat production. In average yield, the 1970 crop is estimated at 25 bushels per acre, which is eight bushels below last year, but similar to the five-year average for the state. It is anticipated that 48 per cent of the entire crop will grade U.S. No. 1 Hard Amber Durum or better. In all, the crop should have good milling properties and should result in high quality pasta products.

Samples and Methods

During the 1970 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 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 taken and 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 durum processing.

Wheat Quality

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 2.4 per cent) and reflects the efficiency of the harvesting operation. Test weight data shows that the crop is heavy and averages 61.3 pounds per bushel with a range from a low of 58.8 pounds per bushel to a high of 63.3 pounds per bushel. In grade the crop is variable among the counties and ranges from a low of U.S. No. 4 Amber 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 Hard Amber Durum. Table 2 lists the official grades and grade requirements for durum wheat as set by the United States Government.

In other grading factors (shrunken and broken kernels, foreign material, damage, total defects and wheat of other classes), the 1970 durum crop is very good. On the average, shrunken and broken kernels are very low (1.3 per cent), foreign material is only 0.4 per cent while damaged kernels is less than 1 per cent. Inasmuch as total defects is the

Dr. Walsh is assistant professor, Sibbitt is associate professor, Department of Cereal Chemistry and Technology.

Table 1. Durum Wheat Survey — 1970 Crop: Grading Information (County Averages).

Counties	Dockage	Test	Moisture	Grade	Vitreous Kernels	Shrunken and Broken		F.M.	Damage	Total Contrasting	
		Weight				%	%			%	Defects
	%	lbs/bu	%		%	%	%	%	%	%	
Barnes	2.25	62.0	11.0	2 Hv HAD	88	3.3	0.4	0.9	4.6	0.7	
Benson	2.53	62.1	12.6	1 Hv HAD	92	1.2	0.4	0.8	2.4	0.0	
Bottineau	3.69	61.3	11.9	1 HAD	77	1.7	0.3	0.5	2.5	0.6	
Burke	2.70	61.0	13.1	2 AD	64	2.7	0.4	0.4	3.5	0.7	
Cass	0.80	62.0	11.3	3 Hv HAD	78	2.3	0.5	1.9	4.7	2.2	
Cavalier	1.30	59.3	14.4	2 HAD	78	1.2	0.3	2.7	4.2	0.3	
Dickey	1.89	62.0	11.2	1 Hv HAD	82	1.8	0.4	0.8	3.0	0.3	
Divide	1.80	61.0	12.8	1 HAD	88	1.2	0.2	0.4	1.8	0.0	
Eddy	4.76	61.5	11.9	2 HAD	91	2.3	0.3	0.5	3.1	0.4	
Foster	4.00	61.8	11.1	2 HAD	89	2.6	0.5	0.6	3.7	0.5	
Grand Forks	3.53	58.8	11.4	2 HAD	89	2.0	0.4	1.9	4.3	0.5	
Griggs	1.85	62.3	11.9	1 Hv HAD	91	1.0	0.3	0.9	2.2	0.3	
LaMoure	1.79	61.8	10.4	1 HAD	94	2.3	0.3	0.7	3.3	0.3	
McHenry	1.27	61.6	10.8	1 HAD	79	0.6	0.2	1.6	2.4	0.0	
McLean	1.83	61.5	12.0	1 AD	71	1.2	0.5	0.9	2.6	0.0	
Mountrail	4.08	61.1	11.9	2 AD	73	2.3	0.7	0.2	3.2	0.3	
Nelson	2.50	61.7	12.3	1 HAD	84	1.4	0.4	1.1	2.9	0.0	
Pembina	2.42	61.6	13.2	4 AD	67	1.4	0.3	0.9	2.6	6.9	
Pierce	0.43	62.1	12.6	1 Hv HAD	86	0.9	0.2	0.8	1.9	0.0	
Ramsey	1.93	61.2	12.6	1 HAD	78	1.0	0.2	1.8	3.0	0.0	
Rolette	3.32	60.0	12.5	2 HAD	77	2.5	0.3	1.2	4.0	0.0	
Stutsman	1.36	63.3	11.3	1 Hv HAD	94	1.0	0.5	0.9	2.4	0.0	
Towner	2.17	60.1	13.8	2 HAD	76	1.9	0.2	1.2	3.3	0.0	
Traill	0.12	61.8	12.0	2 HAD	77	1.6	0.3	1.9	3.8	0.0	
Walsh	1.28	60.8	12.8	1 HAD	87	0.8	0.0	1.3	2.1	0.0	
Ward	0.73	62.5	11.7	1 Hv HAD	84	1.1	0.3	1.2	2.6	0.3	
Wells	6.70	62.7	12.1	1 Hv HAD	91	1.3	0.5	0.9	2.7	0.0	
Williams	0.47	62.9	11.0	1 Hv HAD	92	1.6	0.2	1.1	2.9	0.0	
Average	2.35	61.3	12.3	1 HAD	80	1.3	0.4	0.8	2.9	0.2	

