PGI

Plains Grains Inc.

2015 Hard Red Winter Wheat Regional Quality Survey

127 Noble Research Center, Stillwater, OK 74078
Phone: (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.

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 (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.

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

This fall seeded wheat is a versatile wheat with moderately high protein content and excellent milling and baking characteristicsD. 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 2015 HRW wheat crop in many ways were much like the conditions that prevailed in 2014. 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 drought that began in 2010 in Texas and Oklahoma and progressed northward through the upper Great Plains over the next four years, began to abate and moderate. However, dry conditions existed over the majority of the HRW growing region through the late fall, winter months and into early spring. Most areas of Washington, Oregon and Idaho saw seasonably hot temperatures and scarce precipitation during the spring months causing early maturity of the crop.

During the spring of 2015 a late freeze (relative to crop development) affected parts of southern Kansas, Oklahoma and Texas followed by over 20 inches (51 cm) of rain during the month of May in north Texas and southern Oklahoma and lesser amounts as far north as Nebraska. This event, while detrimental to the crops in Texas and Oklahoma because of stage of development, had a beneficial effect for crops north of those two states. Precipitation also allowed temperatures to moderate over an extended period relative to normal. Stripe rust had already been observed in southern areas in early spring so the extended period of seasonably cooler temps allowed it to flourish throughout the southern and central US. While not variety specific, the impact on yield and quality was related to crop stage development during peak infection.

The Pacific Northwest and the Montana crops experienced unseasonably hot temperatures in early spring causing stress, shortened grain filling period and early maturity across many areas. The result was HRW wheat harvest being spread over an extended period with more variation as compared to normal years. The common descriptor from the trade was "mosaic" when ask to describe the 2015 Pacific Northwest and the Montana wheat crops.

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. Five hundred (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. Ninety-five 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.

Crop Production Review & Analysis

Wheat and Grade Data

The overall composite 2015 HRW crop official grade averaged 76% Grade #2 or better (Gulf tributary averaging 67% and PNW tributary averaging 89%) when considering all protein levels and weighting for the production. The overall dockage level of 0.8% was above last year's average of 0.4% and the 5-year average of 0.5%. Total defects of 1.8% are above last year's average of 1.4% and 5-year average of 1.6%. Foreign material, and shrunken and broken were also equal to or slightly exceeding the 5-year average. Wheat ash exceeded last year and the 5-year average. Overall test weight averaged 59.0 lbs/bu (77.6kg/hl) which is below the 5-year average and last year's average of 60.7 lbs/bu (79.8 kg/hl). The overall average thousand kernel weight of 29.6 g is above the 5-year average of 29.1 g, but below last year's 30.7. Average kernel diameter of 2.59 mm is similar to the 5-year average and last year. The average protein of 12.4% is lower than last year and slightly lower than the 5-year average of 12.7%. The kernel characteristics were generally smaller in the higher protein southern region and larger with lower protein in the northern production region. Protein content splits varied across the testing region and by tributary with approximately 22% of samples being in the <11.5% protein content category, 41% in the 11.5%–12.5% category and 37% in the <12.5% category. Average falling number for this crop was 400 sec., compared to a 2014 average of 385 sec. This is comparable to the 5-year average of 405 sec. and indicative of sound wheat.

Flour and Baking Data

The Buhler flour yield overall averaged 74.1%, and is comparable to the 2014 average of 73.9%, but above the 5-year average of 73.3%. Flour ash contents exceed the 2014 and the 5-year average and are on the upper side of acceptable ranges. Protein loss during flour conversion averaged 0.7% (when wheat is converted to 14% mb), this was below the 5-year average of 1.0%. Gluten index values averaged 92% which is comparable to last year and slightly lower than the 5-year average of 94%. The W value of 214 (10-4 J) is significantly lower than last year average of 266 (10-4 J) and the 5-year average of 250 (10-4 J). Overall average bake absorption was 62.5% which is lower than the 2014 absorption of 63.7%, but is higher than the 5-year average of 61.8%. Farinograph development time and stability were 4.8 min and 6.9 min. respectively, both are significantly lower than last year and the 5-year average. Overall loaf volume averaged 870cc, this was comparable to 2014 (859cc), but significantly higher than the 5-year average of 825cc.

Summary

Every wheat crop can be defined as unique due to environmental influences, the 2015 HRW crop is no different. The 2015 HRW crop has protein quantity as compared to the 5-year average although lower than the last two years. From a protein quality standpoint his crop has very good wheat to flour conversion, good bake absorption and good farinograph water absorption. Loaf volumes are outstanding and again significantly exceed long-term averages. While consideration needs to be given to peak and stability times which are below average, in the final analysis this crop can attractively convert wheat into flour while making a great end product. 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.)

	2008	2009	2010	2011	2012	2013	2014	2015	Average
Colorado	57,000	98,000	105,750	78,000	83,250	43,500	89,300	89,300	81,100
Kansas	356,000	369,600	360,000	276,500	387,000	328,000	246,400	246,400	325,913
Montana	94,380	89,540	93,600	89,790	81,320	96,750	91,840	91,840	90,055
North Dakota	22,550	26,160	17,600	13,875	38,500	13,440	27,195	27,195	22,696
Nebraska	73,480	76,800	64,070	65,250	55,440	41,760	71,050	71,050	66,516
Oklahoma	166,500	77,000	120,900	70,400	155,400	115,500	47,600	47,600	106,413
Pacific NW	16,246	16,194	19,869	22,004	37,990	35,330	28,350	28,350	24,228
South Dakota	103,950	64,260	63,700	66,780	62,400	25,350	59,400	59,400	67,610
Texas	99,000	61,250	127,500	49,400	91,450	64,000	67,500	67,500	87,588
Wyoming	3,780	5,016	4,640	4,420	3,000	2,640	3,375	3,375	3,765
Regional Total	992,886	883,820	977,629	736,419	995,750	766,270	732,010	732,010	875,883

Hard Winter Wheat Harvested Acres (1,000 Acres)

	2008	2009	2010	2011	2012	2013	2014	2015	Average
Colorado	1,900	2,450	2,350	2,000	2,250	1,500	2,350	2,350	2,144
Kansas	8,900	8,800	8,000	7,900	9,000	8,200	8,800	8,800	8,525
Montana	2,420	2,420	1,950	2,190	2,140	2,150	2,240	2,240	2,213
North Dakota	550	545	320	375	700	320	555	555	476
Nebraska	1,670	1,600	1,490	1,450	1,320	1,160	1,450	1,450	1,513
Oklahoma	4,500	3,500	3,900	3,200	4,200	3,500	2,800	2,800	3,638
Pacific NW	258	276	289	293	535	530	417	417	362
South Dakota	1,890	1,530	1,300	1,590	1,300	650	1,080	1,080	1,415
Texas	3,300	2,450	3,750	1,900	2,950	2,000	2,250	2,250	2,800
Wyoming	135	132	145	130	120	120	125	125	129
Regional Total	25,523	23,703	23,494	21,028	24,515	20,130	22,067	22,067	23,213

