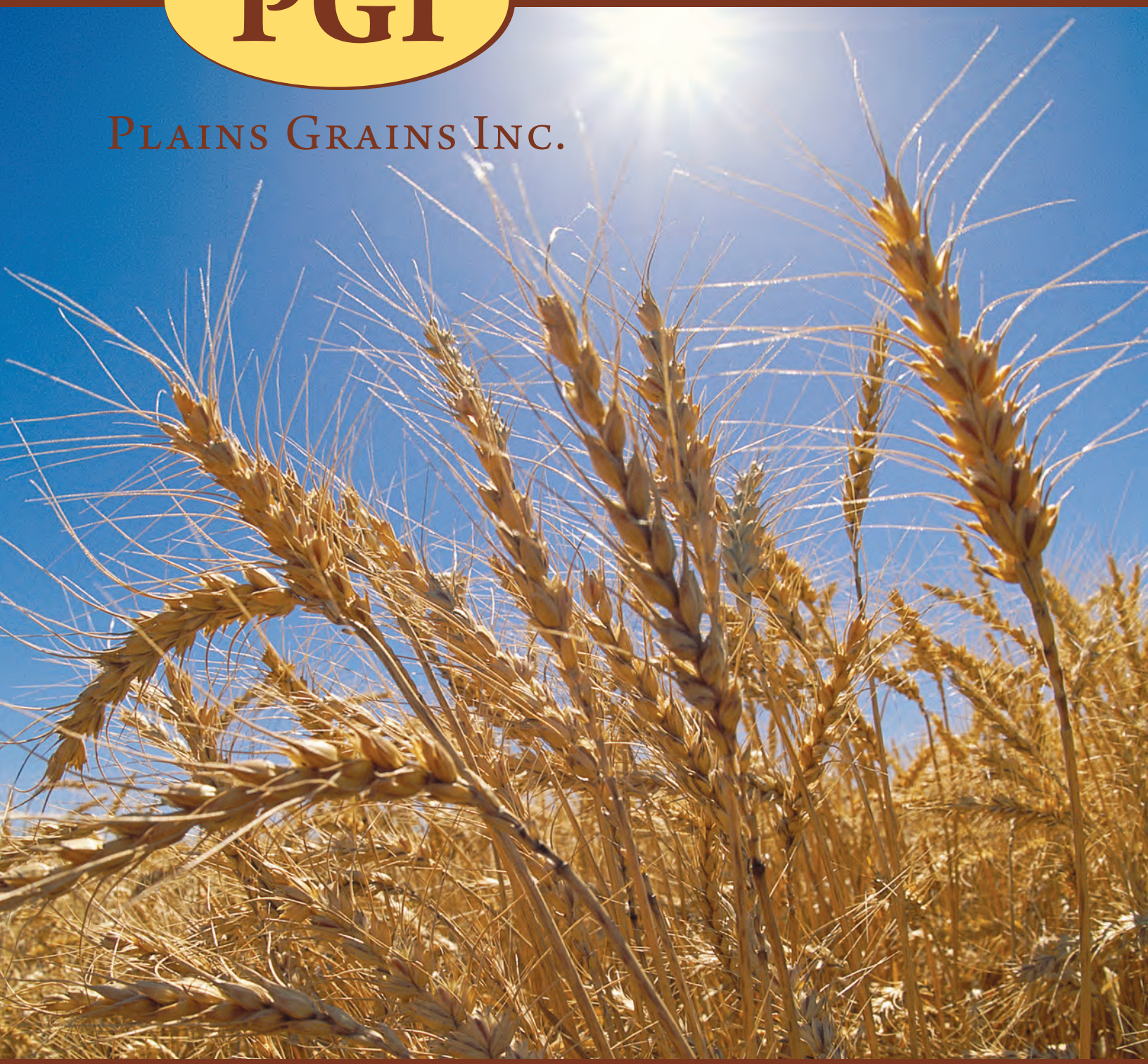
PGI

Plains Grains Inc.



2011 Hard Red Winter Wheat Regional Quality Survey

Plains Grains Inc.

321B CITD, Stillwater, OK 74078
Phone: (405) 744- 9333
pgiadmin@plainsgrains.org • www.plainsgrains.org

Colorado Wheat Administrative Committee
www.coloradowheat.org

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

North Dakota Wheat Commission
www.ndwheat.com

Kansas Wheat Commission
www.kswheat.com

South Dakota Wheat Commission
www.sdwheat.org

Washington Grain Commission
www.washingtongrainalliance.com

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

Texas Wheat Producers Board and Association
www.texaswheat.org

Oregon Wheat Commission
www.owgl.org

Nebraska Wheat Board
www.nebraskawheat.com

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.

PGI

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 web site 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 antioxidants 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 2009 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 moderatly 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.

Crop Production Review and Analysis

Weather and Harvest

The 2011 Hard Red Winter (HRW) wheat crop could be characterized as one of contrast. The Southern Great Plains (middle of Kansas southward) is experiencing a drought of historical proportions. Texas, Southwest Oklahoma, and Southwest Kansas were particularly hard hit with total precipitation over the normal growing season of less 5% of normal over large areas. Most of that precipitation came in the fall at planting time which did allow for germination and emergence, but little moisture after that. Planting and emergence in these areas were within the 5 year average range, but moisture stress was observed soon after and continued to be an issue throughout the remainder of the growing season. In sharp contrast, wheat planted from central Kansas northward to Pacific Northwest was planted in a timely manner with early season condition reports ranging from fair in Colorado and Kansas to better than average in Montana. By late May areas of northern Colorado and Northern Kansas had started to receive timely moisture that proved to be beneficial to the crop while areas of the Northern Plains and Pacific Northwest were experiencing excessive moisture. By mid-July the northwestern production areas (Pacific Northwest) had excessive moisture give way to heat and high winds which stressed the crop.

Survey Methods

Sample collection and analysis were conducted by the USDA ARS Hard Red Winter Wheat Quality Lab, Manhattan, Kansas, American Institute of Baking, and Plains Grains, Inc. A total of 473 samples were collected from grain elevators when the local harvest was at least 30% complete in Texas, Oklahoma, Colorado, Kansas, Nebraska, South Dakota, Wyoming, North Dakota, Montana, Washington and Oregon. The area sampled represents approximately 80% of HRW production. Official grade and non-grade factors were determined on each individual sample and each resulting composite sample. Milling, dough functionality and bake tests were run on 101 composites based on 46 production areas and three protein ranges of <11.5%, 11.5% - 12.5%, and >12.5%. Results were then mathematically aggregated to represent Gulf-tributary, PNW-tributary, and Overall results. The analytical methods used are described in the Analysis Methods section of this booklet.

