

durum will grade U. S. No. 2 Hard Amber Durum or better. To be in this grade, the wheat must contain a minimum of 75 per cent vitreous kernels, have a test weight of at least 58 pounds per bushel and be within the maximum limits for defects.

Quality Comparisons of the 1973 Crop With Other Years' Durum Crops

Compared with the five-year state averages, the 1973 durum wheat crop is similar in test weight, hectoliter weight, and vitreous kernel content, but higher in protein content. The 1973 crop shows a significantly higher average thousand kernel weight (40.9 g.) than the previous five years' durum crops. The falling number value and visual inspection indicate that approximately 2.6 per cent of the crop shows detectable sprouting. The semolina milling yield of the crop is equal to the five-year average for the state. In addition, the crop has the highest average semolina protein content and lowest ash content of the North Dakota durum crops harvested over the last five years. Spaghetti color of the crop is lower than last year but is still well within the acceptable range for good quality spaghetti.

Summary

The 1973 durum crop from North Dakota is considered good in general quality. An estimated 76 million bushels (2.1 million metric tons) were produced in 1973, most of which is of excellent quality. However, an estimated 2.6 per cent of the total crop showed sprouting. The sprouting is not considered serious enough to cause any significant difficulties in processing or reduce the quality of the finished pasta products. Buyers will need to be selective in order to consistently obtain top quality lots of durum wheat.

The wheat is low in moisture, has generally a high vitreous kernel content, and is exceptionally high in protein content. An estimated 66 per cent of the crop will grade U. S. No. 2 Hard Amber Durum or better. When compared with the 5-year state averages for durum wheat, the 1973 crop is equal in milling yield but contains slightly more bran particles in the semolina. Spaghetti of the 1973 crop is slightly lower in color than average. However, the cooking quality of spaghetti from the crop is significantly better than the average and has high cooked spaghetti firmness and low cooking loss.

The Quality of North Dakota's 1973 Hard Red Spring Wheat

L. D. Sibbitt and O. J. Banasik

USDA estimates place the 1973 North Dakota hard red spring wheat harvest at about 174 million bushels (4.7 million metric tons). This is the second largest hard red spring wheat crop on record for the state. It is estimated that 84 per cent of the crop should grade U. S. No. 2 Dark Northern Spring or better. Average wheat protein content for the state (expressed on a 14.0 per cent moisture basis) is 14.6 per cent, which is .6 per cent higher than last year, and more than one per cent higher than that reported for the 1971 crop. In general, the overall quality of the 1973 hard red spring crop is considered to be very good to excellent.

The overall quality of North Dakota's 1973 hard red spring wheat crop is considered to be generally very good to excellent and appears to be in certain instances similar to the crop produced in 1970. Average test weight is 59.7 pounds per bushel, which is about five-tenths of a pound

lower than last year. The moisture content is low, with an average of 11.5 per cent reported.

Average wheat protein content is 15.0 per cent expressed on an "as is" moisture basis, or when expressed on a 14.0 per cent moisture basis it becomes 14.6 per cent, which is 0.6 percentage points higher than the 1972 crop. Vitreous kernel content in this year's Northern Spring Wheat Crop is set at 84 per cent. This is one percentage

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

point higher than the 1972 crop, but a little lower than the five-year average. Foreign material and damaged kernels are both about the same as last year.

The percentage of shrunken and broken kernels and total kernel defects are higher than last year's crop, but are somewhat similar to the five-year average. Flour yield and flour ash content are about the same as last year. On the average, wet gluten and falling number are a little lower than that reported for the 1972 crop. All of the samples milled in a normal manner.

Baking characteristics, in general, are very good to excellent. Dough handling properties are very elastic with no "buckiness" of the doughs observed. Loaves of large volume with an excellent external appearance were obtained. Crumb grain and textures were a little more open than last year. Crumb colors were about the same as last year. On the average, farinogram peak point and tolerance provided higher values than last year's crop. Very good to excellent elastic properties as indicated by the Extensograph were obtained.

It has been observed that, in general, the 1973 Dark Northern Spring wheat crop appears to be more variable in test weight and protein content than either of the two previous crops.

The USDA estimates the North Dakota hard red spring (Dark Northern Spring) wheat crop at about 174 million bushels (4.7 million metric tons). This is about 17 per cent above last year's crop and is the second largest crop produced in North Dakota. An estimated average yield of 28.0 bushels per acre is one bushel below a year ago. A preponderance of the crop (84 per cent) should grade U. S. No. 2 Dark Northern Spring or better. The USDA also estimates the total U. S. production of hard red (Northern Spring) wheat at about 357 million bushels.