Hard Winter Wheat Yield (bu/ac)

	2008	2009	2010	2011	2012	2013	2014	2015	Average
Colorado	30	40	45	39	37	29	38	38	37
Kansas	40	42	45	45	43	40	28	28	40
Montana	39	37	48	41	38	45	41	41	41
North Dakota	41	48	55	37	55	42	49	49	47
Nebraska	44	48	43	45	42	36	49	49	44
Oklahoma	37	22	31	22	37	33	17	17	28
Pacific NW	57	58	68	76	75	68	66	66	66
South Dakota	55	42	49	42	48	39	55	55	47
Texas	30	25	34	26	31	32	30	30	31
Wyoming	28	38	32	34	25	22	27	27	29
Regional Avg	40	40	45	41	43	39	40	40	41

*** 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)

	2008	2009	2010	2011	2012	2013	2014	2015	Average
Colorado	1.55	2.67	2.88	2.12	2.27	1.18	2.43	2.16	2.16
Kansas	9.69	10.06	9.80	7.53	10.53	8.93	6.71	8.76	9.00
Montana	2.57	2.44	2.55	2.44	2.21	2.63	2.50	2.48	2.48
North Dakota	0.61	0.71	0.48	0.38	1.05	0.37	0.74	0.23	0.57
Nebraska	2.00	2.09	1.74	1.78	1.51	1.14	1.93	1.25	1.68
Oklahoma	4.53	2.10	3.29	1.92	4.23	3.14	1.30	2.69	2.90
Pacific NW	0.44	0.44	0.54	0.60	1.03	0.96	0.77	0.78	0.70
South Dakota	2.83	1.75	1.73	1.82	1.70	0.69	1.62	1.16	1.66
Texas	2.69	1.67	3.47	1.34	2.49	1.74	1.84	2.90	2.27
Wyoming	0.10	0.14	0.13	0.12	0.08	0.07	0.09	0.11	0.11
Regional Total	27.02	24.06	26.61	20.04	27.10	20.86	19.92	22.51	23.52

Hard Winter Wheat Harvested Acres (1,000 ha)

	2008	2009	2010	2011	2012	2013	2014	2015	Average
Colorado	769	992	951	810	911	607	951	866	857
Kansas	3,603	3,563	3,239	3,198	3,644	3,320	3,563	3,522	3,456
Montana	980	980	789	887	866	870	907	899	897
North Dakota	223	221	130	152	283	130	225	77	180
Nebraska	676	648	603	587	534	470	587	490	574
Oklahoma	1,822	1,417	1,579	1,296	1,700	1,417	1,134	1,538	1,488
Pacific NW	104	112	117	119	217	215	169	176	153
South Dakota	765	619	526	644	526	263	437	393	522
Texas	1,336	992	1,518	769	1,194	810	911	1,437	1,121
Wyoming	55	53	59	53	49	49	51	53	52
Regional Total	10,333	9,596	9,512	8,513	9,925	8,150	8,934	9,451	9,302

Hard Winter Wheat Yield (tons/ha)

	2008	2009	2010	2011	2012	2013	2014	2015	Average
Colorado	2.02	2.69	3.03	2.62	2.49	1.95	2.56	2.49	2.48
Kansas	2.69	2.82	3.03	3.03	2.89	2.69	1.88	2.49	2.69
Montana	2.62	2.49	3.23	2.76	2.56	3.03	2.76	2.76	2.77
North Dakota	2.76	3.23	3.70	2.49	3.70	2.82	3.30	2.96	3.12
Nebraska	2.96	3.23	2.89	3.03	2.82	2.42	3.30	2.56	2.90
Oklahoma	2.49	1.48	2.08	1.48	2.49	2.22	1.14	1.75	1.89
Pacific NW	3.83	3.90	4.57	5.11	5.04	4.57	4.44	4.71	4.52
South Dakota	3.70	2.82	3.30	2.82	3.23	2.62	3.70	2.96	3.14
Texas	2.02	1.68	2.29	1.75	2.08	2.15	2.02	2.02	2.00
Wyoming	1.88	2.56	2.15	2.29	1.68	1.48	1.82	2.15	2.00
Regional Avg	2.70	2.69	3.03	2.74	2.90	2.60	2.69	2.68	2.75

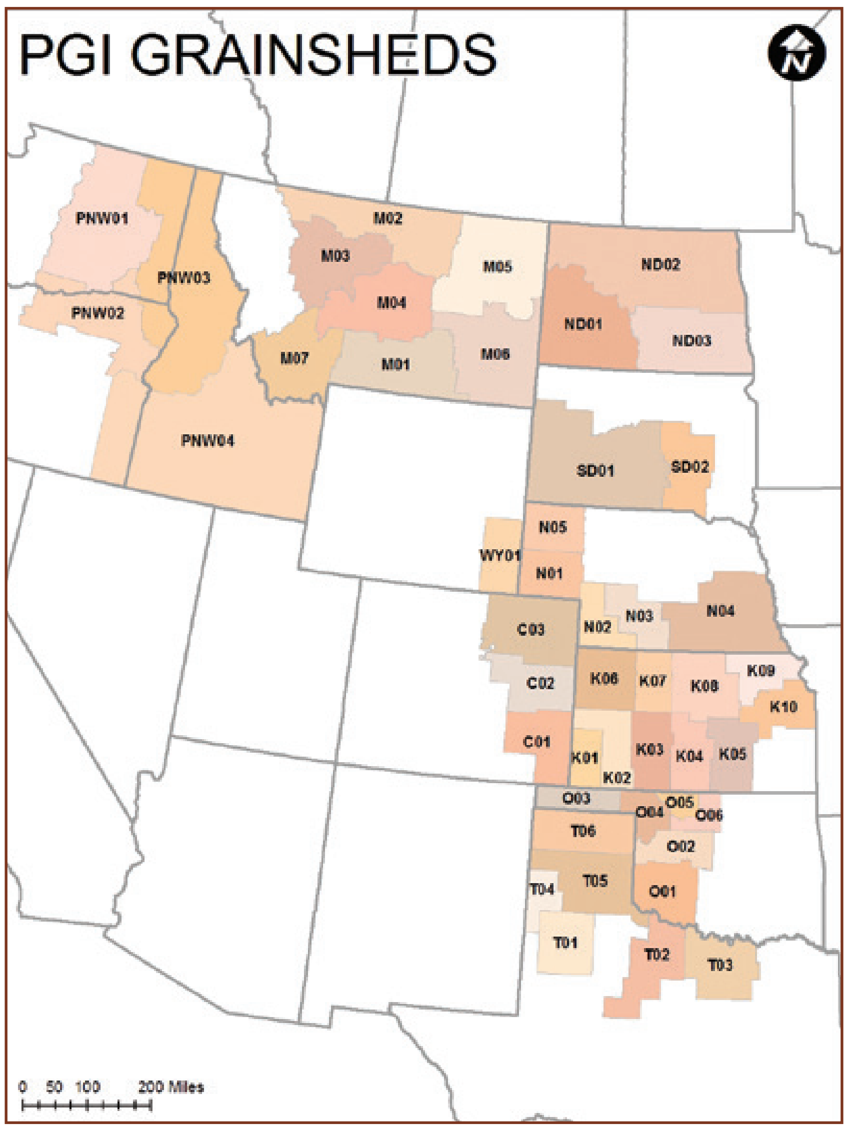
*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2015.*