Wheat and Grade Data

Seventy-two percent of individual samples graded US #1 and ninety-seven percent graded US #2 or better. Average dockage is 0.5%, damaged kernels and shrunken & broken kernels and total defects are all below the five-year averages while foreign material is equal to the five-year average. Kernel characteristics, including test weight (above the five-year average), thousand kernel weight (above the five-year average) and kernel diameter(above the five-year average), are very good considering the adverse growing conditions the crop developed under (moisture stress (high and low) and heat stress in the PNW).

Growing conditions also favored protein accumulation in the grain. Protein content is 12.3% which is consistent with the five-year average and significantly higher than the 2010 crop of 11.8% protein. Forty percent of the crop is in excess of 12.5 % protein. While a majority of the protein was in southern half the US where precipitation was limited, northern areas exceeded the 2010 protein levels even with excessive precipitation. Moisture 10.8% is significantly lower than the five-year average of 11.2% and the falling number of 403 seconds indicates a sound crop.

Crop Production Review and Analysis

Flour and Baking Data

The Buhler laboratory mill flour yield of (70.4%), while below the 2010 overall average of 70.9%, is similar to the five-year average of 70.3%. Flour protein averages 10.5%, which is below the five-year average, but is significantly higher than 2010. Farinograph peak time of 5.0 minutes is similar to the five-year average and is significantly higher than the 2010 average. Farinograph stability significantly exceeds the five-year average by over 3 minutes at 14.7 minutes. Farinograph absorption is lower than the five-year average, but significantly higher than the 2010 average. The average W value is equal to the five-year average. Loaf volume averages 804 cc, comparable to the 2010 crop, but below the five-year average of 831 cc.

Summary

The 2011 HRW crop can be characterized as one with low dockage, very good kernel characteristics, in most cases exceeding the five-year average, has very good grain protein and is sound. It has good milling properties with flour extraction equal to the five-year average with similar to average flour protein content. Dough properties include very good stability with a peak time that equals the five-year average and a W value that compares to the five-year average.

A complete set of individual data, data broken out by protein level, tributary, histograms, charts and graphs was used to develop this analysis; that data set can be found at: **http://www.plainsgrains.org/pdfs/wheat_quality_survey_22_2134523057.XLS** or you can visit www.plainsgrains.org and select the "2011 Crop Analysis" link.

Hard Red Winter Wheat Production Charts

English Units

Hard Winter Wheat Production (1,000 bu.)

	2004	2005	2006	2007	2008	2009	2010	2011	Average
Colorado	45,900	52,800	39,900	94,000	57,000	98,000	105,750	78,000	71,419
Kansas	314,500	380,000	291,200	283,800	356,000	369,600	360,000	276,500	328,950
Montana	66,830	92,250	82,560	83,220	94,380	89,540	93,600	89,790	86,521
North Dakota	9,900	11,115	7,920	22,250	22,550	26,160	17,600	13,875	16,421
Nebraska	61,050	68,640	61,200	84,280	73,480	76,800	64,070	65,250	69,346
Oklahoma	164,500	128,000	81,600	98,000	166,500	77,000	120,900	70,400	113,363
Pacific NW	19,491	19,993	19,368	17,841	16,246	16,194	19,869	22,004	18,876
South Dakota	56,250	63,360	41,400	95,040	103,950	64,260	63,700	66,780	69,343
Texas	108,500	96,000	33,600	140,600	99,000	61,250	127,500	49,400	89,481
Wyoming	3,510	4,350	3,645	3,250	3,780	5,016	4,640	4,420	4,076
Regional Total	850,431	916,508	662,393	922,281	992,886	883,820	977,629	736,419	867,796

Hard Winter Wheat Harvested Acres (1,000 Acres)

	2004	2005	2006	2007	2008	2009	2010	2011	Average
Colorado	1,700	2,200	1,900	2,350	1,900	2,450	2,350	2,000	2,106
Kansas	8,500	9,500	9,100	8,600	8,900	8,800	8,000	7,900	8,663
Montana	1,630	2,050	1,920	2,190	2,420	2,420	1,950	2,190	2,096
North Dakota	225	285	180	445	550	545	320	375	366
Nebraska	1,650	1,760	1,700	1,960	1,670	1,600	1,490	1,450	1,660
Oklahoma	4,700	4,000	3,400	3,500	4,500	3,500	3,900	3,200	3,838
Pacific NW	293	283	299	294	258	276	289	293	286
South Dakota	1,250	1,440	1,150	1,980	1,890	1,530	1,300	1,590	1,516
Texas	3,500	3,000	1,400	3,800	3,300	2,450	3,750	1,900	2,888
Wyoming	145	135	135	125	135	132	145	130	135
Regional Total	23,593	24,653	21,184	25,244	25,523	23,703	23,494	21,028	23,553

Hard Winter Wheat Yield (bu/ac)

	2004	2005	2006	2007	2008	2009	2010	2011	Average
Colorado	27	24	21	40	30	40	45	39	33
Kansas	37	40	32	33	40	42	45	45	39
Montana	41	45	43	38	39	37	48	41	42
North Dakota	44	39	44	50	41	48	55	37	45
Nebraska	37	39	36	43	44	48	43	45	42
Oklahoma	35	32	24	28	37	22	31	22	29
Pacific NW	64	64	60	59	57	58	68	76	63
South Dakota	45	44	36	48	55	42	49	42	45
Texas	31	32	24	37	30	25	34	26	30
Wyoming	26	30	27	26	28	38	32	34	30
Regional Total	39	39	35	40	40	40	45	41	40