Samples and Methods

During the 1973 harvest, samples were collected and submitted by cooperating elevators from all of the counties producing substantial amounts of hard red spring wheat, with at least two elevators in each county participating. The number of collected samples reflected the anticipated crop production of each county. Elevator operators were requested to collect a sample from each truck load of hard red spring wheat delivered and place the sample in a suitable container. Twice a week the samples were thoroughly mixed, a three-pound aliquot taken and placed in a moisture proof plastic bag, and sent to the Department of Cereal Chemistry and Technology at North Dakota State University, Fargo, for a complete grade and ultimate quality evaluation. These

samples were uncleaned and reflected the condition of the grain delivered to the elevator.

Each of the individual wheat samples was tested for test weight, dockage, moisture, and protein. Aliquots of the samples were taken and transmitted to the federally licensed Grain Inspection Department located in Fargo, North Dakota for a complete official grade.

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

QUALITY DATA FOR COMPOSITES

Wheat Data

Test weight of this year's crop, as shown in Table 1, ranged from 56.9 to 61.5, with an average of 59.7 pounds per bushel. About 90 per cent of the 1973 crop would fall between 58.0 and 61.9 pounds per bushel. Average wheat moisture content for the state is 11.6 per cent. Vitreous kernels ranged from 62 to 95, with an average of 84 per cent.

Shrunken and broken kernels averaged 1.8 per cent, well below the allowable limit for the two top grades. Foreign material (FM) is quite low, showing an average of 0.2 per cent with a range of 0.1 to 0.6 per cent. Damaged kernels are also low, ranging from 0.1 to 0.6 with an average of 0.2 per cent. Total defects, which is the sum of shrunken and broken kernels, foreign material, and damaged kernels, including heat damaged kernels are, with the exception of five samples, within the limits listed for the two top grades. None of the samples is in excess of 3.9 per cent and the average is considerably less. Contrasting classes in this year's crop are negligible. The grades of the composites ranged from U. S. No. 3 Northern Spring to U. S. No. 1 **Heavy** Dark Northern Spring.

All of the 1973 crop samples in this survey were carefully examined for the presence of ergot, a fungus which was observed in the 1971 Northern Spring Wheat crop. Very little of this fungus was found in any of the samples; as a matter of fact, a very high percentage of the samples were completely free from this disease. It is apparent that there will be no problem with ergot in the 1973 crop of Northern Spring Wheat from North Dakota.

Flour Data

Experimental flour extractions data, ranged from 66.6 to 71.8 per cent, with a state average of 69.0 per cent. The ash content of this long patent, experimentally milled flour ranged from 0.38 per cent in Burke county to 0.52 per cent in Kidder

county, with an average for the state of 0.43 per cent.

None of the samples displayed any abnormal milling characteristics. Milling properties, in general, were similar to the hard red spring wheat produced in 1972. Flour protein content average is 13.7 per cent, with a range of 12.3 to 16.2 per cent expressed on a 14.0 per cent moisture basis. This average flour protein content is four-tenths of a per cent higher than last year, but 1.1 per cent higher than that reported for the 1971 crop. The average drop in protein from wheat to flour is again less than 1.0 per cent.

Average baking absorption for the state is 64.4 per cent expressed on a 14.0 per cent moisture basis, with a range of 60.8 to 67.8 per cent. This average absorption value compares very favorably with the 64.5 per cent reported for last year's crop. Wet gluten ranged from 33.2 to 51.1, with an average of 42.1 per cent. Somewhat surprisingly, this wet gluten average is lower than that reported for the 1972 crop, but is well above the average for the past five years. Average falling number for the state is 436 units, with a range from 273 to 590 units.

All of the county averages indicate the absence of excessive enzyme activity (sprout damaged kernels) in this year's crop. Although the samples examined in this survey were not damaged, reports have been received to the effect that there has been a limited acreage of wheat adjacent to the Canadian border and in certain counties of the Red River Valley where some of the grain has been damaged by sprouting to a slight degree.