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.

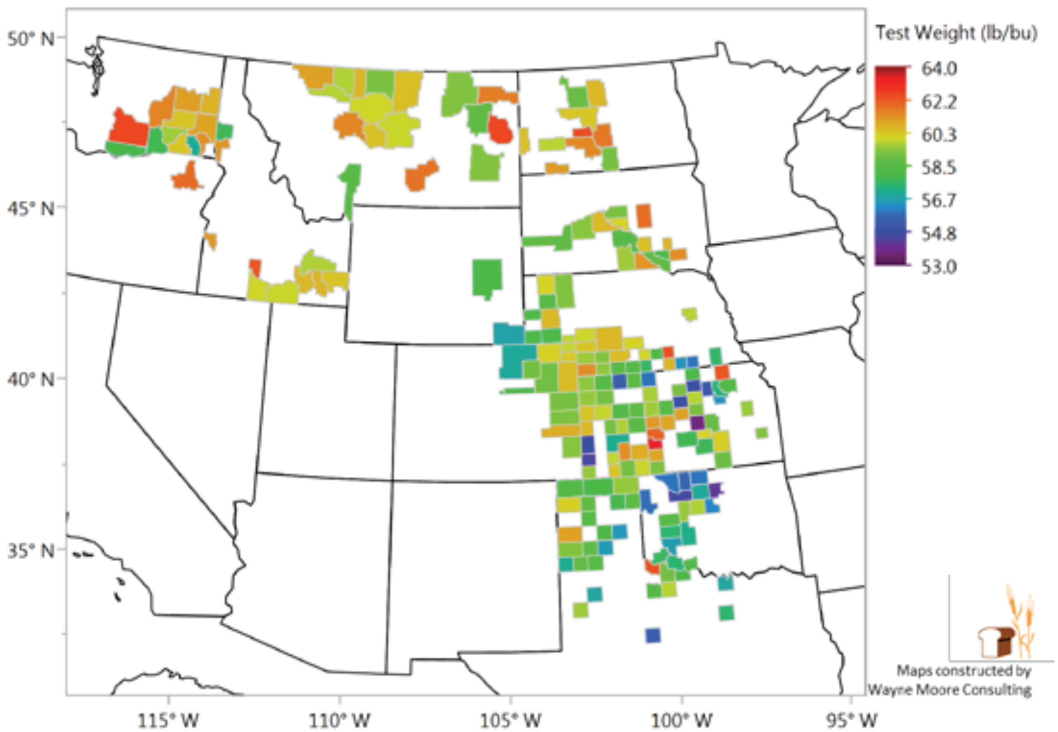
Foreign material is all matter other than wheat that remains in the sample after the removal of dockage and shrunken and broken kernels.

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.

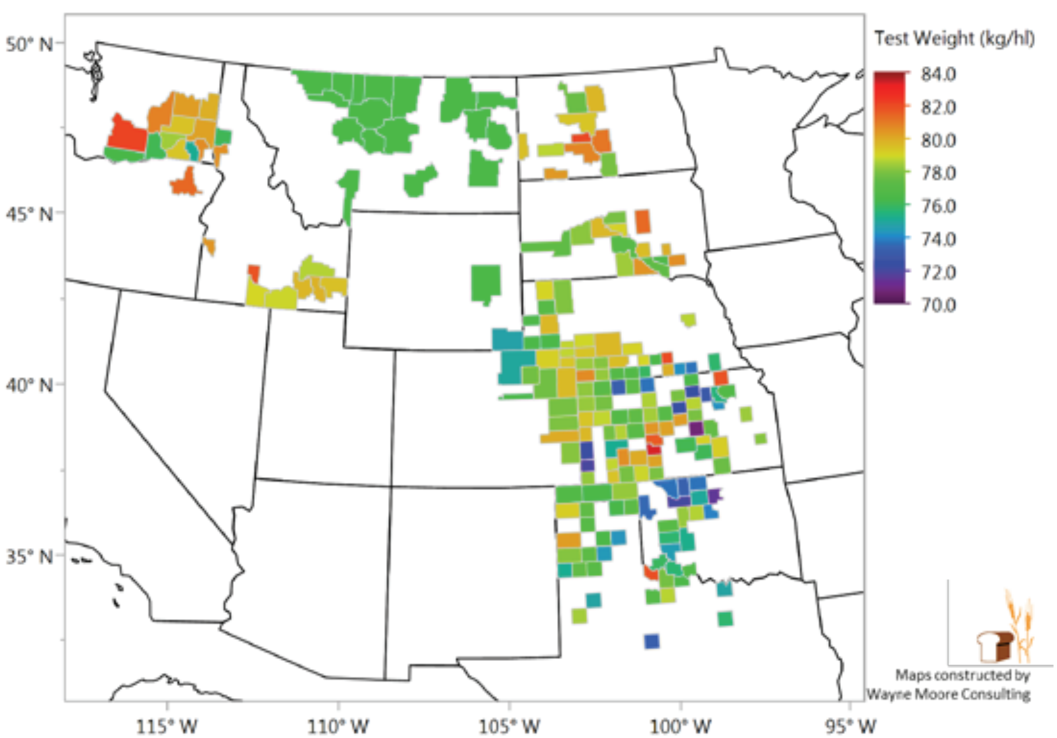
Damaged kernels are kernels, pieces of wheat kernels, and other grains that are badly ground-damaged, badly weather damaged, diseased, frost-damaged, germ damaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged.

