PGI

PLAINS GRAINS INC.

2016 Hard Red Winter Wheat Regional Quality Survey

127 Noble Research Center
Stillwater, OK 74078
Ph 405.744.9333
pgiadmin@plainsgrains.org
www.plainsgrains.org

PGI
PLAINS GRAINS INC.

Colorado Wheat
Administrative Committee
www.coloradowheat.org

Idaho Wheat Commission
www.idahowheat.org

Oklahoma Wheat Commission
www.wheat.state.ok.us

Kansas Wheat Commission
www.kswheat.com

North Dakota
Wheat Commission
www.ndwheat.com

South Dakota
Wheat Commission
www.sdwheat.org

Nebraska Wheat Board
www.nebraskawheat.com

Washington Grain Commission
www.washingtongrainalliance.com

Texas Wheat Producers
Board and Association
www.texaswheat.org

Montana Wheat & Barley
Committee
wbc.agr.mt.gov

Oregon Wheat Commission
www.owgl.org

Wyoming Wheat
Growers Association
www.wyomingwheat.com

Plains Grains, Inc.

Plains Grains, Inc., a non-profit, private quality based marketing initiative, was formed in 2004 through the Oklahoma Wheat Commission, the Oklahoma Department of Agriculture, Food and Forestry, the Oklahoma State University Division of Agricultural Sciences and Natural Resources.

PGI was designed to bridge the gap between wheat producers, grain companies and foreign and domestic flour millers to benefit all segments of the wheat industry.

PGI facilitates the appropriate wheat quality tracking needed to provide millers with the quality information they need to purchase U.S. wheat. While state data is important, it is critical to Plains Grains marketing goals to have quality data for the entire HRW wheat production area. Each state may be able to produce the quality needed by foreign buyers, but it will take multiple states to achieve the critical mass needed to meet the quantity needs. By working together as a region we can meet both quality and quantity demands.

PLAINS GRAINS INC.

In 2004, PGI's crop quality survey included the Oklahoma HRW wheat crop. Designed as a regional marketing entity, PGI then brought five other HRW wheat producing states on board for the crop quality survey in 2005. Due to the welcome reception and success of PGI in the foreign marketplace, the entire Great Plains HRW wheat production region subscribed to the PGI crop quality survey in 2006.

Visit our website at **www.plainsgrains.org** for up-to-date information, interactive maps and more!

Feeding the World

Wheat is one of the oldest and most widely used food crops in the nation and it supplies approximately 20 percent of food calories for the world's population. Whole grains contain protective anti-oxidants in amounts near or exceeding those in fruits and vegetables.

Wheat is the United State's leading export crop and the fourth leading field crop. The most common class produced in the United States is Hard Red Winter (HRW) wheat. The class a variety fits into is determined by its hardness, the color of its kernels and by its planting time. Other classes are: Durum, Hard Red Spring, Soft Red Winter, Hard White and Soft White.

Almost 50 percent of the U.S.'s total wheat production is exported. Approximately one-third of the HRW produced is exported. Nigeria is the number one importer of U.S. HRW, with a little over 75 percent of its total imports coming from the U.S.

Wheat flour is the major ingredient in many favorite foods found across the globe. More foods are made from wheat than any other cereal grain. Wheat has the ability to produce a widely diverse range of end-use products because each class of wheat has distinct characteristics that create unique functionality.

HRW wheat is a versatile wheat with excellent milling and baking characteristics for pan breads. Principally used to make bread flour, HRW is also a choice wheat for Asian noodles, hard rolls, flat breads and as a blending improver.

Hard Red Winter wheat accounts for about 40 percent of total U.S. wheat production and is grown primarily in the Great Plains states of Colorado, Kansas, Nebraska, Oklahoma, Texas, Montana, South Dakota, North Dakota, Wyoming, and the Pacific Northwest.

National Wheat Overview

Wheat Major Classes

The six major classes of U.S. wheat are Hard Red Winter, Hard Red Spring, Soft Red Winter, Soft White, Hard White and Durum. Each class has a somewhat different end use and production tends to be region-specific. This region is mostly limited to production of Hard Red Winter and Hard White wheat classes, therefore the data in this publication will focus on the quality of those classes for the current crop year.

Hard Red Winter wheat accounts for about 40 percent of total U.S. wheat production

Hard Red Winter (HRW) wheat accounts for about 40 percent of total U.S. wheat production, dominates the U.S. wheat export market and is grown primarily in the Great Plains, stretching from the Mississippi River to the Pacific Ocean and from Canada to Mexico.

This fall seeded wheat is a versatile wheat with moderately high protein content and excellent milling and baking characteristics. Principally used to make bread flour, HRW is also a choice wheat for Asian noodles, hard rolls, flat breads and is commonly used as an improver for blending.

Hard White (HW) is the newest class of wheat, used for the same basic products as HRW wheat, can provide higher milling extraction and requires less sweetener in whole-wheat products due to its milder, sweeter flavor.

HW, which is closely related to Red wheats, receives enthusiastic reviews when used for Asian noodles, hard rolls, bulgar, tortillas, whole wheat or high extraction applications, pan breads or flat breads.

Weather and Harvest

The establishment and development of the 2016 HRW wheat crop were much like the conditions that existed during the fall and winter of 2014 and 2015. Establishment of the crop (root and tiller development) was generally good across all planting regions. Wheat producers in most areas reported adequate moisture at planting which prevailed through late fall and early winter. The exception was north Texas where excessive moisture prevented planting of the crop and as a result Texas was down 17% in planted acres this past year, much of it in this area. Over the past 3 years most wheat producers were satisfied with the planting, establishment and tillering of the crop during the fall and winter. However, the other common theme in the central and southern US has been excessively dry conditions during the late winter and early spring, then excessive moisture during the later stages of crop development. The exceptions were Washington, Oregon, Idaho and Montana where unseasonably warm temperatures during the late spring accompanied by a very erratic rainfall pattern throughout later stages crop development resulted in wide range of kernel characteristics and protein levels in the crop.

In 2016 excessive moisture in late May came when the crops in Texas and the southern half of Oklahoma were already mature, so it was of very little help to the crop at that point and to the contrary negatively affected test weight. However, the moisture was in time to make a significant difference to the crop in northwest Texas, the northern half of Oklahoma, Kansas, Colorado and Nebraska. Those areas saw record yields with very good kernel fill and development. Most producers fertilized for a normal yield and finished harvest with 50% to 70% higher than average yields. As a result of these conditions wheat protein was lower than normal across most of the production region. Similar to last year the precipitation also allowed temperatures to moderate over an extended period relative to normal. As in 2015 stripe rust inoculum was again present, but in contrast to 2015 most areas reported timely use of fungicides on over 70% of the crop at risk abating wide-spread damage.

Samples and Methods

Sample collection and analysis were conducted in a collaborative effort between the USDA/ARS Hard Winter Wheat Quality Lab, Manhattan, Kansas and Plains Grains, Inc., a private non-profit company designed to do quality testing of the Hard Red Winter Wheat crop. 499 (94% of the long-term average due to environment production factors) samples were collected from grain elevators when at least 30% of the local harvest was completed in the 12 states of Texas, Oklahoma, Kansas, Colorado, Nebraska, Wyoming, South Dakota, North Dakota, Montana, Washington, Oregon and Idaho.

Official grade and non-grade parameters were determined on each sample. 122 composites were then formed based on production regions and protein ranges of < 11.5%, 11.5% - 12.5%, and >12.5% and milling, dough functionality and bake tests were run on each of the composites. Results by protein ranges were then segregated by export region and reported by tributary as well as overall. Sampling was targeted at testing over 80% of the Hard Red Winter Wheat production in the 12 states referenced above with weighting factors based on production calculated. The analytical methods used to define the reported parameters are described in the Analysis Methods section of this book.

Wheat and Grade Data

The overall composite 2016 HRW crop official grade averaged 93% Grade #2 or better (Gulf tributary averaging 91% and PNW tributary averaging 96%) when considering all protein levels and weighting for the production. The overall dockage level of 0.5% is significantly below last year's average of 0.8% and equal to the 5-year average of 0.5%. Total defects of 1.3% are well below last year's average of 1.8% and 5-year average of 1.6%. Foreign material is equal to last year's 1.2% while shrunken and broken (0.9%) and total defects (1.3%) are significantly below the 5-year average (0.1% and 1.6% respectively). Wheat ash (14% mb) is 1.49% and well below last year's 1.59% and the 5-year average of 1.54%. Overall test weight averaged 60.5 lb/bu (79.6 kg/hl) which is above the 5-year average of 60.3 lb/bu (79.3 kg/hl) and significantly above last year's average of 59.0 lbs/bu (77.6 kg/hl). The overall average thousand kernel weight of 31.7 g significantly exceeds the 5-year average of 29.1 g by 2.6 g. Average kernel diameter is 2.66 mm exceeds the 5-year average and last year. The average protein of 11.5 % is over a full percentage point lower than the 5-year average of 12.8%. Overall kernel characteristics were outstanding in the 2016 crop with protein quantity being of the most concern. Protein content splits varied across the testing region and by tributary with approximately 50% of samples being in the < 11.5% protein content category, 35% in the 11.5% – 12.5% category and 15% in the < 12.5% category. The average wheat falling number for this crop is 392 seconds, and is comparable to the 2015 average of 400 seconds and the 5-year average of 404 seconds and is indicative of sound wheat.