Baking Data

In general, the baking characteristics of the 1973 crop are considered very good to excellent. Dough handling properties are excellent with no "buckiness" of the doughs observed. The flour produced loaves of large volume coupled with good break and shred, and excellent crust and crumb color. Crumb grain and texture is a little more open than last year, which might be attributed to the slightly larger loaf volumes obtained on this year's samples. Loaf volumes ranged from 775 to 995 cc's with an average of 887 cc's. Individual loaf volumes were within about 12 per cent of the mean loaf volume for the state. Crumb grain and texture and crumb colors showed a range of about 6 per cent from the mean.

As was reported for the past two years' crops, the 1973 flours required very little, if any, oxidizing agents to produce optimum baking performance. This is unusual, as in previous years 10 ppm of potassium bromate on flours produced from North Dakota bread wheats were required to ob-

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

Physical Dough Properties

Mixing characteristics of this year's crop as indicated by the farinogram pattern are classified as medium-strong. Farinogram absorption averaged 64.3, which is similar to last year's value. Mixing time ranged from 4.5 to 10.5 minutes with an average of 7.6 minutes. Mixing tolerance average is 12.6 minutes with a range of 6.0 to 19.5 minutes. Generally, both mixing time and tolerance are considerably higher than last year. The MTI value (mixing tolerance index) shows the characteristics of a medium-strong type curve. The average overall empirical farinogram classification is 6.4. This is higher than last year's classification which was 5.3. In general, the 1973 crop produced doughs with excellent elastic properties and are classed as stronger and more elastic than last year.

Grade and Market Quality Factors

Figures indicate that 84 per cent of the 1973 hard red spring wheat crop (approximately 146 million bushels) should grade U. S. No. 2 Dark Northern Spring or better. This is higher than the 1972 crop, which estimated that 79 per cent should grade U. S. No. 2 Dark Northern Spring or better.

Quality Comparisons of the 1973 Crop with Other Years

Average data from this year's crop, when compared with the 1972 crop, shows slightly lower values for test weight, hectoliter weight, falling number, and wet gluten. Wheat protein content is six-tenths of a per cent higher than that reported for the 1972 crop. Percentage of vitreous kernels, flour yield, and flour ash contents are similar to last year. In general, the baking properties are quite similar to last year with the exception of the crumb grain and texture which appears to be, on the average, a little more open. The physical dough properties, as measured by the Farinograph and Extensograph, are all significantly higher than last year's crop.

When compared with the five-year average, the 1973 crop is better in wheat protein content, wet gluten, baking absorption, and loaf volume. The physical dough properties indicate that the gluten properties of the 1973 crop are somewhat more elastic.

These yearly quality differences are to be expected and are attributed to both the changing environmental conditions and the wheat varieties grown.

Table 1. HRS Wheat Survey - 1973 Crop: Grading Information (County Averages).