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					
pounds	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	
1	60.0	0.1	2.0	0.5	3.0	3.0	1.0	3.0	
2	58.0	0.2	4.0	1.0	5.0	5.0	2.0	5.0	
3	56.0	0.5	7.0	2.0	8.0	8.0	3.0	10.0	
4	54.0	1.0	10.0	3.0	12.0	12.0	10.0	10.0	
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.

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 1.8 per cent to 4.7 per cent, and averages 2.9 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 (0.22 per cent).

Other important factors used for assessing

the quality of the 1970 durum wheat are shown in Table 3. Included are test weight, hectoliter weight, 1,000 kernel weight, kernel size distribution, mineral content (ash), and wheat protein. The hectoliter weight of this year's crop ranges from 78.0 to 84.0 and averages 81.4 kilograms per hectoliter. Moreover, the thousand kernel weight is up over last year and averages 36.7 grams compared with 34.7 grams for 1969.

Table 3. Durum Wheat Survey — 1970 Crop: Wheat Data (County Averages).

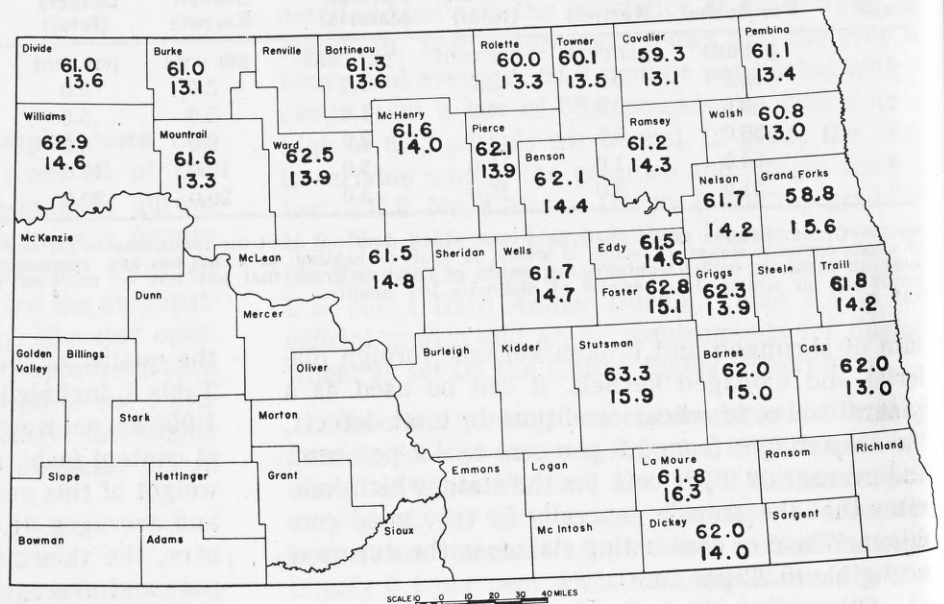
Counties	Test Weight lbs/bu	Hectoliter weight kg.	1000 kernel weight g.	Kernel Distribution			Protein %	Mineral Content (ash) %
				Large %	Medium %	Small %		
Barnes	62.0	82.4	36.2	31	61	8	15.0	1.72
Benson	62.1	82.5	37.5	38	57	5	14.4	1.61
Bottineau	61.3	81.4	36.1	25	67	8	13.6	1.61
Burke	61.0	81.0	37.6	30	60	10	13.1	1.62
Cass	62.0	82.3	36.4	29	66	5	13.0	1.60
Cavalier	59.3	78.8	36.5	29	61	10	13.1	1.56
Dickey	62.0	82.4	37.5	21	74	5	14.0	1.63
Divide	61.0	81.1	40.2	44	49	7	13.6	1.62
Eddy	61.5	81.7	37.0	26	67	7	14.6	1.62
Foster	61.8	82.1	36.8	19	71	10	15.1	1.72
Grand Forks	58.8	78.0	33.1	11	79	10	15.6	1.89
Griggs	62.3	82.7	36.9	19	76	5	13.9	1.64
LaMoure	61.8	82.0	34.7	13	78	9	16.3	1.69
McHenry	61.6	81.8	41.2	32	62	6	14.0	1.64
McLean	61.5	81.7	33.8	27	68	5	14.8	1.74
Mountrail	61.1	81.2	36.6	25	67	8	13.3	1.58
Nelson	61.7	82.0	35.2	19	73	8	14.2	1.64
Pembina	61.6	81.8	38.6	35	60	5	13.4	0.71
Pierce	62.1	82.5	35.6	24	71	5	13.9	1.64
Ramsey	61.2	81.3	36.9	24	69	7	14.3	1.66
Rolette	60.0	79.7	33.4	12	74	14	13.3	1.71
Stutsman	63.3	84.0	35.3	15	78	7	15.9	1.51
Towner	60.1	79.8	35.0	21	67	12	13.5	1.59
Traill	61.8	82.1	32.5	22	71	7	14.2	1.64
Walsh	60.8	80.8	40.7	26	66	8	13.0	1.61
Ward	62.5	83.1	40.0	30	64	6	13.9	1.65
Wells	61.7	81.9	36.9	30	64	6	14.7	1.58
Williams	62.9	83.6	38.9	20	71	9	14.6	1.56
Average	61.3	81.4	36.7	25	68	7	13.9	1.61