Flour and Baking Data

The Buhler flour yield overall averaged 76.6% and significantly exceeds the 2015 average of 74.1% and the 5-year average of 73.9%. Flour ash (14% mb) 0.56% is comparable to 2015 (0.59%) and the 5-year average of 0.53%. Gluten index values averaged 93% which is comparable to last year and is equal to the 5-year average of 93%. The W value of 211 (10-4 J) is slightly lower than last year average of 214 (10-4 J) and well below the 5-year average of 246 (10-4 J). Overall average bake absorption is 62.9% which slightly above the 2015 absorption of 62.5% and the 5-year average of 62.5%. Farinograph development time and stability were 4.0 minutes and 6.7 minutes respectively, both are lower than last year and significantly below the 5-year averages of 5.4 minutes and 10.9 minutes respectively. Overall loaf volume averaged 821cc and is well below 2015 (870cc), but comparable to the 5-year average of 836cc.

Summary

Environmental influences played a much bigger role in the development of the 2016 HRW crop than in recent years, this was true in all production areas. The result is a crop that has generally outstanding kernel characteristics and will provide the miller with a potential increased flour yield of over 2.5% as compared to the 5-year average. Protein accumulation is also an issue in the 2016 HRW crop as most producers fertilized (N) for an average crop, but in many locations yields were 50% to 70% above normal. Results of this "protein dilution" effect (increases in nitrogen is recognized as enhancing grain protein concentration) were lower quantities of protein in the wheat and flour. However, testing would also indicate that even though mixing times and tolerances are shorter than the five-year averages, the loaf volumes achieved indicate there is adequate protein quality to make good quality bread. This crop meets or exceeds typical HRW contract specifications and provides high value to the customer.

Hard Red Winter Wheat Production Charts

English Units

Hard Winter Wheat Production (1,000 bu.)

	2009	2010	2011	2011	2012	2014	2015	2016	Average
Colorado	98,000	105,750	78,000	83,250	43,500	89,300	79,180	105,120	85,263
Kansas	369,600	360,000	276,500	387,000	328,000	246,400	321,900	467,400	344,600
Montana	89,540	93,600	89,790	81,320	96,750	91,840	91,020	105,350	92,401
North Dakota	26,160	17,600	13,875	38,500	13,440	27,195	8,360	5,760	18,861
Nebraska	76,800	64,070	65,250	55,440	41,760	71,050	45,980	70,740	61,386
Oklahoma	77,000	120,900	70,400	155,400	115,500	47,600	98,800	136,500	102,763
Pacific NW	16,194	19,869	22,004	37,990	35,330	28,350	28,543	36,707	28,123
South Dakota	64,260	63,700	66,780	62,400	25,350	59,400	42,680	63,800	56,046
Texas	61,250	127,500	49,400	91,450	64,000	67,500	106,500	89,600	82,150
Wyoming	5,016	4,640	4,420	3,000	2,640	3,375	4,160	4,250	3,938
Regional Total	883,820	977,629	736,419	995,750	766,270	732,010	827,123	1,085,227	875,531

Hard Winter Wheat Harvested Acres (1,000 Acres)

	2009	2010	2011	2011	2012	2014	2015	2016	Average
Colorado	2,450	2,350	2,000	2,250	1,500	2,350	2,140	2,190	2,118
Kansas	8,800	8,000	7,900	9,000	8,200	8,800	8,700	8,200	8,538
Montana	2,420	1,950	2,190	2,140	2,150	2,240	2,220	2150	2,216
North Dakota	545	320	375	700	320	555	190	120	444
Nebraska	1,600	1,490	1,450	1,320	1,160	1,450	1,210	1,310	1,419
Oklahoma	3,500	3,900	3,200	4,200	3,500	2,800	3,800	3,500	3,675
Pacific NW	276	289	293	535	530	417	434	456	379
South Dakota	1,530	1,300	1,590	1,300	650	1,080	970	1,100	1,289
Texas	2,450	3,750	1,900	2,950	2,000	2,250	3,550	2,800	2,769
Wyoming	132	145	130	120	120	125	130	125	130
Regional Total	23,703	23,494	21,028	24,515	20,130	22,067	23,344	25,523	22,976

Hard Winter Wheat Yield (bu/ac)

	2009	2010	2011	2011	2012	2014	2015	2016	Average
Colorado	40	45	39	37	29	38	37	48	39
Kansas	42	45	45	43	40	28	37	57	42
Montana	37	48	41	38	45	41	41	49	43
North Dakota	48	55	37	55	42	49	44	48	47
Nebraska	48	43	45	42	36	49	38	54	44
Oklahoma	22	31	22	37	33	17	26	39	28
Pacific NW	58	68	76	75	68	66	70	82	70
South Dakota	42	49	42	48	39	55	44	58	47
Texas	25	34	26	31	32	30	30	32	30
Wyoming	38	32	34	25	22	27	32	34	31
Regional Avg	40	45	41	43	39	40	40	50	42

*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2015.*

Hard Red Winter Wheat Production Charts

Metric Units

Hard Winter Wheat Production (MMT)

	2009	2010	2011	2011	2012	2014	2015	2016	Average
Colorado	2.67	2.88	2.12	2.27	1.18	2.43	2.16	2.86	2.32
Kansas	10.06	9.80	7.53	10.53	8.93	6.71	8.76	12.72	9.38
Montana	2.44	2.55	2.44	2.21	2.63	2.50	2.48	2.87	2.52
North Dakota	0.71	0.48	0.38	1.05	0.37	0.74	0.23	0.16	0.51
Nebraska	2.09	1.74	1.78	1.51	1.14	1.93	1.25	1.93	1.67
Oklahoma	2.10	3.29	1.92	4.23	3.14	1.30	2.69	3.72	2.80
Pacific NW	0.44	0.54	0.60	1.03	0.96	0.77	0.78	1.00	0.77
South Dakota	1.75	1.73	1.82	1.70	0.69	1.62	1.16	1.74	1.53
Texas	1.67	3.47	1.34	2.49	1.74	1.84	2.90	2.44	2.24
Wyoming	0.14	0.13	0.12	0.08	0.07	0.09	0.11	0.12	0.11
Regional Total	24.06	26.61	20.04	27.10	20.86	19.92	22.51	29.54	23.83

Hard Winter Wheat Harvested Acres (1,000 ha)

	2009	2010	2011	2011	2012	2014	2015	2016	Average
Colorado	992	951	810	911	607	951	866	887	872
Kansas	3,563	3,239	3,198	3,644	3,320	3,563	3,522	3,320	3,421
Montana	980	789	887	866	870	907	899	870	884
North Dakota	221	130	152	283	130	225	77	49	158
Nebraska	648	603	587	534	470	587	490	530	556
Oklahoma	1,417	1,579	1,296	1,700	1,417	1,134	1,538	1,417	1,437
Pacific NW	112	117	119	217	215	169	176	185	163
South Dakota	619	526	644	526	263	437	393	445	482
Texas	992	1,518	769	1,194	810	911	1,437	1,134	1,096
Wyoming	53	59	53	49	49	51	53	51	52
Regional Total	9,596	9,512	8,513	9,925	8,150	8,934	9,451	8,887	9,121

Hard Winter Wheat Yield (tons/ha)

	2009	2010	2011	2011	2012	2014	2015	2016	Average
Colorado	2.69	3.03	2.62	2.49	1.95	2.56	2.49	3.23	2.63
Kansas	2.82	3.03	3.03	2.89	2.69	1.88	2.49	3.83	2.83
Montana	2.49	3.23	2.76	2.56	3.03	2.76	2.76	3.30	2.86
North Dakota	3.23	3.70	2.49	3.70	2.82	3.30	2.96	3.23	3.18
Nebraska	3.23	2.89	3.03	2.82	2.42	3.30	2.56	3.63	2.98
Oklahoma	1.48	2.08	1.48	2.49	2.22	1.14	1.75	2.62	1.91
Pacific NW	3.90	4.57	5.11	5.04	4.57	4.44	4.71	5.51	4.73
South Dakota	2.82	3.30	2.82	3.23	2.62	3.70	2.96	3.90	3.17
Texas	1.68	2.29	1.75	2.08	2.15	2.02	2.02	2.15	2.02
Wyoming	2.56	2.15	2.29	1.68	1.48	1.82	2.15	2.29	2.05
Regional Avg	2.69	3.03	2.74	2.90	2.60	2.69	2.68	3.37	2.84