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.)	Test Wt (lb/bu)	Test Wt (kg/hl)	Dockage (%)	Damage Kernels Total (%)	Shrunken & Broken Kernels (%)	Total Defects (%)
Colorado	C01	2	59.8	78.7	0.6	0.3	0.9	1.2
	C02	2	59.1	77.7	0.8	0.4	1.1	1.7
	C03	1	60.0	78.9	0.5	0.2	0.8	1.5
Kansas	K01	3	57.2	75.3	1.1	0.6	1.3	2.0
	K02	2	59.5	78.2	0.6	0.4	0.9	1.4
	K03	1	60.3	79.3	0.7	0.6	0.9	1.6
	K04	1	61.4	80.7	0.5	1.9	0.9	1.5
	K05	2	58.4	76.9	0.6	0.5	1.1	1.8
	K06	2	59.2	77.9	0.6	0.4	1.1	1.5
	K07	2	58.4	76.9	0.8	0.5	1.6	2.1
	K08	2	58.6	77.2	0.7	0.6	1.4	2.1
	K09	3	56.7	74.6	0.7	0.6	1.6	2.7
	K10	2	58.3	76.7	0.8	0.5	1.6	2.2
Montana	M01	1	61.9	81.3	0.5	0.0	1.1	1.1
	M02	1	60.1	79.1	0.5	0.0	1.3	1.4
	M03	1	60.5	79.6	0.5	0.0	1.2	1.4
	M04	1	60.0	78.9	0.4	0.1	1.8	1.9
	M05	1	60.7	79.8	0.3	0.1	0.8	1.0
	M06	2	59.4	78.2	0.4	0.1	0.6	0.8
	M07	2	58.6	77.1	1.1	0.0	1.2	1.2
Nebraska	N01	2	59.0	77.6	0.7	0.3	1.1	1.6
	N02	1	60.1	79.1	0.7	0.4	1.3	1.9
	N03	2	58.8	77.3	0.9	1.4	1.2	1.7
	N04	2	59.6	78.4	1.0	1.2	1.0	2.2
	N05	2	59.2	77.9	1.1	0.3	1.0	1.5
North Dakota	ND01	1	61.0	76.2	0.3	0.2	1.0	1.3
	ND02	1	60.1	79.1	0.5	0.3	0.8	1.2
Oklahoma	O01	3	57.6	75.8	0.7	0.7	1.3	2.1
	O02	2	59.9	78.8	0.8	0.2	1.2	1.5
	O03	2	58.8	77.4	0.7	0.3	1.1	1.5
	O04	3	57.2	75.4	1.2	0.8	1.0	2.1
	O05	3	56.0	73.8	0.6	0.4	1.6	2.3
	O06	3	56.6	74.6	0.8	0.5	1.9	2.7
	O07	4	54.9	72.4	0.8	0.6	2.0	3.1
Pacific Northwest	PNW01	1	60.8	79.9	0.5	0.0	1.1	1.1
	PNW02	2	59.6	78.5	0.8	0.0	3.5	3.5
	PNW03	2	59.7	78.6	0.7	0.1	1.1	1.2
	PNW04	1	60.6	79.7	0.9	0.0	0.6	0.7
South Dakota	SD01	2	59.7	78.6	1.5	0.2	1.0	1.5
	SD02	1	60.7	79.8	0.4	0.5	1.0	1.7
Texas	T01	2	58.9	77.5	0.9	0.2	1.5	1.8
	T02	2	58.7	77.3	0.5	0.7	1.3	2.1
	T03	3	57.7	75.9	0.4	0.8	1.4	2.7
	T04	2	58.5	77.0	0.6	0.4	1.2	1.8
	T05	2	58.3	76.7	1.8	0.5	2.2	2.8
	T06	2	58.8	77.4	1.5	0.4	1.5	2.1
Wyoming	W01	3	57.1	75.1	1.0	0.3	1.4	1.9

Kernel Quality Data

Location		Foreign Material (%)	Kernel Size Large (%)	Kernel Size Med (%)	Kernel Size Small (%)	SKCS Avg TKW (g)	SKCS Avg Diam (mm)
Colorado	C01	0.0	68.7	30.1	1.2	30.5	2.57
	C02	0.2	68.1	30.6	1.3	30.5	2.60
	C03	0.5	71.4	27.6	1.0	31.0	2.62
Kansas	K01	0.1	57.1	41.0	1.8	28.3	2.56
	K02	0.1	69.2	29.6	1.2	30.6	2.65
	K03	0.0	68.3	30.8	0.9	30.0	2.62
	K04	0.0	72.2	27.0	0.7	31.2	2.66
	K05	0.2	66.2	32.1	1.7	29.6	2.58
	K06	0.1	65.3	33.2	1.5	29.5	2.55
	K07	0.1	67.0	31.4	1.6	29.4	2.58
	K08	0.1	64.3	34.1	1.5	28.8	2.55
	K09	0.1	60.7	37.0	2.3	28.5	2.54
	K10	0.1	62.0	36.6	1.4	28.3	2.53
Montana	M01	0.1	67.7	31.6	0.8	31.9	2.66
	M02	0.1	42.5	55.5	2.1	27.4	2.48
	M03	0.1	50.9	47.8	1.3	28.6	2.55
	M04	0.0	46.4	51.2	2.4	27.4	2.49
	M05	0.1	62.1	36.9	1.0	29.6	2.58
	M06	0.1	63.3	36.2	0.6	30.9	2.63
	M07	0.0	53.6	44.9	1.5	30.0	2.52
Nebraska	N01	0.2	70.5	28.6	1.0	30.3	2.60
	N02	0.2	72.5	26.5	1.1	31.0	2.62
	N03	0.1	68.6	29.9	1.5	30.7	2.60
	N04	0.1	66.6	32.3	1.2	30.4	2.60
	N05	0.2	64.2	34.4	1.4	30.1	2.63
North Dakota	ND01	0.1	68.3	30.8	1.0	29.9	2.58
	ND02	0.1	66.0	32.9	1.1	31.7	2.62
Oklahoma	O01	0.2	51.1	46.9	2.0	27.5	2.55
	O02	0.1	66.3	32.4	1.2	30.2	2.65
	O03	0.1	62.5	35.9	1.6	29.2	2.60
	O04	0.4	60.6	37.6	1.8	28.7	2.59
	O05	0.2	41.4	54.4	4.2	25.1	2.49
	O06	0.3	47.0	49.9	3.0	26.9	2.53
	O07	0.5	51.2	46.3	2.5	27.3	2.54
Pacific Northwest	PNW01	0.0	65.8	33.2	1.0	31.7	2.65
	PNW02	0.0	61.1	36.0	2.9	30.5	2.62
	PNW03	0.0	68.1	30.8	1.1	31.0	2.63
	PNW04	0.1	74.7	24.7	0.6	32.9	2.70
South Dakota	SD01	0.3	56.4	41.5	2.1	29.2	2.57
	SD02	0.1	59.7	38.7	1.5	29.9	2.57
Texas	T01	0.1	55.2	42.0	2.8	28.2	2.56
	T02	0.2	55.5	42.8	1.6	28.0	2.57
	T03	0.5	53.9	44.0	2.1	27.2	2.53
	T04	0.1	62.7	35.4	1.8	29.9	2.61
	T05	0.2	54.8	42.2	3.0	28.0	2.55
	T06	0.2	60.6	37.4	2.0	29.3	2.59
Wyoming	W01	0.2	56.9	40.4	2.7	28.6	2.56

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.