Still another means of measuring kernel size is kernel 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 25, 68, and 7 per

cent, large, medium, and small kernels, respectively.

The average protein content of the crop is 13.9 per cent which is 0.6 per cent higher than last year. 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.

Fig. 1. The average protein content and test weight 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.



Semolina Quality

To characterize the quality of the 1970 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 semolina yield of the 1970 crop averaged 53 per cent. The speck count, a measure of the number of bran particles remaining after purification, averaged 22 per 10 square inches. Since a revised milling and purification system was used this year, it was difficult to compare the milling yield or speck count with last year's data. However, the milling yield and speck data for the 1970 crop indicated that the crop had good overall milling quality.

The semolina was high in protein as measured by the wet gluten tests and chemical protein determinations. Falling number, a test for detecting

Table 4. Durum Wheat Survey — 1970 Crop: Semolina Data (County Averages).

County	Semolina Yield	Mineral Content	Bran Specks	Protein	Wet Gluten	Falling No.
	%	% (ash)	No/10 in ²	%	%	units.
Barnes	53.9	0.65	20	14.0	36.4	489
Benson	52.9	0.64	20	13.2	35.4	477
Bottineau	52.9	0.64	13	12.4	34.6	454
Burke	52.6	0.63	20	12.3	36.6	455
Cass	53.8	0.63	27	12.6	35.3	491
Cavalier	52.7	0.65	23	12.1	33.8	233
Dickey	53.5	0.65	23	13.4	35.7	476
Divide	53.5	0.64	20	12.2	35.1	464
Eddy	52.9	0.65	23	12.8	36.3	453
Foster	53.9	0.65	23	13.5	36.9	448
Grand Forks	51.5	0.78	33	14.4	39.5	402
Griggs	53.7	0.68	33	12.7	34.1	487
LaMoure	53.9	0.70	30	14.4	40.9	524
McHenry	53.4	0.66	27	13.2	34.4	333
McLean	53.4	0.70	17	13.9	40.3	449
Mountrail	53.2	0.66	20	12.7	36.7	434
Nelson	54.1	0.66	23	13.2	36.5	511
Pembina	51.2	0.68	33	11.7	33.4	455
Pierce	52.5	0.68	17	12.9	35.8	455
Ramsey	52.4	0.68	17	13.5	38.1	428
Rolette	51.6	0.69	23	12.4	34.0	467
Stutsman	53.4	0.62	27	13.9	40.5	524
Towner	52.1	0.67	17	12.1	33.2	393
Traill	52.9	0.65	20	13.0	36.1	452
Walsh	52.2	0.63	13	12.2	35.4	361
Ward	53.6	0.69	30	13.3	41.9	463
Wells	52.7	0.62	17	13.5	37.6	549
Williams	53.3	0.63	20	13.1	35.7	488
Average	53.0	0.66	22	13.0	36.4	451