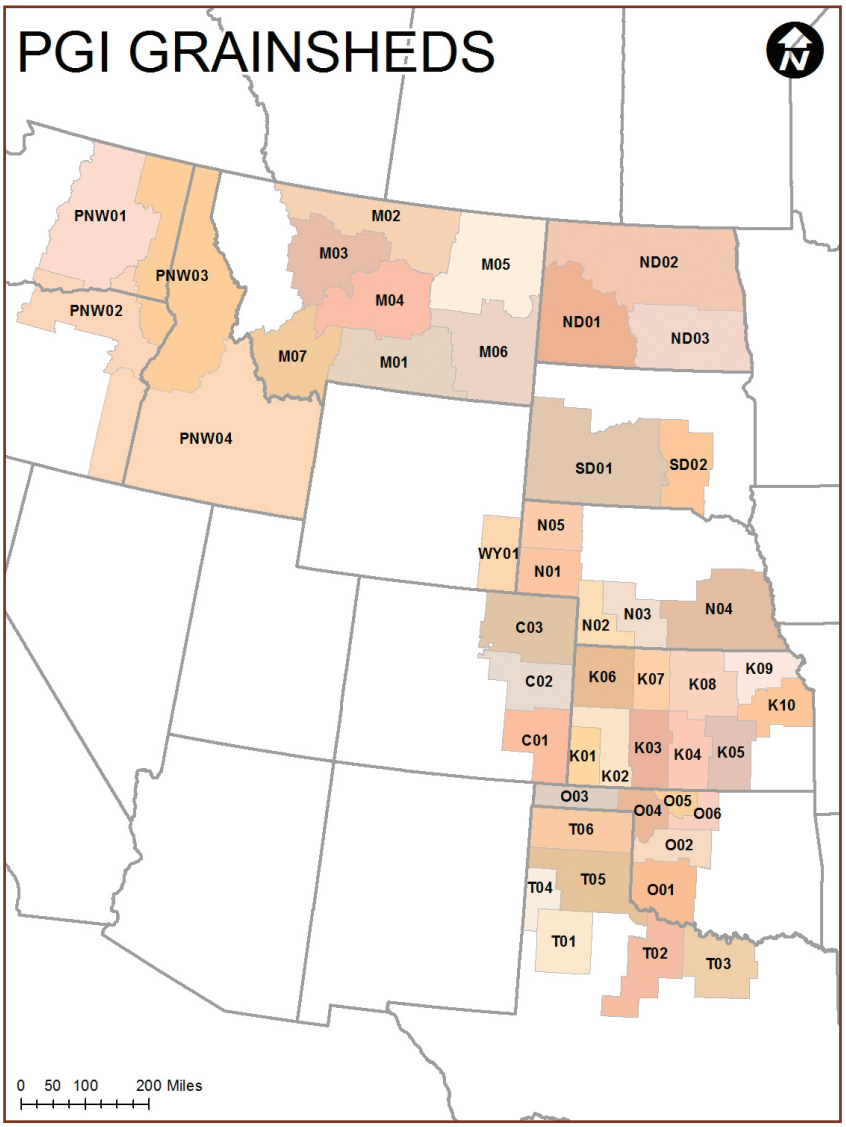
** *Some data derived from Crop Production report issued by USDA NASS updated September 30, 2015.*

Survey Methodology

Plains Grains Inc. (PGI) is an Oklahoma-based regional wheat marketing entity that has designed a wheat quality survey to provide end-use quality information to the U.S. wheat buyer. PGI facilitates collection and testing of wheat samples at harvest in order to provide data that specifically describes the quality of U.S. wheat.

PGI facilitates quality testing on a "grainshed" basis. Grainsheds are defined by identifying key loading facilities and outlining the production region which contributes to that facility's grain supply. By defining the production areas in this manner, PGI's survey is able to more accurately represent and determine the quality of wheat that will come from a specific regional terminal, thereby giving buyers a truer picture of the product available to compose a shipment of HRW wheat.

The quality of wheat originating from a grainshed is determined by pulling samples from country and terminal elevators located within each defined grainshed. These samples are then immediately sent to the USDA, ARS Hard Winter Wheat Quality Lab in Manhattan, Kan., where they are analyzed and tested for more than 25 quality parameters. Official grade is determined at the Federal Grain Inspection Service office in Enid, Oklahoma.



Wheat Grading Characteristics

The Federal Grain Inspection Service (FGIS) of the USDA Grain Inspection, Packers and Stockyards Administration (GIPSA) sets the standard for U.S. grain grades and grade requirements. U.S. grain grades are reflective of the general quality and condition of a representative sample of U.S. wheat. These grades are based on characteristics such as test weight and include limits on damaged kernels, foreign material, shrunken and broken kernels, and wheat of contrasting classes. Each determination is made on the basis of the grain free of dockage. Grades issued under U.S. standards represent a sum of these factors.

Official U.S. Grades and Grade Requirements

Grading Factors	Grades				
	No. 1	No. 2	No. 3	No. 4	No. 5
Hard Red Winter – Minimum Test Weights					
LB/BU	60.0	58.0	56.0	54.0	51.0
Maximum Percent Limits Of:					
DEFECTS					
Damaged Kernels					
Heat (part total)	0.2	0.2	0.5	1.0	3.0
Total	2.0	4.0	7.0	10.0	15.0
Foreign Material	0.4	0.7	1.3	3.0	5.0
Shrunken and Broken Kernels	3.0	5.0	8.0	12.0	20.0
Total*	3.0	5.0	8.0	12.0	20.0
WHEAT OF OTHER CLASSES**					
Contrasting classes	1.0	2.0	3.0	10.0	10.0
Total***	3.0	5.0	10.0	10.0	10.0
Stones	0.1	0.1	0.1	0.1	0.1
Maximum Count Limits Of:					
OTHER MATERIAL (1,000 gram sample)					
Animal Filth	1	1	1	1	1
Castor Beans	1	1	1	1	1
Crotalaria Seeds	2	2	2	2	2
Glass	0	0	0	0	0
Stones	3	3	3	3	3
Unknown Foreign Substance	3	3	3	3	3
Total****	4	4	4	4	4
INSECT DAMAGED KERNELS (in 100 grams)	31	31	31	31	31

Note: U.S. Sample grade is wheat that:
(a) Does not meet the requirements for U.S. Nos. 1, 2, 3, 4, or 5; or
(b) Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic); or
(c) Is heating or of distinctly low quality.

*Includes damaged kernels (total), foreign materials, and shrunken and broken kernels.
**Unclassed wheat of any grade may contain not more than 10.0 percent of wheat of other classes.
***Includes contrasting classes.
****Includes any combination of animal filth, castor beans, crotalaria seeds, glass, stones, or unknown foreign substance.

Wheat Grading Data

Each determination of heat-damaged kernels, damaged kernels, foreign material, wheat of other classes, contrasting classes, and subclasses is made on the basis of the grain when free from dockage and shrunken and broken kernels.

Defects are damaged kernels, foreign materials, and shrunken and broken kernels. The sum of these three factors may not exceed the limit for the factor defects for each numerical grade.