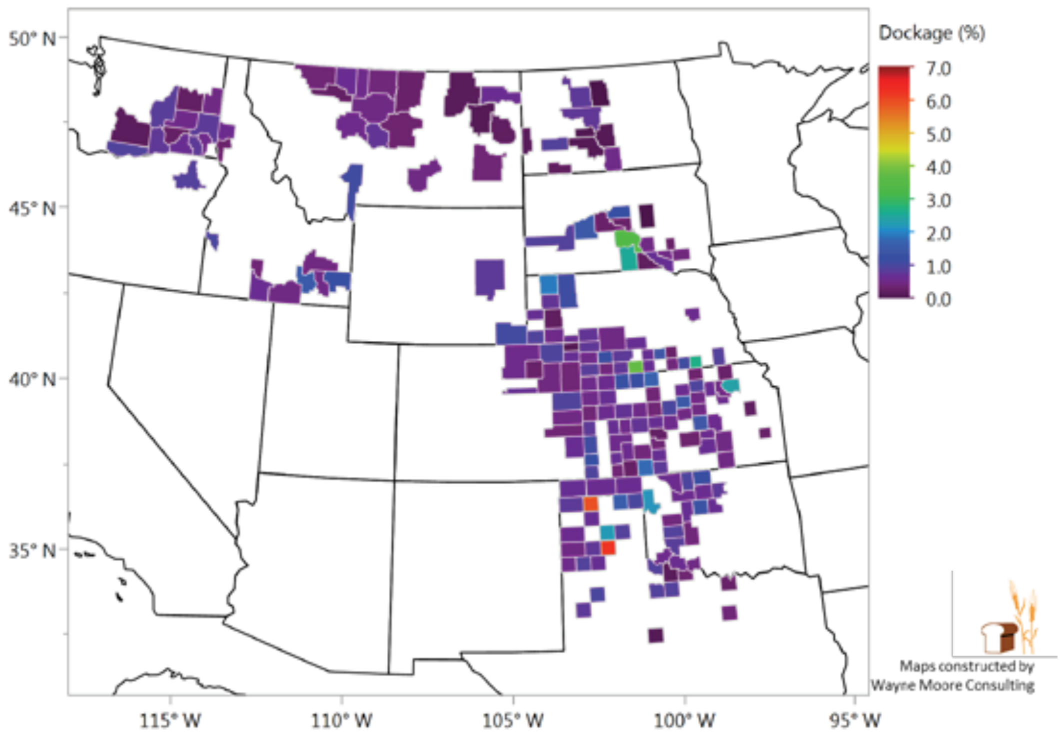
Falling number is an index of enzyme activity in wheat or flour and is expressed in seconds. Falling numbers above 300 are desirable, as they indicate little enzyme activity and a sound quality product. Falling numbers below 300 are indicative of more substantial enzyme activity and sprout damage.

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.

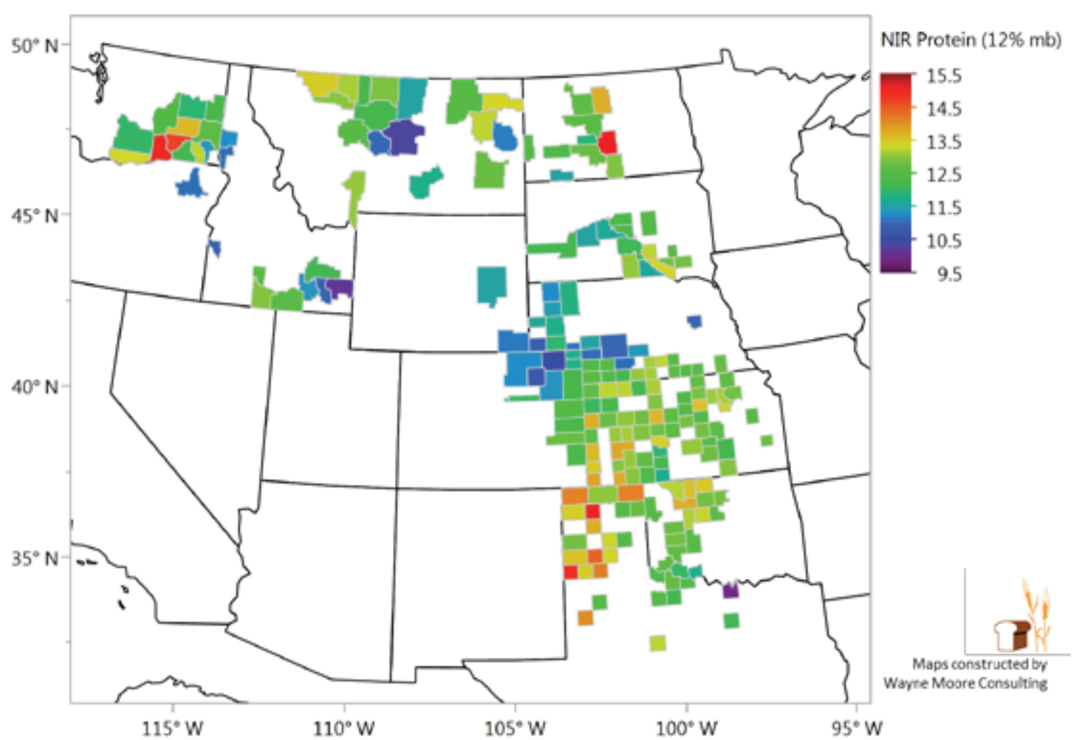
Kernel Size is a measure of the percentage by weight of large, medium and small kernels in a sample. Large kernels or more uniform kernel size may help improve milling yield.

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.