*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2011.*

Hard Red Winter Wheat Production Charts

Metric Units

Hard Winter Wheat Production (MMT)									
	2004	2005	2006	2007	2008	2009	2010	2011	Average
Colorado	1.25	1.44	1.09	2.56	1.55	2.67	2.88	2.12	1.94
Kansas	8.56	10.34	7.93	7.72	9.69	10.06	9.80	7.53	8.95
Montana	1.82	2.51	2.25	2.27	2.57	2.44	2.55	2.44	2.35
North Dakota	0.27	0.30	0.22	0.61	0.61	0.71	0.48	0.38	0.45
Nebraska	1.66	1.87	1.67	2.29	2.00	2.09	1.74	1.78	1.89
Oklahoma	4.48	3.48	2.22	2.67	4.53	2.10	3.29	1.92	3.09
Pacific NW	0.53	0.54	0.53	0.49	0.44	0.44	0.54	0.60	0.51
South Dakota	1.53	1.72	1.13	2.59	2.83	1.75	1.73	1.82	1.89
Texas	2.95	2.61	0.91	3.83	2.69	1.67	3.47	1.34	2.44
Wyoming	0.10	0.12	0.10	0.09	0.10	0.14	0.13	0.12	0.11
Regional Total	23.15	24.95	18.03	25.10	27.02	24.06	26.61	20.04	23.62

Hard Winter Wheat Harvested Acres (1,000 ha)									
	2004	2005	2006	2007	2008	2009	2010	2011	Average
Colorado	688	890	769	951	769	992	951	809	852
Kansas	3,440	3,845	3,683	3,480	3,602	3,561	3,238	3,197	3,506
Montana	660	830	777	886	979	979	789	886	848
North Dakota	91	115	73	180	223	221	130	152	148
Nebraska	668	712	688	793	676	648	603	587	672
Oklahoma	1,902	1,619	1,376	1,416	1,821	1,416	1,578	1,295	1,553
Pacific NW	119	115	121	119	104	112	117	119	116
South Dakota	506	583	465	801	765	619	526	643	614
Texas	1,416	1,214	567	1,538	1,335	992	1,518	769	1,169
Wyoming	59	55	55	51	55	53	59	53	55
Regional Total	9,548	9,977	8,573	10,216	10,329	9,592	9,508	8,510	9,532

Hard Winter Wheat Yield (tons/ha)									
	2004	2005	2006	2007	2008	2009	2010	2011	Average
Colorado	1.84	1.63	1.43	2.72	2.04	2.72	3.06	2.65	2.26
Kansas	2.52	2.72	2.18	2.24	2.72	2.86	3.06	3.06	2.67
Montana	2.79	3.06	2.92	2.58	2.65	2.52	3.26	2.79	2.82
North Dakota	2.99	2.65	2.99	3.40	2.79	3.26	3.74	2.52	3.04
Nebraska	2.52	2.65	2.45	2.92	2.99	3.26	2.92	3.06	2.85
Oklahoma	2.38	2.18	1.63	1.90	2.52	1.50	2.11	1.50	1.96
Pacific NW	4.35	4.35	4.08	4.01	3.88	3.94	4.62	5.17	4.30
South Dakota	3.06	2.99	2.45	3.26	3.74	2.86	3.33	2.86	3.07
Texas	2.11	2.18	1.63	2.52	2.04	1.70	2.31	1.77	2.03
Wyoming	1.77	2.04	1.84	1.77	1.90	2.58	2.18	2.31	2.05
Regional Total	26.32	26.45	23.60	27.34	27.27	27.20	30.60	27.68	27.06

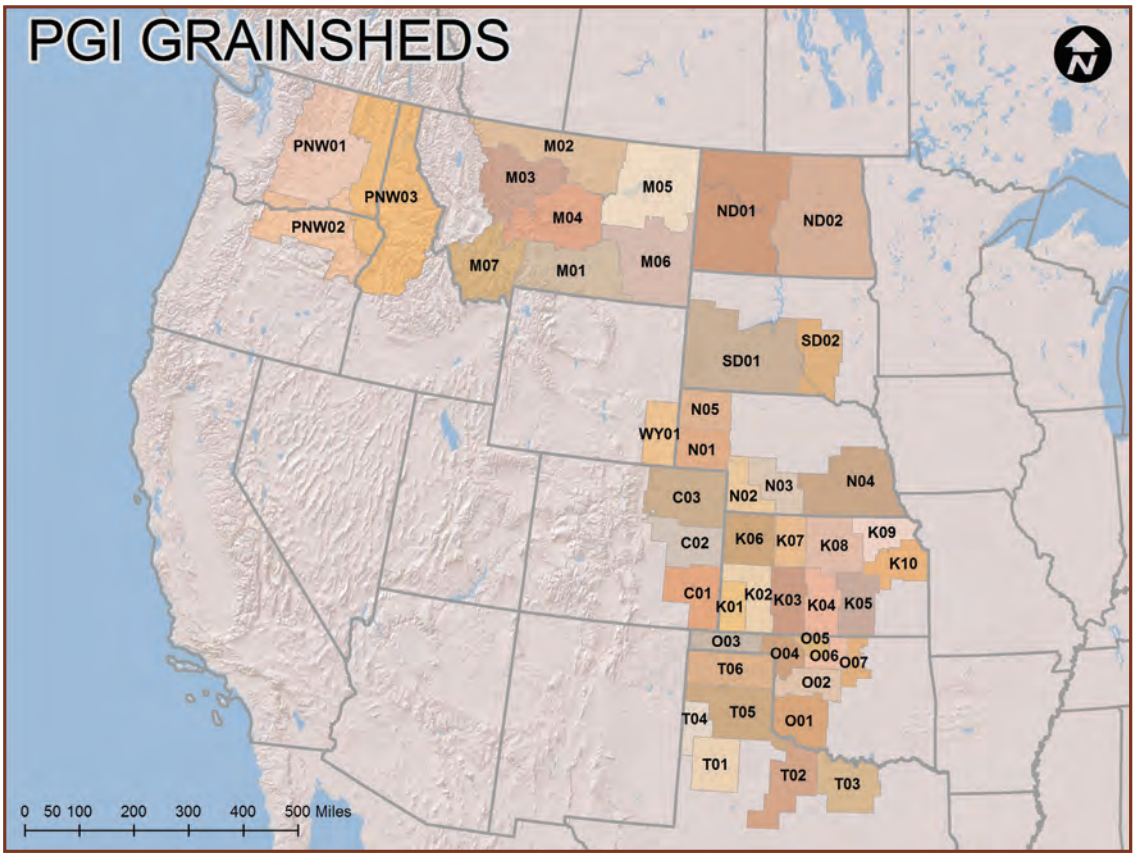
*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2010.*

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 Topeka, Kan.



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
Foregin 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
Unkown Foregin 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 obkectionable foregin odor (except smut or garlic); or

(c) Is heating or of distinctly low quality.

*Includes damaged kernels (total), foregin materials, and shurken 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 forgin 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.