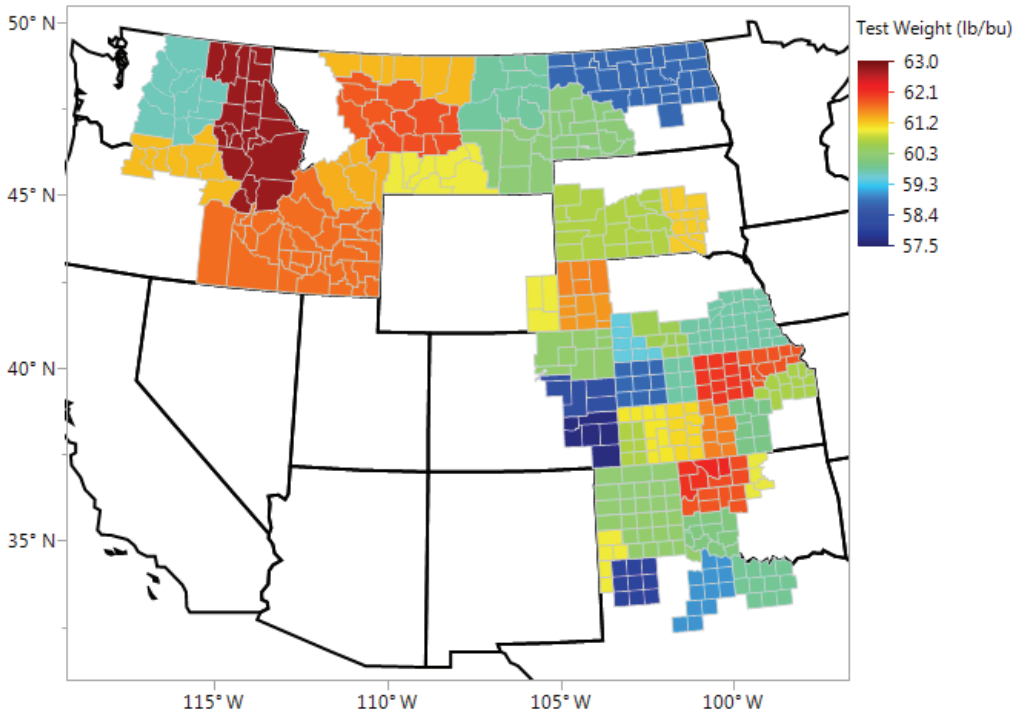
Foreign material is all matter other than wheat that remains in the sample after the removal of dockage and shrunken and broken kernels.

Shrunken and broken kernels are all matter that passes through a 0.064 x 3/8-inch oblong-hole sieve after sieving according to procedures prescribed in the FGIS instructions.

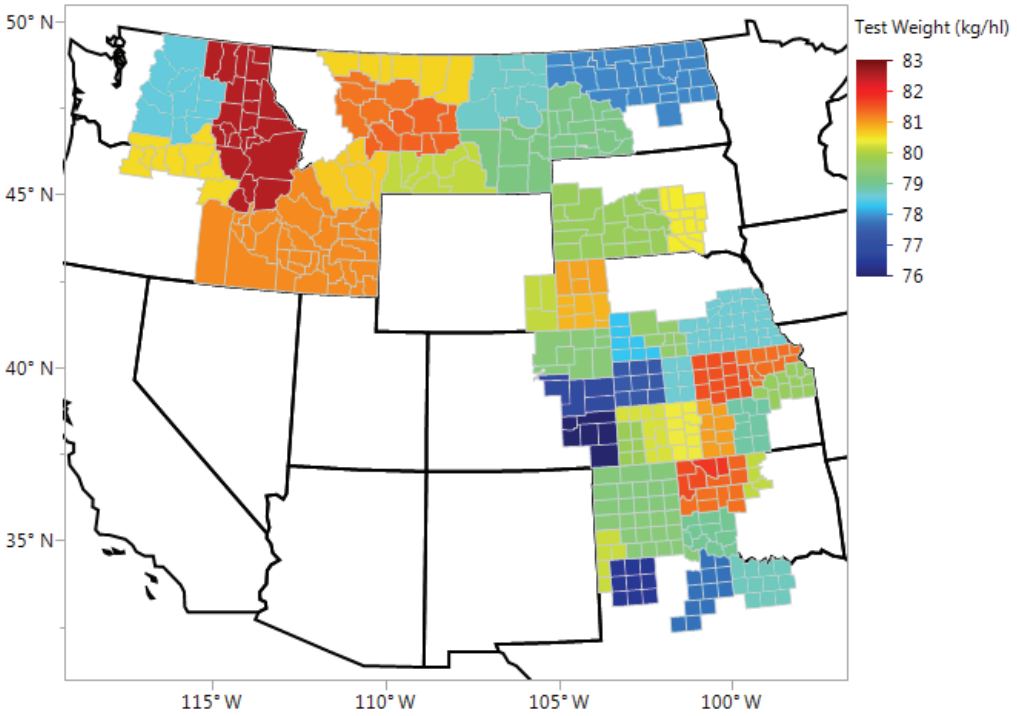
Damaged kernels are kernels, pieces of wheat kernels, and other grains that are badly ground-damaged, badly weather damaged, diseased, frost-damaged, germ damaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged.

Test Weight is a measure of the density of the sample and may be an indicator of milling yield and the general condition of the sample, as problems that occur during the growing season or at harvest often reduce test weight.

Test Weight (lb/bu)



Test Weight (kg/hl)



Wheat Grading Data

Location		Official Grade (U.S. NO.)	Dockage (%)	Test Wt (lb/bu)	Test Wt (kg/hl)	Damage Kernels Total (%)	Shrunken & Broken Kernels (%)	Foreign Material (%)
Colorado	CO1	3	0.7	57.6	75.9	0.3	1.9	0.1
	CO2	2	0.8	58.6	77.2	0.1	1.6	0.2
	CO3	1	0.5	60.3	79.3	0.1	1.4	0.1
Kansas	K01	1	0.5	60.5	79.6	0.1	1.1	0.1
	K02	1	0.4	61.3	80.7	0.2	0.7	0.1
	K03	1	0.4	61.3	80.6	0.1	0.8	0.2
	K04	1	0.4	61.3	80.6	0.1	0.6	0.1
	K05	1	0.3	60.0	78.9	0.2	0.8	0.0
	K06	2	0.4	58.5	73.7	0.2	0.6	0.1
	K07	1	0.4	60.3	79.4	0.1	0.7	0.1
	K08	1	0.2	62.1	81.6	0.0	0.6	0.2
	K09	2	0.2	61.9	81.4	0.4	0.9	0.1
	K10	1	0.3	60.6	79.7	0.2	0.7	0.2
Montana	M01	1	0.4	61.0	80.2	0.0	1.4	0.0
	M02	1	0.4	61.3	80.6	0.1	0.4	0.1
	M03	1	0.6	61.8	81.3	0.0	1.1	0.1
	M04	1	0.6	62.1	81.6	0.1	0.6	0.0
	M05	2	0.5	59.8	78.7	0.3	1.3	0.1
	M06	4	0.4	60.2	79.2	0.2	0.5	2.9
	M07	1	0.4	61.4	80.7	0.0	0.8	0.0
Nebraska	N01	1	0.7	61.6	81.0	0.1	0.9	0.1
	N02	2	0.3	59.5	78.3	0.1	0.8	0.1
	N03	1	0.5	60.1	79.1	0.1	0.8	0.1
	N04	2	0.4	59.5	78.2	0.0	0.6	0.1
	N05	1	0.7	61.5	80.8	0.1	1.0	0.1
N. Dakota	ND	2	0.3	59.3	78.0	1.6	1.2	0.1
Oklahoma	O01	2	0.5	60.2	79.2	0.8	0.8	0.1
	O02	1	0.4	61.8	81.3	0.3	0.6	0.3
	O03	1	0.4	60.4	79.5	0.2	0.7	0.1
	O04	1	0.4	61.1	80.4	0.3	0.8	0.1
	O05	1	0.5	62.2	81.8	0.1	0.7	0.2
	O06	1	0.4	61.9	81.3	0.3	0.8	0.5
	O07	1	0.6	60.4	79.5	0.5	0.9	0.5
Pacific Northwest	PNW01	1	0.9	61.5	80.8	0.0	0.8	0.1
	PNW02	1	0.5	61.3	80.6	0.0	0.5	0.0
	PNW03	1	0.5	63.0	82.8	0.1	0.5	0.0
	PNW04	1	0.5	61.5	80.9	0.0	0.8	0.0
South Dakota	SD01	1	0.8	60.7	79.8	0.2	1.0	0.1
	SD02	1	0.8	61.2	80.5	0.1	0.7	0.1
Texas	T01	2	2.0	59.7	78.6	0.5	1.4	0.5
	T02	2	1.2	59.1	77.8	0.9	0.9	0.4
	T03	2	0.7	59.9	78.8	1.3	1.2	0.2
	T04	1	0.8	61.6	81.0	0.3	0.9	0.4
	T05	1	0.5	60.3	79.3	0.5	0.9	0.1
	T06	1	1.0	60.3	79.3	0.2	1.0	0.2
Wyoming	W01	1	0.7	60.9	80.2	0.1	0.8	0.3