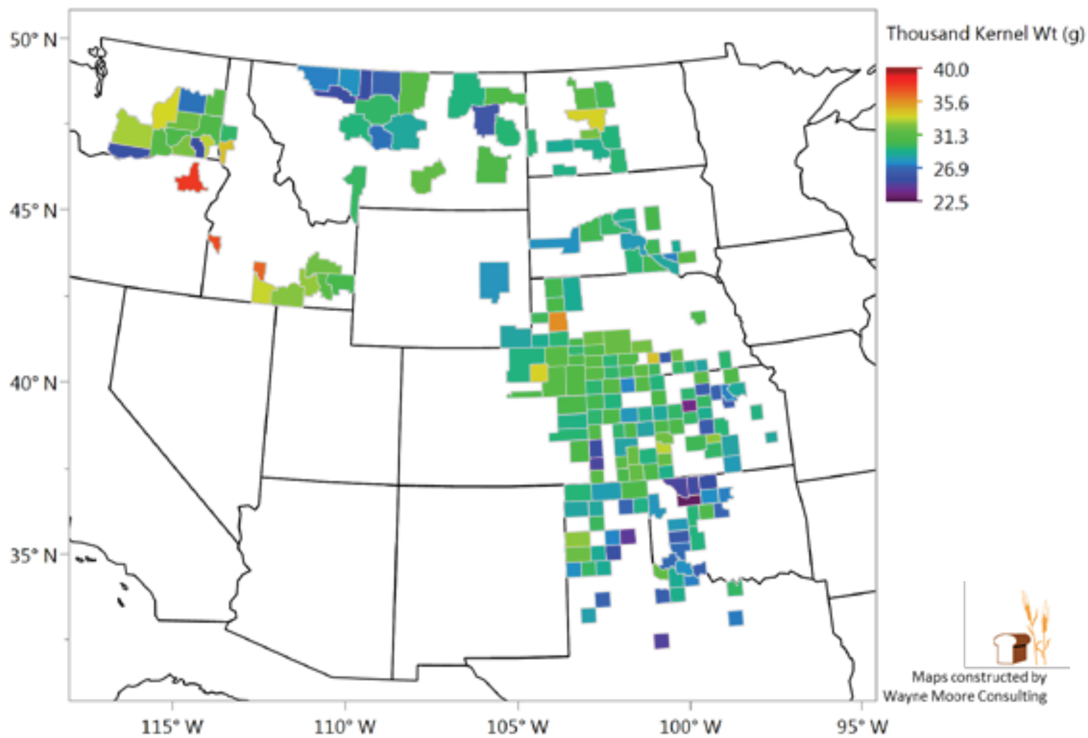
Dockage (%)



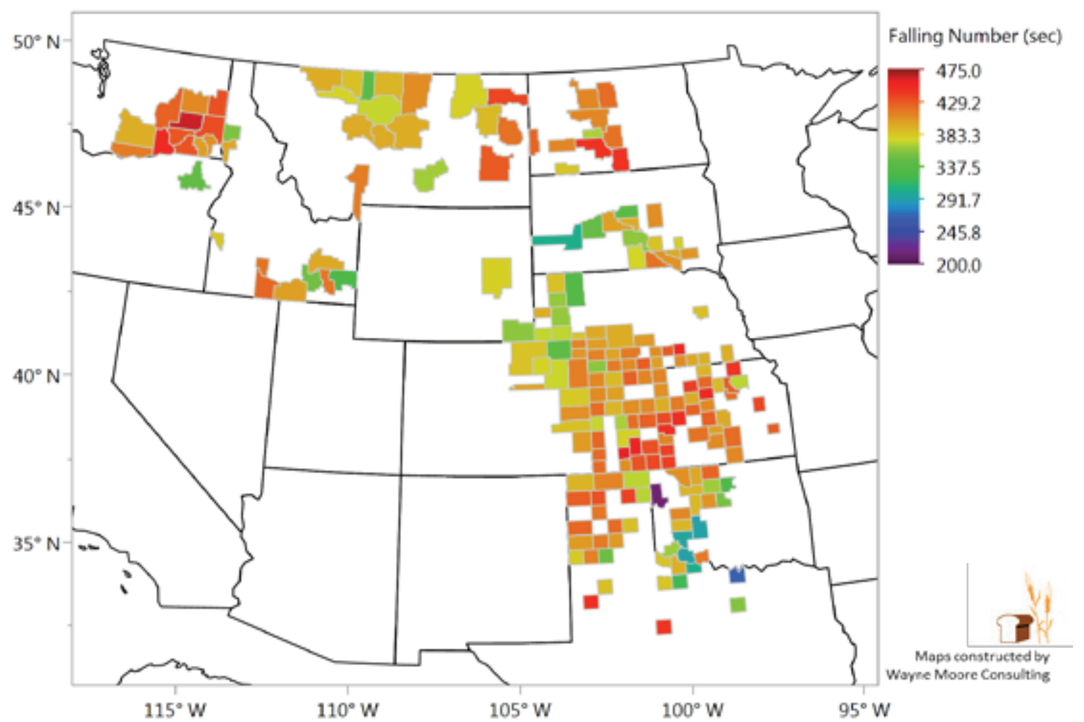
Protein (%)



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	C01	12.0	1.62	401	12.3	54.4
	C02	12.0	1.64	392	11.5	52.2
	C03	11.3	1.57	396	10.7	52.4
Kansas	K01	13.4	1.78	425	10.4	60.9
	K02	12.9	1.65	405	11.8	62.8
	K03	12.3	1.61	436	11.9	65.5
	K04	12.6	1.55	447	11.4	67.4
	K05	12.7	1.71	416	12.4	58.5
	K06	12.5	1.54	412	12.0	59.0
	K07	12.7	1.66	413	11.6	59.7
	K08	12.4	1.57	421	12.0	58.3
	K09	12.7	1.73	416	12.9	57.4
	K10	12.6	1.69	421	12.2	56.1
Montana	M01	11.5	1.44	369	10.2	63.2
	M02	12.2	1.45	384	11.2	66.0
	M03	11.9	1.49	385	10.3	66.3
	M04	10.1	1.47	399	11.0	59.5
	M05	12.3	1.44	416	11.6	56.1
	M06	11.8	1.45	431	9.9	56.3
	M07	12.1	1.42	418	11.1	67.5
Nebraska	N01	11.1	1.60	381	11.4	49.0
	N02	11.6	1.64	405	10.8	53.4
	N03	12.3	1.71	400	12.6	54.9
	N04	12.2	1.69	420	12.6	56.0
	N05	11.3	1.64	365	11.5	50.8
North Dakota	ND01	12.6	1.59	414	12.0	60.7
	ND02	12.8	1.62	418	12.2	55.2
Oklahoma	O01	12.2	1.62	341	12.0	65.7
	O02	12.9	1.64	410	11.2	65.6
	O03	13.2	1.77	399	10.4	64.6
	O04	12.8	1.69	338	12.6	58.5
	O05	12.9	1.65	408	11.8	64.9
	O06	12.9	1.64	386	11.8	63.1
	O07	12.9	1.65	340	11.9	58.9
Pacific Northwest	PNW01	13.2	1.51	437	7.8	70.3
	PNW02	12.0	1.58	415	7.5	70.7
	PNW03	11.6	1.40	407	8.0	69.8
	PNW04	11.5	1.58	386	10.1	67.4
South Dakota	SD01	11.9	1.74	375	12.1	58.9
	SD02	12.4	1.70	400	11.7	59.2
Texas	T01	12.6	1.70	418	11.2	65.9
	T02	12.3	1.53	351	11.7	65.1
	T03	12.2	1.60	374	12.0	60.1
	T04	13.9	1.73	383	11.1	63.9
	T05	13.2	1.76	416	10.8	64.6
	T06	13.3	1.71	420	11.4	64.6
Wyoming	W01	10.9	1.61	367	11.8	46.9