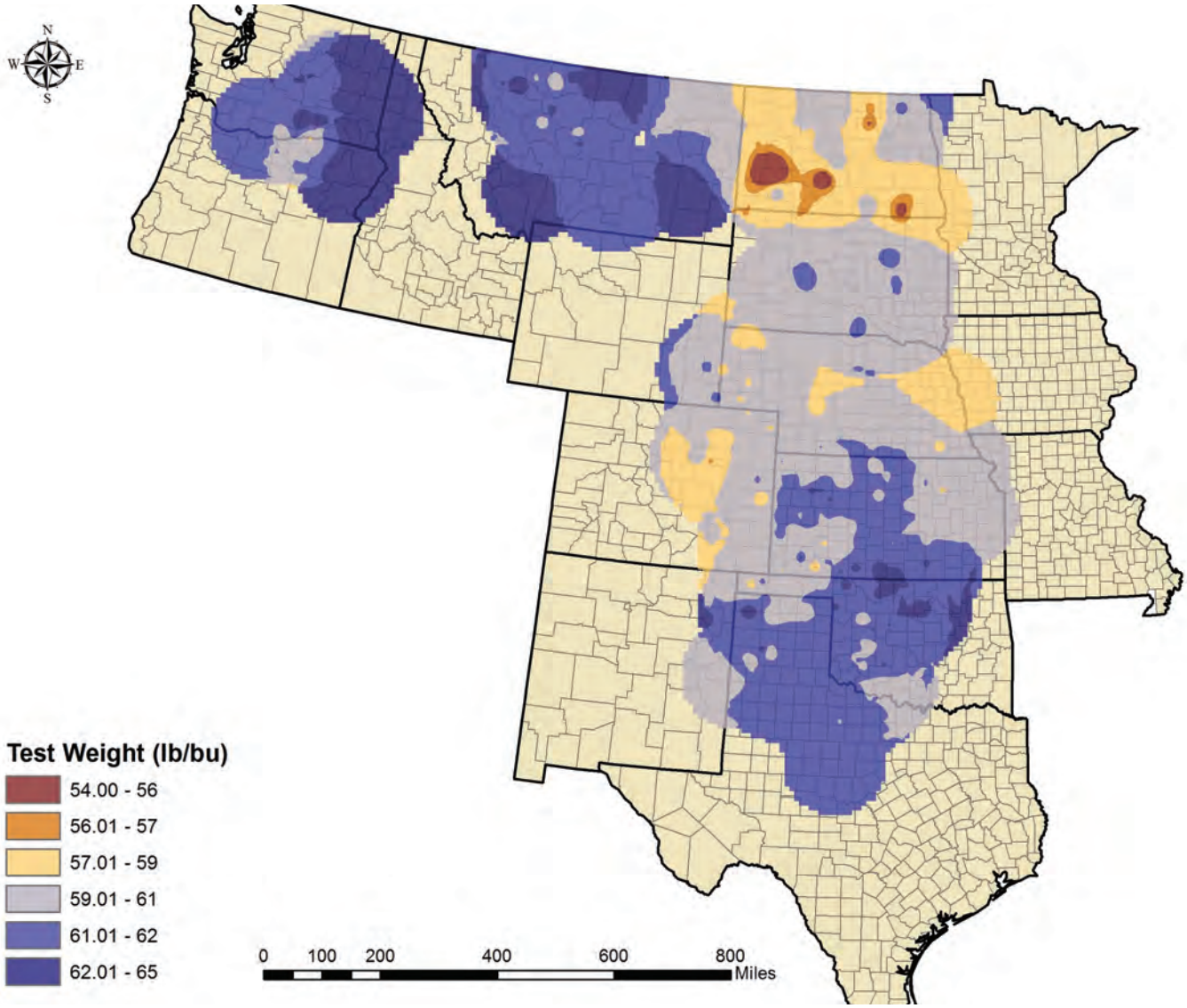
Foreign material is all matter other than wheat that remains in the sample after the removal of dockage and shrunken and broken kernels.

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.

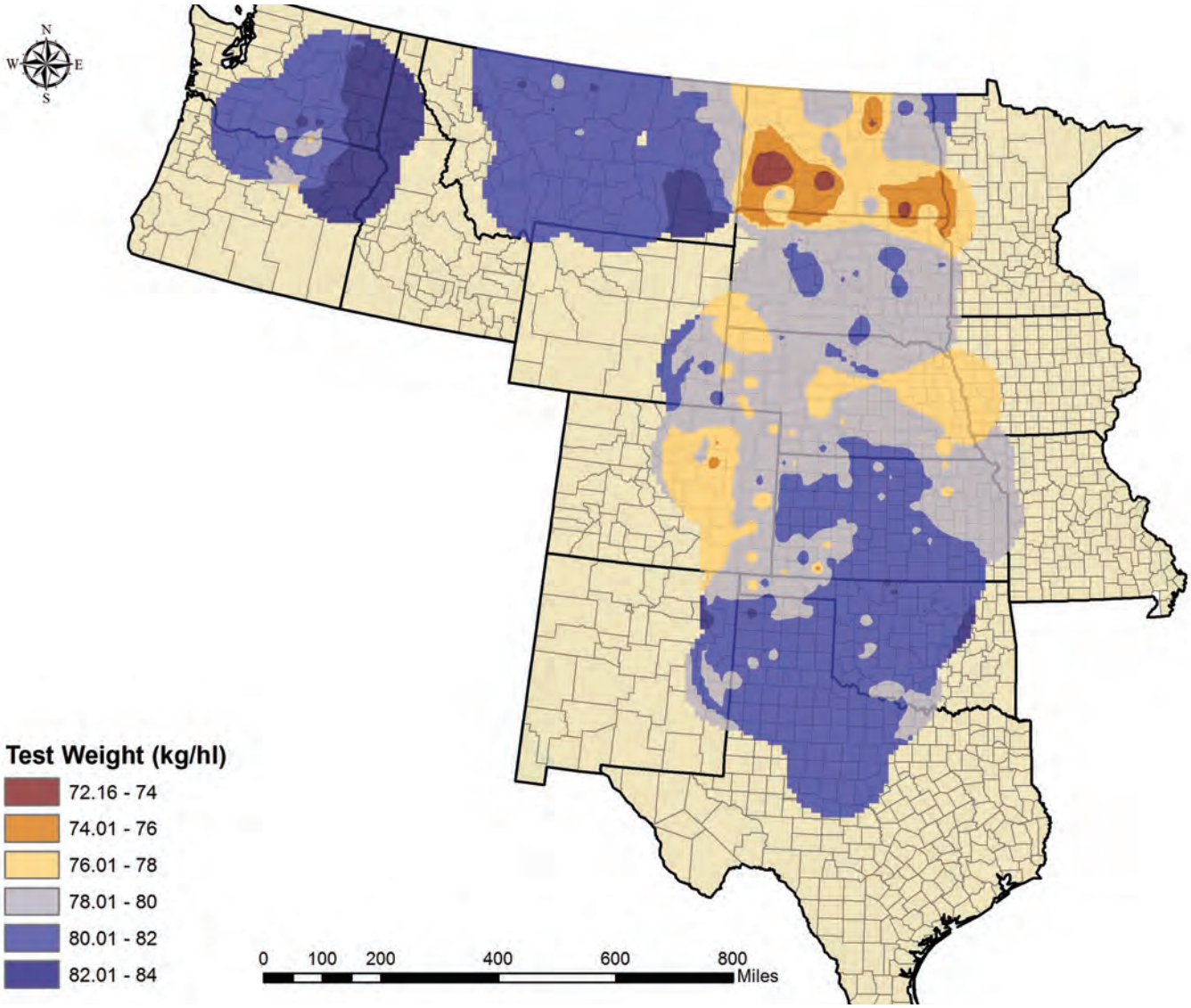
Damaged kernels are kernels, pieces of wheat kernels, and other grains that are badly ground-damaged, badly weatherdamaged, diseased, frost-damaged, germdamaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged.