Kernel Quality Data

Location		Total Defects (%)	Kernel Size Large (%)	Kernel Size Med (%)	Kernel Size Small (%)	Thousand Kernal Wt (g)	SKCS Avg Diam (mm)
Colorado	CO1	2.3	65	33	2	41.7	2.88
	CO2	1.9	56	42	2	28.0	2.45
	CO3	1.6	61	37	2	29.3	2.52
Kansas	K01	1.3	68	31	1	32.5	2.65
	K02	1.0	74	26	1	32.7	2.67
	K03	1.1	72	27	1	32.1	2.67
	K04	0.8	72	28	1	31.2	2.65
	K05	1.0	76	23	1	33.2	2.69
	K06	0.9	75	25	1	31.8	2.61
	K07	0.9	74	25	1	32.1	2.66
	K08	0.8	73	26	1	32.3	2.68
	K09	1.4	73	26	1	32.9	2.67
	K10	1.1	72	27	1	32.3	2.67
Montana	M01	1.4	53	46	1	27.9	2.51
	M02	0.6	64	35	1	33.0	2.68
	M03	1.2	64	36	1	31.0	2.63
	M04	0.7	60	39	1	30.3	2.58
	M05	1.7	57	41	2	29.3	2.51
	M06	3.6	68	32	1	30.5	2.57
	M07	0.8	66	34	1	33.5	2.66
Nebraska	N01	1.1	66	34	1	30.6	2.60
	N02	1.0	73	26	1	30.9	2.59
	N03	1.0	74	25	1	31.7	2.63
	N04	0.7	78	21	1	32.2	2.67
	N05	1.2	63	36	1	30.8	2.62
N. Dakota	ND01	2.9	53	45	2	29.3	2.53
Oklahoma	O01	1.7	78	22	0	33.2	2.76
	O02	1.2	81	19	1	34.2	2.80
	O03	1.0	72	27	1	33.0	2.70
	O04	1.2	70	29	1	31.6	2.69
	O05	1.0	69	30	1	32.3	2.73
	O06	1.6	72	27	1	32.4	2.73
	O07	1.9	74	25	1	31.8	2.72
Pacific Northwest	PNW01	0.9	75	25	1	36.1	2.76
	PNW02	0.5	89	10	0	39.4	2.86
	PNW03	0.6	87	12	0	40.2	2.92
	PNW04	0.8	74	26	1	34.1	2.73
South Dakota	SD01	1.3	59	40	1	29.0	2.54
	SD02	0.9	69	31	1	30.8	2.60
Texas	T01	2.4	60	39	1	30.3	2.59
	T02	2.2	76	23	1	31.8	2.71
	T03	2.7	69	30	1	31.0	2.67
	T04	1.6	63	36	1	31.6	2.64
	T05	1.5	63	36	1	30.8	2.61
	T06	1.4	68	31	1	32.0	2.64
Wyoming	W01	1.2	59	40	1	29.4	2.55

Other Wheat Characteristics

In addition to the U.S. grade factors, there are other characteristics at work to determine the value of the wheat. Examples include dockage, wheat moisture, wheat protein content, thousand-kernel weight (TKW), and falling number.

Moisture content is an indicator of grain condition and storability. Wheat or flour with low moisture content is more stable during storage. Moisture content is often standardized (12 or 14 percent moisture basis) for other tests that are affected by moisture content.

Protein content relates to many important processing properties, such as water absorption and gluten strength, and to finished product attributes such as texture and appearance. Higher protein dough usually absorbs more water and takes longer to mix. HRW wheat generally has a medium to high protein content, making it most suitable for all purpose flour and chewy-texture breads.

Ash content also indicates milling performance and how well the flour separates from the bran. Millers need to know the overall mineral content of the wheat to achieve desired or specified ash levels in flour. Ash content can affect flour color. White flour has low ash content, which is often a high priority among millers.

Thousand-kernel weight and kernel diameter provide measurements of kernel size and density important for milling quality. Simply put, it measures the mass of the wheat kernel. Millers tend to prefer larger berries, or at least berries with a consistent size. Wheat with a higher TKW can be expected to have a greater potential flour extraction.

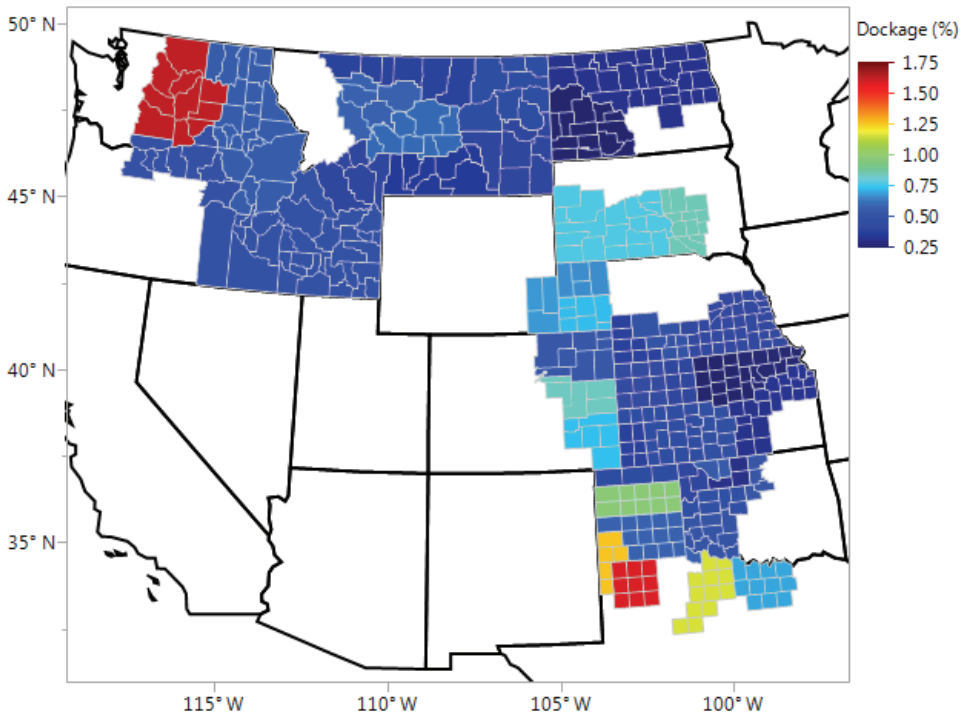
Falling number is an index of enzyme activity in wheat or flour and is expressed in seconds. Falling numbers above 300 are desirable, as they indicate little enzyme activity and a sound quality product. Falling numbers below 300 are indicative of more substantial enzyme activity and sprout damage.

Dockage is all matter other than wheat that can be removed from the original sample by use of an approved device according to procedures prescribed in FGIS instructions.

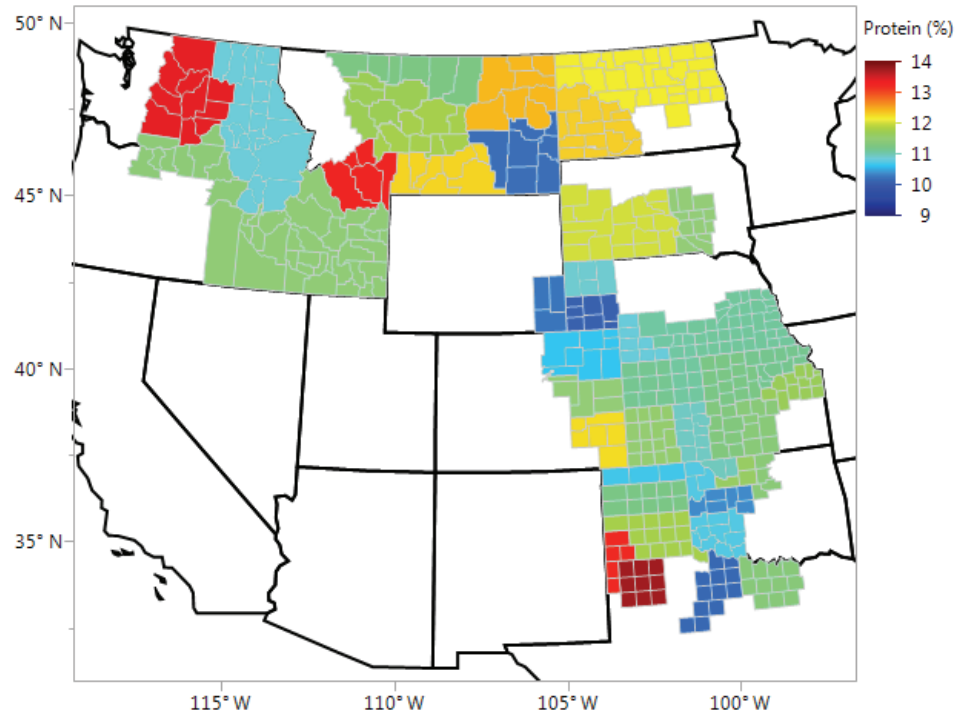
Kernel Size is a measure of the percentage by weight of large, medium and small kernels in a sample. Large kernels or more uniform kernel size may help improve milling yield.