Counties	Dockage %	Test Weight lbs/bu	Moisture %	Grade	Vitreous Kernels %	Shrunken and Broken %	F.M. %	Damage %	Total Defects %	Contrasting Classes %
Adams	1.9	60.2	10.3	1 HDNS	94	1.9	0.3	0.1	2.3	0.0
Barnes	1.3	58.2	11.8	1 DNS	83	1.9	0.2	0.2	2.3	0.0
Benson	2.0	59.0	12.5	1 DNS	82	1.1	0.3	0.2	1.6	0.1
Bottineau	2.1	61.0	11.8	1 HDNS	82	1.2	0.3	0.2	1.7	0.1
Bowman	1.7	61.4	11.2	1 HDNS	93	1.7	0.2	0.1	2.0	0.0
Burke	0.9	60.1	12.5	1 HDNS	76	1.3	0.3	0.4	2.0	0.0
Burleigh	1.5	58.0	11.1	2 DNS	88	2.7	0.3	0.2	3.2	0.1
Cass	0.4	60.8	11.8	1 HNS	74	1.2	0.1	0.3	1.6	0.0
Cavalier	1.7	59.7	12.5	2 NS	73	1.2	0.6	0.4	2.2	0.0
Dickey	1.2	60.4	12.2	1 HDNS	94	1.8	0.2	0.1	2.1	0.0
Divide	1.1	60.6	12.2	1 HDNS	92	1.2	0.2	0.1	1.5	0.0
Dunn	1.8	60.2	10.6	1 HDNS	93	2.0	0.2	0.2	2.3	0.0
Eddy	1.1	57.9	12.1	2 DNS	78	1.3	0.2	0.4	1.9	0.0
Emmons	2.0	58.0	11.5	1 DNS	90	2.5	0.3	0.2	3.0	0.0
Foster	1.0	59.1	11.6	1 DNS	86	1.5	0.3	0.2	2.0	0.0
Golden Valley	0.7	61.5	11.1	1 HDNS	93	2.2	0.3	0.1	2.6	0.0
Grand Forks	0.9	60.1	11.5	1 HDNS	76	1.4	0.2	0.3	1.9	0.0
Grant	3.2	60.7	9.7	2 HDNS	93	3.6	0.2	0.1	3.9	0.0
Griggs	1.6	59.7	10.7	1 DNS	88	1.4	0.3	0.2	1.9	0.0
Hettinger	1.5	60.3	11.0	1 HDNS	93	2.2	0.2	0.1	2.5	0.0
Kidder	1.9	56.9	10.5	3 DNS	88	3.4	0.3	0.1	3.8	0.0
LaMoure	1.0	57.5	11.7	2 DNS	87	2.0	0.2	0.4	2.6	0.0
Logan	0.4	57.8	11.2	2 DNS	93	2.1	0.2	0.1	2.4	0.0
McHenry	1.9	59.7	11.7	1 DNS	78	1.5	0.4	0.3	2.2	0.0
McIntosh	0.3	59.3	11.5	1 DNS	94	1.8	0.2	0.2	2.2	0.0
McKenzie	1.1	61.2	10.9	1 HDNS	95	2.1	0.1	0.1	2.3	0.0
McLean	1.8	59.9	11.3	1 DNS	91	2.2	0.2	0.2	2.6	0.0
Mercer	1.8	59.9	10.9	1 DNS	93	1.9	0.2	0.1	2.2	0.0
Morton	3.0	59.2	10.8	1 DNS	94	2.7	0.2	0.1	3.0	0.0
Mountrail	2.0	60.2	11.5	1 HDNS	93	1.8	0.2	0.1	2.1	0.1
Nelson	1.5	58.9	12.8	1 NS	66	1.1	0.2	0.6	1.9	0.0
Oliver	0.9	58.0	10.4	1 DNS	81	2.0	0.1	0.2	2.3	0.0
Pembina	2.1	59.3	12.6	1 NS	66	1.5	0.4	0.6	2.5	0.0
Pierce	0.2	60.0	11.8	1 HDNS	78	0.7	0.2	0.5	1.4	0.0
Ramsey	1.8	59.7	12.5	1 DNS	77	1.2	0.2	0.1	1.5	0.0
Ransom	1.4	59.0	12.1	1 DNS	79	1.6	0.2	0.2	2.0	0.0
Renville	2.6	60.8	12.2	1 HDNS	83	1.1	0.3	0.1	1.5	0.1
Richland	0.6	60.4	11.5	1 HNS	71	1.0	0.3	0.3	1.6	0.0
Rolette	1.0	59.5	12.8	1 DNS	77	1.1	0.5	0.4	2.0	0.0
Sargent	0.6	59.6	11.1	1 DNS	78	1.3	0.4	0.6	2.3	0.0
Sheridan	1.8	59.6	11.3	1 DNS	87	1.8	0.2	0.2	2.2	0.1
Sioux	5.4	57.9	11.0	2 DNS	93	2.6	0.4	0.1	3.1	0.0
Stark	2.5	60.6	10.9	2 HDNS	94	2.8	0.2	0.1	3.1	0.0
Steele	1.0	59.1	12.5	1 NS	62	1.6	0.2	0.6	2.4	0.0
Stutsman	1.3	58.9	11.3	1 DNS	89	2.1	0.3	0.2	2.6	0.0
Towner	0.2	61.3	12.3	1 HDNS	89	0.9	0.3	0.2	1.4	0.0
Traill	0.6	59.9	11.5	1 NS	72	1.4	0.2	0.3	1.9	0.0
Walsh	1.1	60.4	11.6	1 HDNS	81	1.2	0.2	0.2	1.7	0.0
Ward	0.9	60.6	11.6	1 HDNS	83	1.2	0.2	0.5	1.9	0.0
Wells	1.1	59.4	11.3	1 DNS	83	0.9	0.2	0.3	1.4	0.0
Williams	1.0	61.4	12.1	1 HDNS	95	1.6	0.1	0.1	1.8	0.0
Average	1.5	59.7	11.5	1 DNS	84	1.8	0.2	0.2	2.2	0.01