sprout damage, showed that the 1970 durum crop was essentially free of sprouting. Finally, the mineral content of the crop averaged 0.66 per cent throughout the state which is an acceptable value for good quality durum semolina.

Spaghetti Processing

To evaluate the crop, a semi-commercial scale continuous extrusion press was used. In processing, ingredients were mixed under vacuum and automatically extruded through a Teflon spaghetti die and dried. Furthermore, the extrusion conditions were controlled precisely to follow modern 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 very good (Table 5). The samples have a deep yellow color with color scores which range from 9.5 to 11.0 with a state average of 10.2. Also shown in Table 5 are spaghetti cooking data for the

Table 5. Durum Wheat Survey — 1970 Crop: Farinogram and Spaghetti Processing Data (County Averages).

Counties	Farinogram Classification	Spaghetti Processing			
		Color	Cooked Weight	Cooking Loss	Firmness
			g.	%	g. cm.
Barnes	2	10.5	37.1	6.0	3.98
Benson	2	10.5	38.7	6.9	3.44
Bottineau	2	11.0	36.6	7.8	4.39
Burke	1	10.0	35.5	8.6	5.13
Cass	3	10.5	35.3	6.0	4.79
Cavalier	2	10.0	35.5	7.0	4.38
Dickey	2	10.0	35.4	6.1	5.14
Divide	3	10.5	34.6	7.0	5.21
Eddy	2	10.5	36.4	7.0	5.03
Foster	2	9.5	37.1	7.8	4.31
Grand Forks	2	9.5	37.6	8.0	4.24
Griggs	1	10.0	36.2	7.4	4.31
LaMoure	2	9.5	36.5	6.0	4.75
McHenry	3	10.0	36.1	6.0	4.71
McLean	2	10.5	36.9	6.0	4.59
Mountrail	2	10.0	36.1	6.0	5.11
Nelson	2	10.5	35.7	6.0	4.14
Pembina	2	9.5	35.1	6.0	4.76
Pierce	2	10.5	35.9	7.1	5.15
Ramsey	3	10.5	35.9	7.4	5.10
Rolette	1	10.0	35.7	6.0	5.31
Stutsman	2	10.5	37.7	6.2	4.74
Towner	2	10.0	34.2	7.2	4.72
Traill	2	10.0	35.8	7.0	4.76
Walsh	3	10.5	35.5	8.1	4.50
Ward	2	10.5	36.2	7.2	5.07
Wells	2	10.5	36.2	7.0	5.10
Williams	2	10.0	37.1	7.3	4.22
Average	2	10.2	36.2	6.9	4.70

crop. Cooked weight averages 36.2 grams which is similar to the average of 36.1 grams obtained last year. In addition, a rather low average cooking loss (6.9 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 4.7 g. cm. which is slightly better than the average firmness of 4.2 g. cm. obtained for last year's crop. Farinogram classification for the crop is 2.0 which indicates that the crop has a mellow type gluten which performs well under modern pasta processing conditions.

With processing and spaghetti quality characteristics considered together, the 1970 North Dako-

ta durum crop appears very good. No problems should be encountered with either the processing or the preparation of high quality pasta products from this year's crop.