Single Kernel Characterization System (SKCS) measures 300 individual kernels from a sample for size (diameter), weight, hardness (based on the force needed to crush) and moisture.

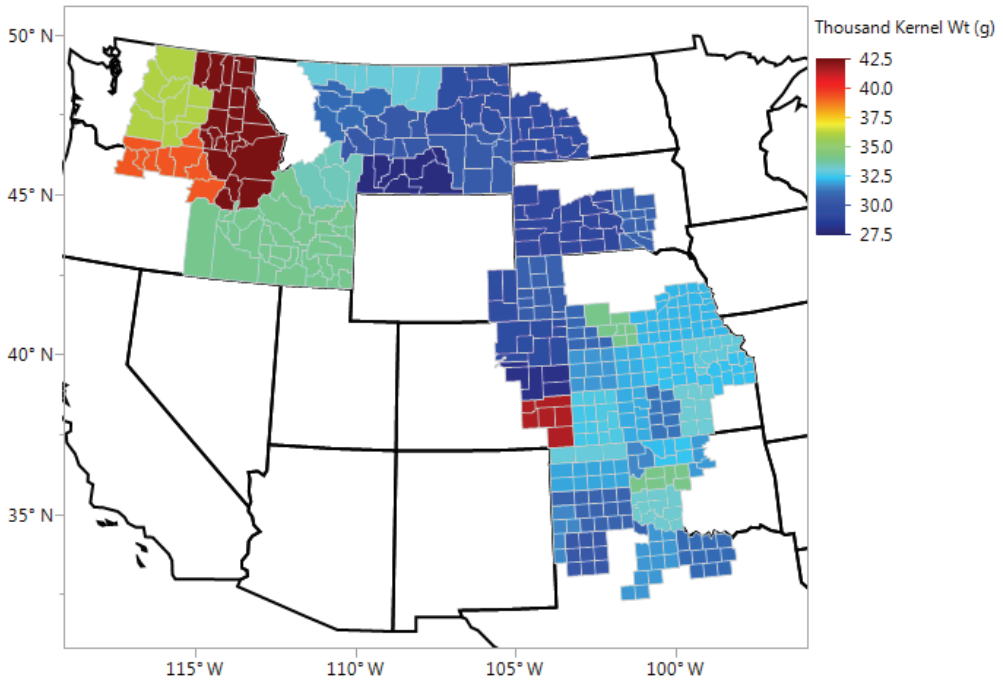
Dockage (%)



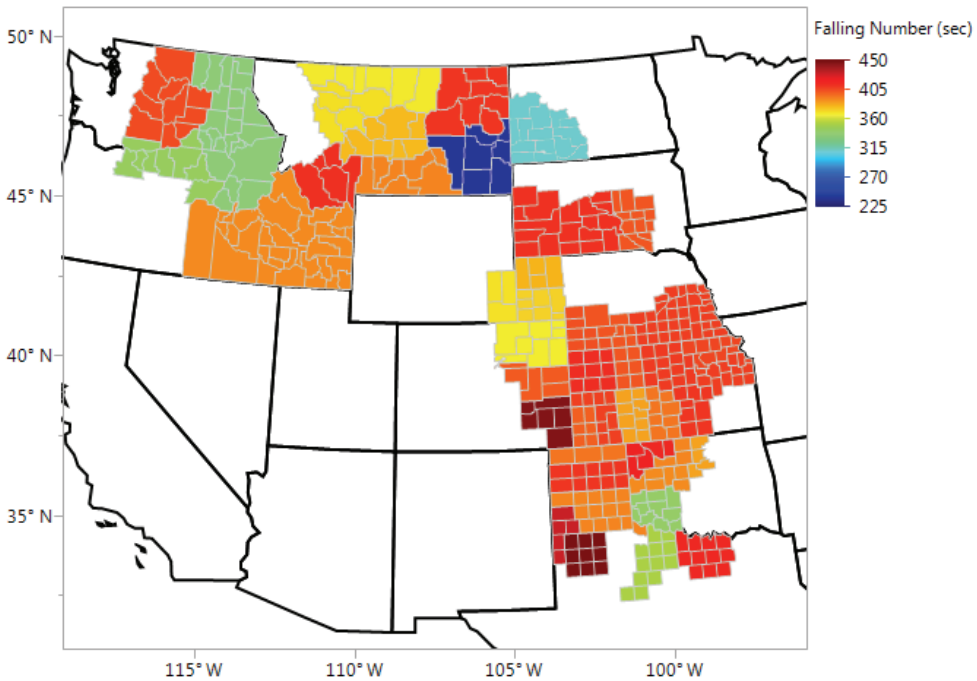
Protein (%)



Thousand Kernel Weight (g)



Falling Number (seconds)



Other Wheat Characteristics (non-grade data)

Location		Wheat Protein (12% mb)	Indv Wheat Ash (12% mb)	Falling Number (sec)	Moisture (%)	SKCS Avg Hard
Colorado	CO1	12.3	1.54	448	10.7	58
	CO2	11.4	1.57	402	10.8	46
	CO3	10.6	1.55	368	10.8	51
Kansas	K01	11.4	1.47	401	10.8	59
	K02	11.6	1.48	409	11.3	61
	K03	10.8	1.51	385	11.6	64
	K04	11.3	1.54	395	11.5	62
	K05	11.4	1.55	412	12.5	52
	K06	11.3	1.49	414	11.7	39
	K07	11.0	1.49	403	11.7	54
	K08	11.2	1.53	410	10.9	63
	K09	11.2	1.57	408	10.7	63
	K10	11.7	1.59	410	12.1	57
Montana	M01	12.3	1.46	392	9.7	68
	M02	11.3	1.41	369	11.3	62
	M03	11.8	1.43	371	10.0	67
	M04	11.5	1.52	380	10.9	64
	M05	12.5	1.39	412	11.3	54
	M06	10.2	1.33	238	11.0	54
	M07	13.3	1.26	414	11.4	70
Nebraska	N01	10.1	1.56	374	11.0	55
	N02	10.7	1.52	405	10.6	40
	N03	11.2	1.58	401	11.5	47
	N04	11.1	1.54	410	11.4	43
	N05	10.8	1.60	381	10.2	55
N. Dakota	ND01	12.3	1.46	311	12.1	55
Oklahoma	O01	10.9	1.38	342	12.1	57
	O02	9.7	1.43	390	12.0	56
	O03	10.6	1.53	396	11.4	55
	O04	11.0	1.48	419	11.1	59
	O05	11.1	1.50	417	11.6	64
	O06	11.6	1.46	392	11.3	62
	O07	11.3	1.43	385	11.8	59
Pacific Northwest	PNW01	12.5	1.47	406	9.0	58
	PNW02	11.4	1.44	344	9.7	57
	PNW03	10.7	1.24	369	9.7	59
	PNW04	11.3	1.56	391	8.3	66
South Dakota	SD01	12.0	1.58	413	11.1	52
	SD02	11.4	1.62	403	11.6	50
Texas	T01	13.2	1.64	451	10.4	57
	T02	10.2	1.47	353	12.3	49
	T03	11.4	1.50	417	12.7	62
	T04	13.0	1.59	431	10.0	61
	T05	12.1	1.57	392	11.2	55
	T06	11.3	1.61	412	11.0	55
Wyoming	W01	10.3	1.51	371	11.7	58

Flour Characteristics

Flour is analyzed for indicators of milling efficiency and functionality properties. These include: flour yield, ash content, falling number and flour protein.

Flour yield is expressed as a percentage and represents the portion of the wheat kernel that can be milled into flour, which is a significant indicator of milling profitability. Millers need to know the mineral content in wheat to achieve the desired ash levels in flour.

Ash content is an indication of how well flour separates from the bran. Flour ash is expressed as a percentage of the initial sample weight, and is usually expressed on a 14 percent moisture basis.

Flour falling number is an index of undesirable enzyme activity that normally occurs when the kernel sprouts or germinates. A high falling number indicates minimal activity, whereas a low falling number indicates more substantial enzyme activity. Too much activity means that too much sugar and too little starch are present in the flour. Starch provides the supporting structure of bread, so high activity results in sticky dough and poor texture in the finished product.

Wet Gluten Index is a measurement that indicates whether the gluten is weak, normal or strong. A weak gluten would be represented by a gluten index of 0 and the strongest gluten index is 100.

Minolta Color results are reported with the values L*, a*, and b*. L* ranges from 100 (white) to 0 (black) a* ranges from +60 (red) to -60 (green) b* ranges from +60 (yellow) to -60 (blue).