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)	Damage Kernels Total (%)	Shrunken & Broken Kernels (%)	Total Defects (%)
Colorado	C01	2	58.8	77.4	0.2	1.2	1.5
	C02	2	59.6	78.4	0.2	1.3	1.8
	C03	2	59.2	77.8	0.3	1.3	2.0
Kansas	K01	1	60.3	79.4	0.2	1.0	1.3
	K02	1	60.5	79.6	0.1	0.9	1.4
	K03	1	61.3	80.6	0.2	1.0	1.4
	K04	1	61.4	80.8	0.2	0.9	1.2
	K05	1	61.3	80.6	0.1	0.9	1.0
	K06	1	60.8	80.0	0.2	0.9	1.2
	K07	1	61.5	80.8	0.1	0.9	1.1
	K08	1	61.0	80.2	0.2	0.8	1.2
	K09	1	60.9	80.0	0.4	0.8	1.3
	K10	2	59.5	78.3	0.4	0.8	1.4
Montana	M1	1	61.3	80.6	0.0	1.3	1.4
	M2	1	61.7	81.1	0.1	1.9	2.1
	M3	1	61.5	80.9	0.1	2.4	2.6
	M4	1	61.5	80.9	0.0	2.4	2.6
	M5	1	60.8	80.0	0.2	1.0	1.3
	M6	3	63.1	82.9	0.0	2.4	3.3
	M7	1	62.2	81.8	0.0	1.3	1.3
Nebraska	N01	1	60.4	79.4	0.3	1.1	1.8
	N02	2	59.9	78.9	0.2	0.9	1.2
	N03	1	60.6	79.7	0.3	0.9	1.5
	N04	2	59.6	78.4	0.3	1.0	1.4
	N05	1	61.0	80.2	0.3	1.2	1.9
North Dakota	ND01	2	58.5	77.0	0.6	1.4	2.2
	ND02	2	58.4	76.9	0.7	1.0	1.9
Oklahoma	O01	1	61.1	80.3	0.2	1.4	1.7
	O02	1	61.2	80.5	0.1	1.7	2.2
	O03	1	60.0	78.9	0.2	1.3	1.7
	O04	1	62.0	81.5	0.2	1.8	2.1
	O05	1	62.2	81.7	0.0	1.7	1.9
	O06	1	61.9	81.4	0.1	1.7	2.0
	O07	1	62.4	82.1	0.1	1.2	1.5
Pacific Northwest	PNW01	1	62.2	81.8	0.1	0.9	1.1
	PNW02	1	61.9	81.4	0.2	0.7	0.9
	PNW03	1	63.8	83.8	0.1	0.7	0.9
South Dakota	SD01	2	59.2	78.0	0.8	1.3	2.3
	SD02	1	60.0	78.9	1.0	1.2	2.4
Texas	T01	1	61.7	81.1	0.1	1.5	1.8
	T02	1	61.5	80.9	0.1	1.2	1.4
	T03	1	61.1	80.4	0.1	0.9	1.1
	T04	1	61.0	80.2	0.1	1.7	1.9
	T05	1	61.4	80.7	0.1	1.6	1.9
	T06	1	61.3	80.6	0.1	1.4	1.6
Wyoming	W01	1	61.4	80.7	0.3	1.2	1.8

Kernel Quality Data

Location		Foreign Material (%)	Kernal Size Large (%)	Kernal Size Med (%)	Kernal Size Small (%)	SKCS Wt (mg)	SKCS Diam (mm)
Colorado	C01	0.1	56	43	1	30.3	2.6
	C02	0.3	62	36	1	31.1	2.6
	C03	0.4	58	40	2	30.1	2.6
Kansas	K01	0.1	45	54	1	29.4	2.5
	K02	0.4	44	55	1	28.9	2.5
	K03	0.2	46	53	1	29.4	2.6
	K04	0.1	50	49	1	30.0	2.6
	K05	0.1	55	44	1	30.8	2.6
	K06	0.1	68	31	1	32.5	2.7
	K07	0.1	63	37	1	31.7	2.7
	K08	0.2	64	35	1	31.4	2.7
	K09	0.2	64	35	1	31.1	2.7
	K10	0.2	71	28	1	31.4	2.7
Montana	M1	0.1	66	32	2	32.8	2.7
	M2	0.1	49	49	3	29.3	2.5
	M3	0.1	38	58	4	26.9	2.5
	M4	0.2	52	45	3	30.5	2.6
	M5	0.1	59	40	1	30.2	2.6
	M6	0.9	58	40	3	28.8	2.6
	M7	0.0	48	50	1	28.6	2.5
Nebraska	N01	0.4	63	36	1	31.2	2.6
	N02	0.1	68	31	1	31.4	2.7
	N03	0.2	73	26	1	32.9	2.7
	N04	0.2	69	30	1	31.2	2.7
	N05	0.3	63	36	1	31.1	2.6
North Dakota	ND01	0.2	60	38	2	29.6	2.6
	ND02	0.1	55	43	2	28.5	2.5
Oklahoma	O01	0.1	38	59	2	27.0	2.5
	O02	0.4	32	65	3	26.4	2.5
	O03	0.2	41	57	2	29.1	2.5
	O04	0.1	37	61	2	28.8	2.6
	O05	0.2	36	61	2	28.9	2.6
	O06	0.2	29	68	3	26.6	2.5
	O07	0.1	43	55	2	28.5	2.6
Pacific Northwest	PNW01	0.1	72	27	1	35.3	2.8
	PNW02	0.1	81	19	0	37.9	2.8
	PNW03	0.1	81	18	1	37.3	2.8
South Dakota	SD01	0.2	59	39	2	30.3	2.6
	SD02	0.3	61	37	1	30.2	2.6
Texas	T01	0.2	39	58	2	28.5	2.5
	T02	0.1	42	56	2	28.6	2.6
	T03	0.1	51	48	1	30.6	2.6
	T04	0.2	36	62	2	28.1	2.5
	T05	0.2	34	64	2	28.0	2.5
	T06	0.2	44	54	2	29.3	2.6
Wyoming	W01	0.3	53	46	1	30.0	2.6