Table 6 shows some of the pertinent average quality data for the 1965, 1966, 1967, 1968, 1969, and 1970 durum wheat crops. Compared with the five-year averages, the 1970 durum wheat is higher in test weight, hectoliter weight, and similar in vitreous kernel content. The crop is higher by 0.5 per cent in protein content than the five-year average and has no detectable sprout damage. Due primarily to a revised semolina milling and purification procedure, the semolina yield is lower and the bran speck count is somewhat higher than the five-year averages. The spaghetti color is considerably better than the five-year averages. In short, the 1970 crop appears better in overall quality than the average durum from North Dakota over the past five years.

Table 6. Durum Wheat Survey: Comparison of Average Quality Factors for North Dakota, 1965, 1966, 1967, 1968, 1969 and 1970 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	%
1965*	58.8	78.1	30.0	71	13.2	280	4.5
1966	59.6	79.1	28.2	74	13.6	272	4.0
1967	61.3	81.4	31.1	85	13.5	431	0.0
1968	59.5	79.1	32.0	74	13.3	260	3.5
1969	62.3	82.7	34.7	89	13.3	471	0.0
1970	61.3	81.4	36.7	80	13.9	451	0.0
5-year Ave.	60.3	80.1	31.2	79	13.4	341	2.4
(Semolina, Macaroni and Physical Dough Data)							
Crop Year	Semolina Yield	Semolina Protein	Mineral Content (ash)	Bran Specks	Spaghetti Color	Farinogram Classification	
	%	%	%	No./10 in ²			
1965*	54.0	12.4	0.63	21	9.5	3.0	
1966	56.3	12.5	0.68	16	9.6	3.7	
1967	54.8	12.6	0.61	14	9.8	3.0	
1968	51.5	12.4	0.62	21	9.3	2.4	
1969	55.8	12.3	0.63	15	10.9	2.0	
1970	53.0	13.0	0.66	22	10.2	2.0	
5-year Ave.	54.5	12.4	0.63	17	9.8	2.8	

*Calculated weighted average for "pre" and "post" rain crops of 1965.

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 1970 crop is divided into four major grades. Approximately 27 per cent of the wheat falls in the top grade, U.S. No. 1 Heavy Hard

Amber Durum (1Hv HAD), 21 per cent is classed as U.S. No. 1 Hard Amber Durum (1 HAD) and another 9 per cent and 11 per cent are in grades U.S. No. 2 Heavy Hard Amber Durum (2 Hv HAD) and U.S. No. 2 Hard Amber Durum (2 HAD), respectively. Of the total crop, approximately 21 million bushels of wheat should grade U.S. No. 1 Hard Amber

Durum or better. To fall into this classification, the grain must contain more than 75 per cent vitreous kernels and have a test weight of at least 60 pounds per bushel.

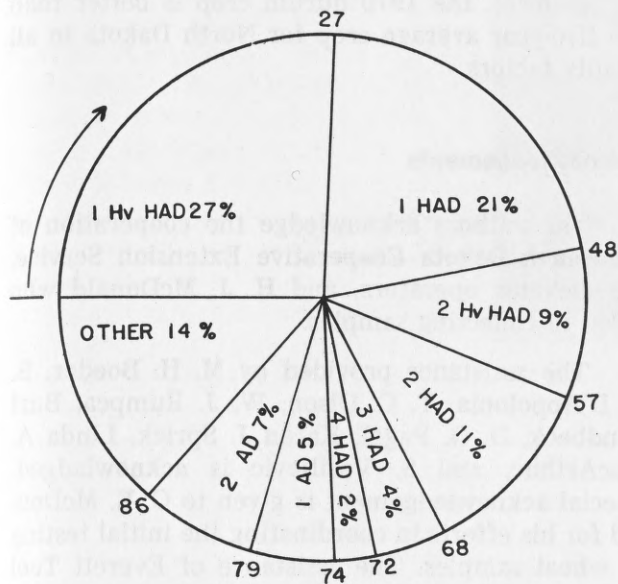


Fig. 2. Diagram showing the durum wheat grade distribution of the 1970 crop.

Figure 3 shows the test weight distribution for the 1970 crop. A preponderance of the wheat is in the test weight range from 60 to 63 pounds per bushel. According to the data, approximately 83 per cent of the crop will have a test weight of 60 pounds per bushel or greater.