Flour Data

Location		Buhler Flour Yield (%)	Zeleny Sedimen Test (cc)	NIR Flour Protein (14% mb)	Flour Ash (14% mb)	Gluten Index	Flour Color L*	Flour Color a*	Flour Color b*
Colorado	CO1	76.6	42.8	11.2	0.6	96.1	89.9	-1.1	10.2
	CO2	75.3	45.7	10.4	0.51	97.5	90.5	-1.2	9.9
	CO3	75.2	42.5	9.5	0.51	95.9	90.8	-1.3	10.1
Kansas	K01	75.4	41.0	10.3	0.55	93.6	90.6	-1.3	10.6
	K02	76.8	42.8	10.6	0.58	93.4	90.1	-1.2	10.8
	K03	77.2	41.5	9.9	0.58	93.9	89.6	-1.1	10.8
	K04	77.9	41.0	10.4	0.55	88.1	89.6	-1.1	10.7
	K05	77.9	36.0	10.5	0.57	90.2	89.4	-1.1	10.6
	K06	77.4	39.4	10.4	0.51	90.9	90.0	-1.2	10.5
	K07	76.5	39.4	10.1	0.51	96.1	90.1	-1.1	10.5
	K08	77.9	39.4	10.4	0.56	92.1	89.8	-1.2	10.8
	K09	77.5	36.0	10.3	0.55	88.5	90.1	-1.3	10.9
	K10	77.1	40.5	10.8	0.55	93.3	89.5	-1.2	10.5
Montana	M01	74.2	57.1	10.9	0.46	97.3	90.9	-1.2	10.0
	M02	75.8	53.9	10.5	0.49	96.4	90.3	-1.3	10.3
	M03	76.2	58.3	11.1	0.49	96.3	90.6	-1.3	10.5
	M04	73.3	52.2	10.4	0.53	96.5	90.8	-1.3	10.3
	M05	76.9	62.5	11.5	0.5	96.5	89.6	-1.1	10.1
	M06	76.9	44.1	9.4	0.48	97.7	89.9	-1.0	10.0
	M07	74.3	63.8	12.2	0.47	95.8	90.4	-1.2	10.6
Nebraska	N01	75.2	39.5	8.9	0.51	97.6	90.6	-1.2	9.7
	N02	76.6	38.5	9.5	0.49	97.2	90.1	-1.3	10.4
	N03	77.1	38.8	10.1	0.52	96.7	89.8	-1.2	10.4
	N04	76.8	39.4	10.1	0.51	96.7	90.2	-1.3	10.4
	N05	76.3	42.7	9.8	0.48	96.9	90.4	-1.1	9.6
N. Dakota	ND01	74.8	55.6	11.0	0.50	96.8	89.7	-1.1	9.3
Oklahoma	O01	77.1	44.2	9.8	0.53	92.8	90.1	-1.3	9.9
	O02	77.2	37.1	8.7	0.55	96.4	90.5	-1.4	10.1
	O03	77.0	38.5	9.7	0.58	95.8	90.1	-1.3	10.5
	O04	75.3	43.9	10.0	0.54	97.1	90.2	-1.3	10.2
	O05	77.0	46.1	10.2	0.57	96.5	90.2	-1.3	10.6
	O06	77.3	50.4	10.7	0.56	96.4	89.7	-1.1	10.3
	O07	76.7	39.6	10.2	0.57	96.4	89.8	-1.3	10.2
Pacific Northwest	PNW01	78.1	47.7	11.5	0.50	83.7	89.8	-1.0	9.7
	PNW02	76.6	46.2	10.4	0.51	94.5	90.0	-1.0	9.4
	PNW03	77.0	44.8	9.7	0.47	95.8	90.3	-1.2	9.3
	PNW04	78.6	43.2	10.5	0.51	92.6	89.8	-1.2	10.7
South Dakota	SD01	76.2	52.3	11.1	0.51	97.4	90.4	-1.1	9.7
	SD02	77.6	44.0	10.2	0.48	96.6	90.3	-1.1	9.5
Texas	T01	75.0	46.5	12.6	0.63	84.2	89.5	-0.9	9.9
	T02	77.2	41.6	9.4	0.57	96.6	89.8	-1.2	9.9
	T03	78.1	38.6	11.1	0.62	92.2	88.8	-0.8	10.3
	T04	76.2	46.1	12.4	0.60	70.7	89.6	-0.9	10.2
	T05	75.7	48.1	11.5	0.62	90.4	89.6	-1.1	10.4
	T06	77.1	40.4	10.5	0.60	89.8	90.4	-1.3	10.5
Wyoming	W01	72.3	42.1	9.3	0.50	99.5	91.1	-1.3	10.0

Dough Characteristics

The strength and mixing properties of dough help the baker determine the value of the flour they purchase. Flour specifications often require specialized testing to determine how flour will perform during processing.

Farinograph testing is one of the most common flour quality tests in the world. Farinograph results are used to determine dough strength and processing requirements.

Absorption is a measurement of the amount of water required for the flour to be optimally processed into the finished product. Peak time indicates the time it takes for the dough to develop from the moment the water is added until maximum consistency is achieved. This measurement is expressed in minutes.

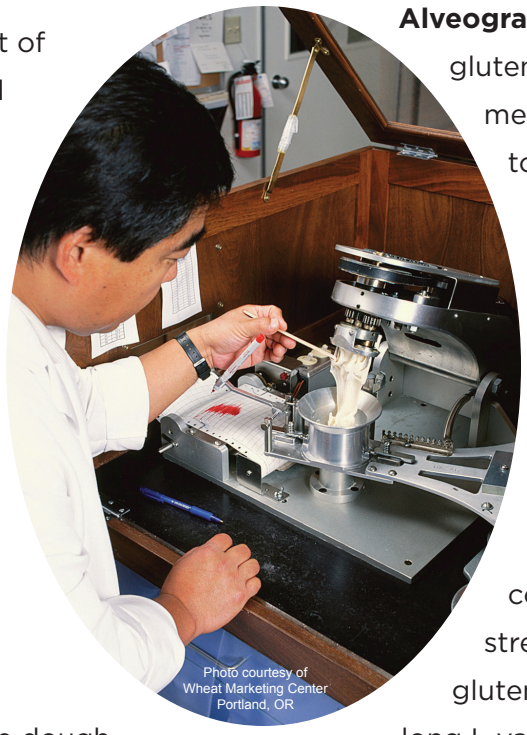


Photo courtesy of Wheat Marketing Center Portland, OR

Stability is an indication of dough strength, as it is a measurement of how long the dough maintains maximum consistency. Stability is also expressed in minutes. Weak gluten flour has a lower water absorption and shorter stability time than strong gluten flour.

Peak time represents dough development time by measuring the length of time from the moment water is added until the dough reaches maximum consistency. This measurement indicates optimum mixing time for the dough under standardized conditions.

Mixing Tolerance Index is the resistance of the dough to breakdown during continued mixing. It is the difference in Brabender Unit (BU) value at the top of the curve at peak time and the value at the top of the curve five minutes after the peak. This indicates tolerance to over-mixing and is expressed as a numerical score based on comparison to a control.

Alveograph testing determines the gluten strength of dough by measuring the force required to blow and break a bubble of dough. The results of the test are used by millers to ensure a more consistent product. “P” relates to the force required to blow the bubble of dough; “L” relates to the extensibility of the dough; “W” is a combination of dough strength and extensibility. Weak gluten flour with low P value and long L value is preferred for cakes, where as strong gluten flour used for breads will have a higher P value.

Development Time is the time interval from the first addition of water to the maximum consistency immediately prior to the first indication of weakening. Long peak times indicate strong gluten and dough properties while short peak times may indicate weak gluten.