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 allpurpose 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.

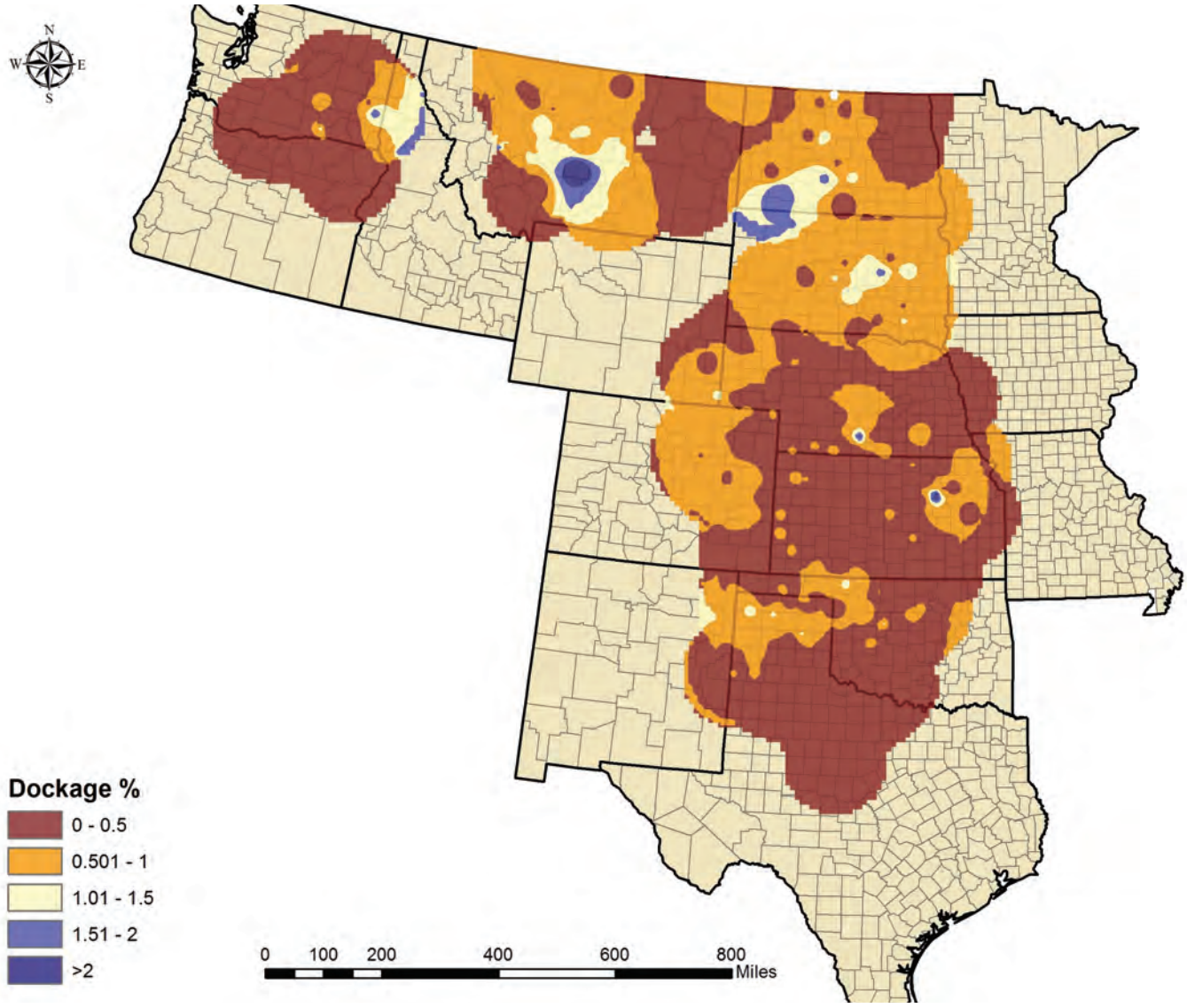
Falling number is an index of enzyme activity in wheat or flour and is expressed in seconds. Falling numbers above 300 are desirable, as they indicate little enzyme activity and a sound quality product. Falling numbers below 300 are indicative of more substantial enzyme activity and sprout damage.

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.