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	C01	77.0	47.3	11.1	0.59	97.0	87.7	-1.2	10.4
	C02	73.8	48.3	11.0	0.57	97.2	88.1	-1.2	9.6
	C03	77.1	47.0	10.3	0.54	98.8	88.3	-1.4	10.0
Kansas	K01	72.6	58.8	12.5	0.66	89.7	87.6	-1.1	9.6
	K02	75.2	54.0	12.1	0.62	88.4	87.5	-1.1	9.8
	K03	74.6	47.7	11.2	0.61	92.3	87.9	-1.2	9.8
	K04	75.0	47.2	11.5	0.58	76.5	88.0	-1.2	9.8
	K05	73.9	46.2	11.6	0.61	92.1	87.4	-1.2	9.9
	K06	75.3	47.4	11.5	0.60	93.9	87.2	-1.2	10.1
	K07	75.6	51.3	11.8	0.60	92.4	87.3	-1.2	9.8
	K08	75.4	42.9	11.4	0.60	91.5	87.4	-1.2	10.2
	K09	75.1	40.9	11.7	0.65	91.9	86.8	-1.1	10.3
	K10	73.8	42.8	11.4	0.63	85.4	87.4	-1.1	9.8
Montana	M01	74.2	47.4	10.5	0.51	96.9	88.3	-1.2	9.5
	M02	73.4	64.1	11.5	0.53	96.8	88.0	-1.2	9.6
	M03	75.3	53.4	11.2	0.53	98.2	88.3	-1.4	10.0
	M04	70.0	46.8	9.0	0.52	98.3	89.1	-1.3	9.2
	M05	75.5	58.6	11.3	0.52	97.6	87.8	-1.0	8.8
	M06	72.9	65.0	11.7	0.50	98.0	88.4	-1.0	8.7
	M07	71.2	67.9	11.8	0.51	97.8	88.6	-1.2	9.6
Nebraska	N01	72.9	42.5	10.1	0.47	94.1	88.1	-1.4	9.4
	N02	75.3	42.6	10.6	0.57	95.3	87.8	-1.3	9.9
	N03	75.0	44.6	11.3	0.59	90.9	87.9	-1.2	9.9
	N04	74.5	42.8	11.1	0.58	91.9	87.7	-1.1	9.8
	N05	74.9	46.1	10.1	0.55	95.7	87.7	-1.3	9.5
North Dakota	ND01	76.4	51.6	11.1	0.51	99.0	87.8	-1.1	9.4
	ND02	73.4	60.3	11.8	0.52	97.3	88.0	-1.2	9.5
Oklahoma	O01	71.4	47.9	10.9	0.58	90.0	87.5	-1.2	9.6
	O02	74.4	54.2	12.0	0.65	89.2	86.5	-1.0	9.9
	O03	73.5	60.2	12.3	0.65	86.4	86.7	-1.0	9.7
	O04	76.9	43.6	12.2	0.74	90.8	86.1	-0.8	9.3
	O05	73.0	61.3	11.8	0.62	90.2	87.2	-1.1	10.0
	O06	73.0	55.8	12.0	0.61	93.7	87.2	-1.1	10.1
	O07	73.0	48.1	11.7	0.67	92.2	86.5	-1.0	9.5
Pacific Northwest	PNW01	77.0	53.5	12.2	0.55	96.1	88.1	-1.0	9.5
	PNW02	76.7	47.9	11.4	0.60	95.2	87.9	-1.1	9.9
	PNW03	76.7	47.5	10.7	0.53	97.5	87.9	-1.0	9.9
	PNW04	74.7	44.8	10.2	0.52	97.3	88.7	-1.3	9.8
South Dakota	SD01	71.7	47.3	10.8	0.61	95.1	87.8	-1.2	9.2
	SD02	74.3	49.3	11.4	0.57	95.8	87.8	-1.2	9.3
Texas	T01	73.8	47.7	11.8	0.64	88.7	87.1	-1.1	9.8
	T02	72.0	52.6	11.2	0.57	94.2	87.7	-1.2	9.6
	T03	73.9	49.4	11.4	0.61	90.3	87.4	-1.1	9.8
	T04	73.0	56.0	12.9	0.68	81.2	87.4	-1.0	9.6
	T05	72.2	54.3	12.2	0.71	84.0	87.5	-1.1	9.7
	T06	74.6	52.9	12.5	0.69	85.4	87.0	-0.9	9.6
Wyoming	W01	73.5	45.0	9.9	0.54	94.2	87.9	-1.3	9.4

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.