Dough Data

Location		ALVEOGRAPH				FARINOGRAPH			
		P (mm)	L (mm)	W (10-4 J)	P/L Ratio	Abs (14%mb)	Development Time (min)	Stability (min)	MTI (BU)
Colorado	CO1	89	79	235	1.1	58.5	4.3	8.7	29
	CO2	75	85	220	0.88	55.7	5.7	8.3	34
	CO3	88	67	214	1.31	55.9	2.2	5.9	32
Kansas	K01	97	67	220	1.45	60.1	4.2	6.9	31
	K02	95	62	202	1.53	60.7	4.4	6.0	40
	K03	94	61	196	1.54	59.2	4.0	6.2	37
	K04	92	64	192	1.44	59.0	5.2	7.6	30
	K05	93	58	189	1.60	59.5	4.9	6.4	38
	K06	69	73	165	0.95	57.1	5.0	8.0	28
	K07	89	61	184	1.46	59.0	4.2	6.0	39
	K08	97	63	208	1.54	61.0	4.8	5.8	43
	K09	94	52	178	1.81	60.4	4.7	8.5	24
	K10	100	73	242	1.37	60.4	4.7	8.5	27
Montana	M01	105	62	259	1.69	58.8	3.7	8.7	28
	M02	83	100	279	0.83	58.5	5.3	9.0	30
	M03	96	86	292	1.13	58.8	5.5	9.0	30
	M04	98	61	224	1.61	59.2	5.0	7.7	34
	M05	88	99	288	0.9	59.6	5.0	8.9	27
	M06	82	56	174	1.46	57.0	2.4	5.9	31
	M07	105	74	278	1.42	62.7	5.2	7.9	33
Nebraska	N01	82	66	196	1.24	56.7	1.7	4.2	38
	N02	74	74	189	1.00	56.0	1.9	5.9	30
	N03	77	81	213	0.95	56.1	5.2	7.8	32
	N04	80	67	197	1.19	56.3	4.2	7.9	26
	N05	89	73	232	1.22	56.9	5.5	8.3	37
N. Dakota	ND01	72	102	239	0.71	58.6	4.9	7.6	32
Oklahoma	O01	102	51	191	2.00	59.4	4.1	5.5	43
	O02	99	53	185	1.87	59.9	2.0	4.6	43
	O03	86	60	171	1.43	58.5	4.0	4.9	48
	O04	95	70	212	1.36	60.3	4.0	5.5	43
	O05	105	70	236	1.50	61.2	3.7	6.0	35
	O06	102	71	236	1.44	62.0	4.0	5.3	46
	O07	91	68	203	1.34	59.9	4.4	5.5	44
Pacific Northwest	PNW01	98	82	258	1.20	62.5	5.5	5.3	42
	PNW02	101	69	241	1.46	61.1	4.8	6.4	41
	PNW03	114	49	216	2.33	62.7	2.0	5.4	32
	PNW04	99	60	215	1.65	61.7	4.4	6.7	27
South Dakota	SD01	87	93	291	0.94	57.2	6.0	9.5	30
	SD02	77	81	210	0.95	55.9	4.7	6.1	53
Texas	T01	101	75	240	1.35	62.5	5.4	5.7	39
	T02	82	65	179	1.26	58.0	2.5	5.9	30
	T03	97	77	251	1.26	59.6	4.8	9.0	25
	T04	92	80	221	1.15	63.0	5.8	6.3	30
	T05	92	73	212	1.26	60.4	4.5	7.5	26
	T06	74	85	175	0.87	59.1	4.0	4.5	47
Wyoming	W01	95	59	212	1.61	57.7	1.5	2.5	42

Baking Characteristics

Baking tests are the final laboratory testing method in the evaluation of wheat quality. Generally, the amount and type of protein present determines baking performance, though starch quality can also have an influence.

Technicians evaluate loaves for their volume, or size, and the interior appearance of the loaf such as crumb grain and crumb color. Other performance factors include dough absorption, or bake absorption, and the optimum mixing time of the dough.

Baking Absorption is the amount of water added to achieve properly hydrated dough. It is expressed as a percentage, with higher values being better.

Crumb Grain and Texture measures the cell size and shape. It is rated on a scale of one to 10 and higher numbers are preferred.

Bake Mix Time represents mixing time when all normal ingredients are added for producing an end product (in addition to water and flour) prior to baking.

Baking Data

Location		Bake Mix (min)	Bake Abs (14% mb)	Loaf Volume (cc)	Crumb Grain (1–10)	Crumb Texture (1–10)	Crumb Color
Colorado	CO1	4.8	64.0	907	5.5	5.5	Dull
	CO2	6.3	63.0	835	6.3	5.5	Dull
	CO3	4.8	60.4	780	4.8	4.0	Dull
Kansas	K01	4.0	63.4	845	4.0	5.5	Dull
	K02	3.8	64.2	825	4.0	5.5	Dull
	K03	3.6	62.6	765	4.0	5.5	Dull
	K04	3.8	63.5	845	4.0	5.5	Dull
	K05	3.8	63.4	775	3.3	5.5	Dull
	K06	4.3	62.3	810	4.8	5.5	Dull
	K07	4.3	63.1	850	6.3	7.0	Dull
	K08	3.8	64.3	820	4.8	5.5	Dull
	K09	3.8	64.4	790	3.3	5.5	Dull
	K10	3.8	64.5	875	4.0	5.5	Dull
Montana	M01	6.5	64.2	835	7.8	7.0	Dull
	M02	6.3	64.7	905	6.3	7.0	Dull
	M03	5.4	65.5	910	7.0	5.5	Dull
	M04	5.0	63.1	810	6.3	5.5	Dull
	M05	6.3	65.7	858	5.9	5.5	Dull
	M06	6.0	60.8	785	6.3	4.0	Dull
	M07	5.5	65.9	890	7.0	5.5	Dull
Nebraska	N01	5.3	59.4	740	4.8	4.0	Dull
	N02	5.8	61.3	820	5.5	4.0	Dull
	N03	5.0	62.0	810	5.5	5.5	Dull
	N04	5.0	62.3	850	6.3	5.5	Dull
	N05	4.8	60.9	795	5.5	4.0	Dull
N. Dakota	ND01	5.8	65.2	855	6.3	7.0	Dull
Oklahoma	O01	4.5	62.4	780	5.5	5.5	Dull
	O02	4.8	60.7	705	5.5	5.5	Dull
	O03	3.9	61.4	800	2.5	5.5	Dull
	O04	4.0	61.4	775	4.0	7.0	Dull
	O05	4.4	64.3	845	5.5	7.0	Dull
	O06	4.0	64.5	850	5.5	5.5	Dull
	O07	3.8	62.7	815	5.5	5.5	Dull
Pacific Northwest	PNW01	3.5	66.1	845	4.8	7.0	Dull
	PNW02	4.5	63.1	810	7.0	7.0	Dull
	PNW03	4.5	63.1	735	4.0	4.0	Dull
	PNW04	3.8	63.9	850	4.8	5.5	Dull
South Dakota	SD01	6.5	64.4	890	7.0	5.5	Dull
	SD02	4.8	62.6	830	6.3	5.5	Dull
Texas	T01	3.5	62.6	855	4.8	7.0	Dull
	T02	5.1	60.7	805	6.3	7.0	Dull
	T03	4.5	61.6	850	4.0	7.0	Dull
	T04	3.4	64.8	855	4.0	7.0	Dull
	T05	4.3	63.0	865	4.8	7.0	Dull
	T06	3.5	61.3	810	4.0	7.0	Dull
Wyoming	W01	5.8	61.8	795	4.8	5.5	Dull

Methods

The harvest samples were evaluated using these methods:

Grade: Official U.S. Standards for Grain.

Dockage: Official USDA procedure using the Carter Dockage Tester.

Test Weight: AACC Method 55-10; the weight Per Winchester Bushel (2150.42 in3) as determined using an approved device, USDA approved. The test weight is mathematically converted to hectoliter weight: kg/hl = lb/bu x 1.292 + 1.419.

Moisture: DJ Gac 2100.

Protein: NIRT method

Ash: AACC Method 08-01 expressed on a 14 percent moisture basis.

Falling Number: AACC Method 56-81B. An average value is a simple mean of sample results.

Kernel Size Distribution: Cereal Foods World (Cereal Science Today) 5:71-71, 75 (1960). Wheat is sifted with a RoTap sifter using a Tyler No. 7 screen (2.82 mm) and a Tyler No. 9 Screen (2.00 mm). Kernels retained on the No. 7 screen are classified as "Large." Kernels passing through the No. 7 screen and retained on the No. 9 screen are "Medium." Kernels passing through the No. 9 screen are "Small".

Single Kernel Characterization: AACC Method 55-31 using SKCS Model 4100.

Extraction: Samples cleaned and tempered according to AACC Method 26-10A. All were milled with identical mill settings on a Buhler laboratory mill as follows: AACC Method 26-21A.

Moisture: NIR Protein: NIR Ash: AACC Method 08-01 expressed on a 14 percent moisture basis.

Falling Number: AACC Method 56-81B.

Wet Gluten & Gluten Index: AACC Method 38-12

Farinograph: AACC Method 54-21 with 50-gram bowl.

Absorption is reported on 14 percent moisture basis.

Alveograph: AACC Method 54-30A.

Loaf Volume: AACC Method 10-10B producing two loaves per batch using wet compressed yeast and ascorbic acid. After mixing, dough is divided into two equal portions, fermented for 160 minutes, proofed and baked in "pup loaf" pans. Loaf volume is measured immediately after baking by rapeseed displacement.