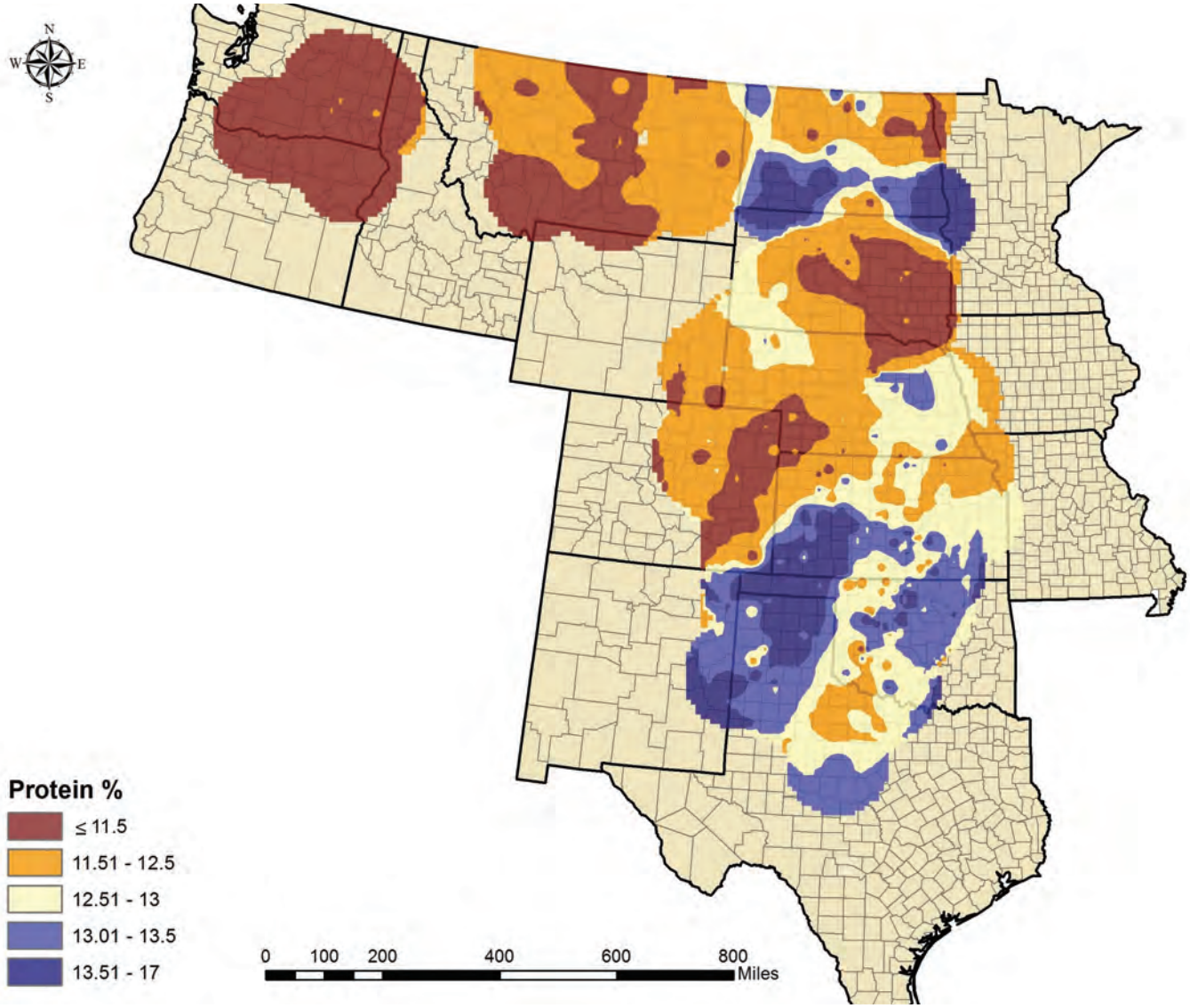
Kernel Size is a measure of the percentage by weight of large, medium and small kernels in a sample. Large kernels or more uniform kernel size may help improve milling yield.

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.

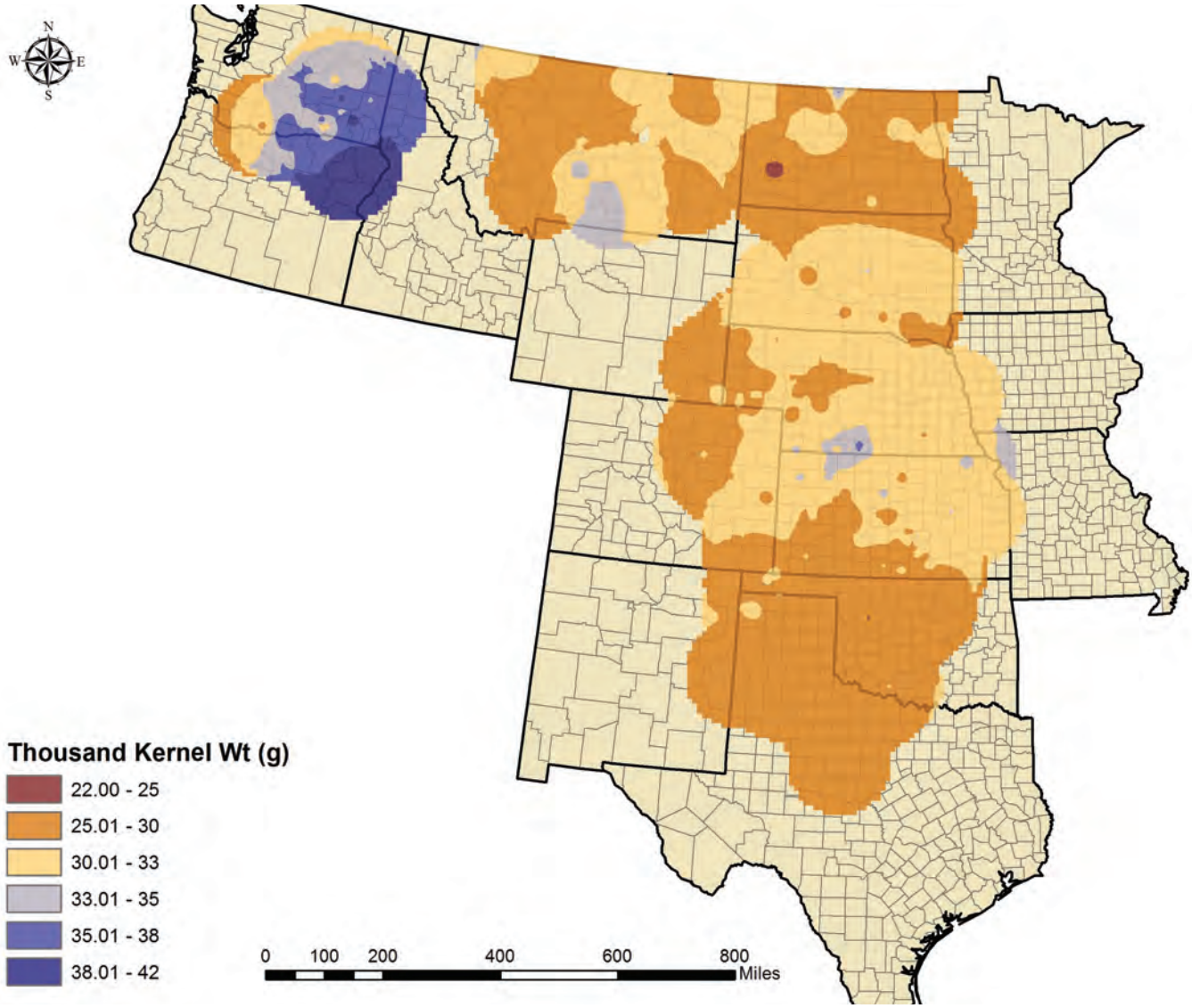
Dockage (%)