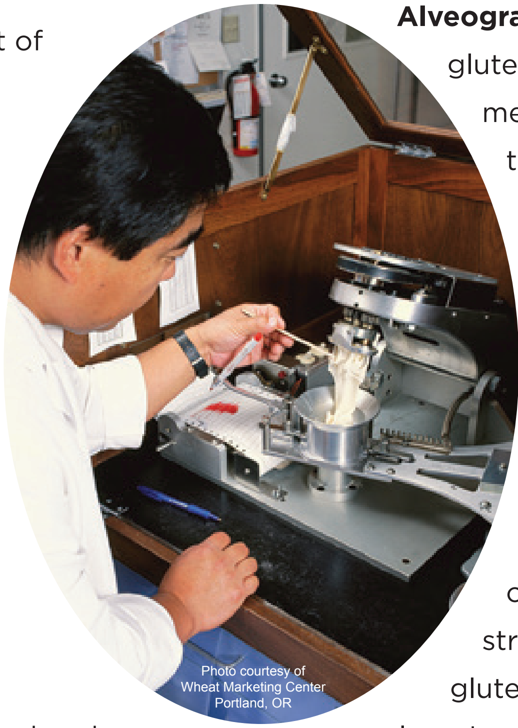


Photo courtesy of Wheat Marketing Center Portland, OR

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

PGI

Location		ALVEOGRAPH				FARINOGRAPH			
Location		P (mm)	L (mm)	W (10-4 J)	P/L Ratio	Abs (14%mb)	Development Time (min)	Stability (min)	MTI (BU)
Colorado	C01	63	103	193	0.61	57.4	4.8	6.7	33
	C02	67	100	207	0.67	58.4	5.0	7.1	29
	C03	61	99	193	0.62	55.6	5.2	6.6	44
Kansas	K01	80	94	221	0.85	61.2	5.4	7.6	28
	K02	78	94	212	0.83	61.6	4.9	5.7	35
	K03	104	78	258	1.33	61.0	4.5	6.8	37
	K04	77	94	207	0.82	61.4	5.0	5.6	41
	K05	70	91	187	0.77	60.0	5.0	6.4	44
	K06	72	92	197	0.78	59.0	5.0	6.9	35
	K07	71	100	202	0.71	60.0	5.3	6.3	41
	K08	67	94	182	0.71	59.5	5.3	7.1	32
	K09	62	94	160	0.66	59.2	4.3	4.8	53
	K10	60	94	162	0.64	58.1	4.5	5.4	45
Montana	M01	88	78	243	1.13	58.3	4.2	7.7	31
	M02	89	91	293	0.98	58.3	6.2	10.3	31
	M03	82	103	285	0.80	57.8	5.2	8.2	27
	M04	68	84	200	0.81	55.0	1.8	7.1	22
	M05	82	104	289	0.79	58.3	5.5	8.1	36
	M06	97	93	342	1.04	60.1	4.4	10.4	21
	M07	86	100	309	0.86	59.9	4.8	9.0	28
Nebraska	N01	56	107	179	0.52	55.7	4.5	6.2	49
	N02	58	101	170	0.57	57.5	4.3	5.4	46
	N03	62	99	183	0.63	57.7	4.8	6.5	33
	N04	65	90	173	0.72	59.2	4.3	5.4	45
	N05	60	88	176	0.68	55.0	4.7	6.6	43
North Dakota	ND01	68	112	243	0.61	58.0	5.0	7.5	32
	ND02	61	120	214	0.51	59.5	4.4	5.3	39
Oklahoma	O01	87	78	206	1.12	60.8	4.2	5.1	55
	O02	88	85	216	1.04	62.6	5.4	7.1	31
	O03	93	85	238	1.09	62.9	5.3	7.9	24
	O04	77	76	168	1.01	62.2	5.7	6.3	35
	O05	93	101	283	0.92	60.8	5.2	9.2	23
	O06	84	98	235	0.86	61.7	4.5	6.1	38
	O07	87	77	207	1.13	61.1	4.2	7.0	28
Pacific Northwest	PNW01	98	95	318	1.03	60.5	5.9	10.9	18
	PNW02	88	84	252	1.05	60.0	4.7	6.5	37
	PNW03	98	74	269	1.32	59.4	4.7	8.4	29
	PNW04	95	78	267	1.22	60.3	4.8	7.9	31
South Dakota	SD01	73	96	216	0.76	57.8	4.5	5.8	52
	SD02	72	93	203	0.77	57.8	4.5	5.6	48
Texas	T01	81	86	202	0.94	60.5	4.0	5.0	46
	T02	84	100	251	0.84	60.4	3.4	5.9	39
	T03	87	83	212	1.05	62.2	4.5	5.8	40
	T04	82	96	219	0.85	62.4	6.5	6.3	33
	T05	78	96	208	0.81	61.6	4.0	5.3	39
	T06	87	93	227	0.94	61.9	4.9	5.1	41
Wyoming	W01	57	81	145	0.70	55.1	4.5	6.4	40

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	C01	4.9	61.8	820	7.0	7.0	Dull
	C02	4.3	61.8	825	6.3	7.0	Dull
	C03	4.5	59.7	865	8.5	7.0	Dull
Kansas	K01	3.5	63.8	900	5.5	8.5	Dull
	K02	3.9	63.3	900	6.3	8.5	Dull
	K03	4.3	64.6	895	7.0	8.5	Dull
	K04	3.8	64.0	890	5.5	8.5	Dull
	K05	3.8	63.0	895	6.3	8.5	Dull
	K06	4.1	63.4	900	7.0	8.5	Dull
	K07	3.8	63.5	910	6.3	8.5	Dull
	K08	4.1	62.4	850	7.0	7.0	Dull
	K09	3.5	62.7	875	4.0	7.0	Dull
	K10	4.0	60.2	840	7.0	5.5	Dull
Montana	M01	5.0	61.5	835	8.5	7.0	Dull
	M02	6.4	62.4	875	6.3	7.0	Dull
	M03	5.4	62.6	850	7.8	7.8	Dull
	M04	6.6	58.7	750	5.5	5.5	Dull
	M05	5.5	63.0	850	6.3	7.0	Dull
	M06	6.8	64.2	895	7.8	7.0	Dull
	M07	7.5	63.7	895	7.0	7.0	Dull
Nebraska	N01	4.5	60.6	830	6.3	7.0	Dull
	N02	3.8	60.7	840	5.5	5.5	Dull
	N03	4.0	60.8	870	5.5	7.0	Dull
	N04	3.9	61.7	870	5.5	7.0	Dull
	N05	4.8	60.4	825	4.8	7.0	Dull
North Dakota	ND01	4.6	61.9	860	4.8	5.5	Dull
	ND02	4.0	62.6	825	3.3	5.5	Dull
Oklahoma	O01	4.3	63.5	880	5.5	8.5	Dull
	O02	3.5	64.3	895	4.0	7.0	Dull
	O03	3.5	64.7	900	4.0	7.0	Dull
	O04	3.5	63.7	895	5.5	7.0	Dull
	O05	4.3	63.6	925	5.5	7.0	Dull
	O06	4.0	62.9	900	3.3	7.0	Dull
	O07	3.8	62.9	895	6.3	7.0	Dull
Pacific Northwest	PNW01	4.3	63.8	905	6.3	7.0	Dull
	PNW02	4.5	61.9	830	5.5	5.5	Dull
	PNW03	6.0	62.6	825	5.5	5.5	Dull
	PNW04	4.3	63.2	785	4.8	5.5	Dull
South Dakota	SD01	4.3	61.3	855	7.8	7.0	Dull
	SD02	4.3	62.2	860	8.5	7.0	Dull
Texas	T01	3.5	62.1	850	4.0	7.0	Dull
	T02	4.5	62.5	870	4.0	7.0	Dull
	T03	3.8	62.5	840	3.3	7.0	Dull
	T04	3.4	62.9	850	4.0	6.3	Dull
	T05	3.5	62.5	900	6.3	7.0	Dull
	T06	3.5	63.6	900	4.8	8.5	Dull
Wyoming	W01	4.8	60.1	840	7.0	7.0	Dull

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.