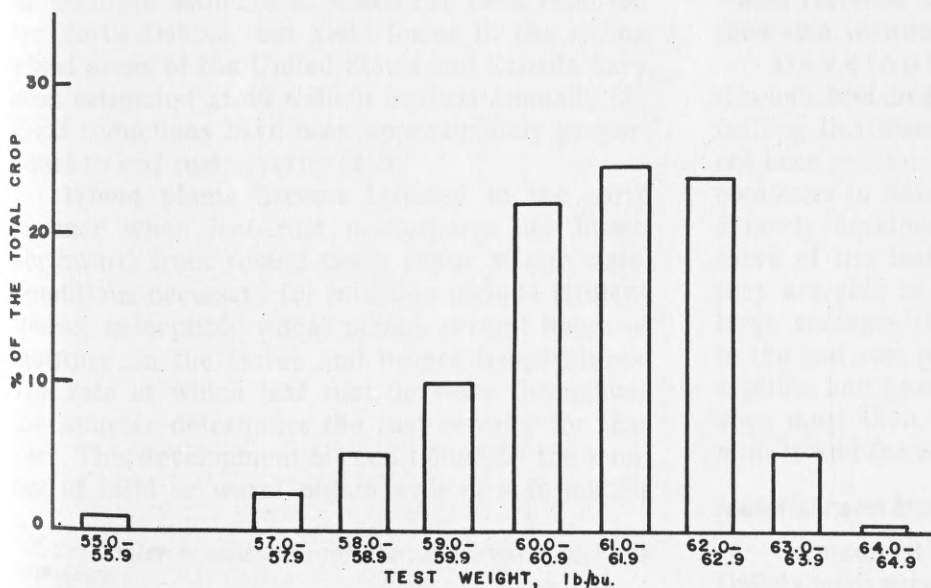


Fig. 3. Histogram showing the test weight distribution of the 1970 durum crop.

WEATHER AND HARVEST

To acquaint the readers with seeding, growing, and harvesting conditions which influenced the quality of the 1970 durum crop, a brief resumé is presented.

Due to excessive moisture and a late spring thaw, durum wheat seeding in the northern counties was later than usual. By May 19, only 11 per cent of the crop was planted, and it was not until the week of June 2 that a major portion of the durum acreage was seeded. Because of the late seeding, some farmers, especially near the Canadian border, switched from durum to an earlier maturing crop such as hard red spring wheat.

Prevailing weather, during the remainder of June, July, and August was quite good. Most areas reported adequate soil moisture. However, toward the end of August, rains and wet weather slowed the durum harvest and by the last week of August only 21 per cent of the crop had been harvested. Because of the late seeding and the August rains, the durum harvest proceeded behind schedule in September. By September 15, only 65 per cent of the crop was in the bin compared with 94 per cent last year. However, by the end of September virtually all of the crop had been harvested.

As the new wheat began reaching the local elevators, it became apparent that in spite of the slow harvest, the crop was of good quality. The

wheat was relatively free of diseased or damaged kernels. Although a few samples contained bleached kernels, the greatest portion of the crop was high in test weight and grade. Estimates by the USDA placed the North Dakota durum crop at about 44 million bushels. This represented a drop in production from last year's record crop of 92 million bushels. However, nearly half of the crop was graded as U.S. No. 1 Hard Amber Durum or higher.

Summary

In 1970, North Dakota farmers produced a crop of 44 million bushels of durum wheat. In spite of delayed spring planting, and a slow harvest, the crop has very good quality.

Characteristically, the crop has low moisture, high test weight, and a high content of vitreous kernels. It is estimated that nearly half of the crop will grade U.S. No. 1 Hard Amber Durum or better. The crop is generally free from damaged kernels, contains little dockage, (about 2 per cent) and has a higher 1,000 kernel weight than last year's durum crop.

The wheat has normal milling properties and results in bright yellow semolina. When processed, the semolina has normal extrusion properties and

produces bright yellow spaghetti with excellent cooking quality. Again, Leeds durum is the predominant wheat variety in the crop.

In brief, the 1970 durum crop is better than the five-year average crop for North Dakota in all quality factors.

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