N
W
E
S
Dockage %
0 - 0.5
0.501 - 1
1.01 - 1.5
1.51 - 2
>2
0
100
200
400
600
800
Miles

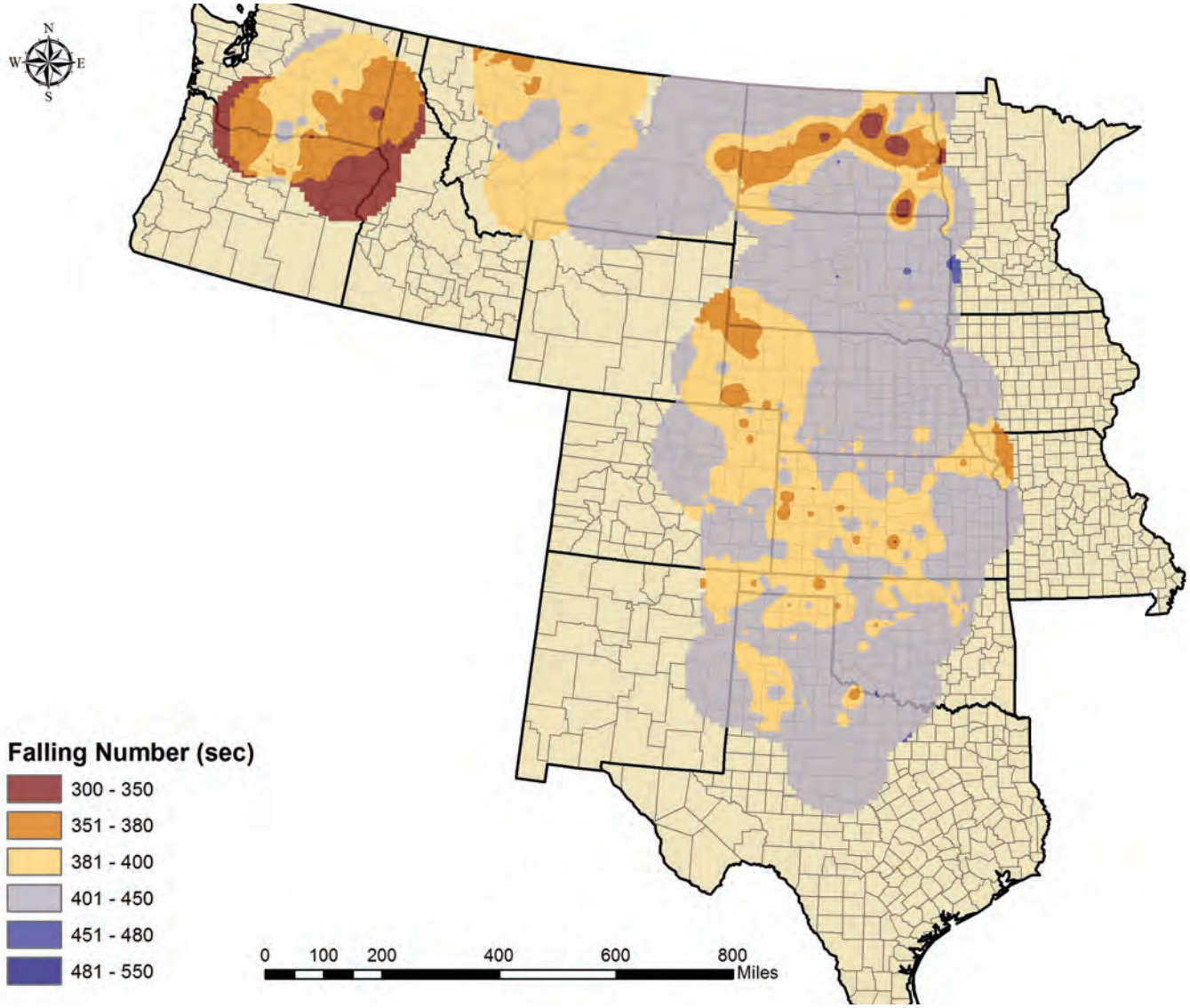
Protein (%)


N
W
E
S
Protein %
≤ 11.5
11.51 - 12.5
12.51 - 13
13.01 - 13.5
13.51 - 17
0
100
200
400
600
800
Miles

Thousand Kernel Weight (g)



Falling Number (seconds)



Other Wheat Characteristics *(Non-Grade Data)*

Location		NIR Wheat Protein (12% mb)	Wheat Ash (12% mb)	Falling Number (sec)	Moisture (%)	SKCS Ave Hard
Colorado	C01	11.4	1.6	407	10.9	61
	C02	11.0	1.5	403	10.3	60
	C03	11.4	1.5	404	10.4	57
Kansas	K01	14.1	1.6	395	10.2	76
	K02	13.9	1.6	390	10.7	78
	K03	13.4	1.4	405	10.8	78
	K04	13.3	1.5	395	10.5	73
	K05	13.0	1.5	398	10.4	68
	K06	12.0	1.5	393	11.0	66
	K07	12.4	1.6	394	9.9	65
	K08	12.7	1.6	399	11.1	65
	K09	12.6	1.6	410	11.1	63
	K10	12.5	1.6	405	11.9	60
Montana	M1	11.2	1.5	437	11.7	66
	M2	11.6	1.4	380	11.0	75
	M3	12.3	1.4	397	9.6	78
	M4	11.5	1.6	405	10.6	70
	M5	11.6	1.5	402	11.8	59
	M6	11.8	1.65	448	10.8	66
	M7	10.7	1.32	383	10.7	73
Nebraska	N01	11.0	1.6	383	10.7	62
	N02	11.2	1.6	403	10.2	56
	N03	11.8	1.6	406	11.3	59
	N04	12.6	1.7	410	11.8	57
	N05	11.0	1.6	392	10.9	62
North Dakota	ND01	12.4	1.6	396	12.1	55
	ND02	13.1	1.7	395	12.5	57
Oklahoma	O01	13.0	1.5	422	11.3	81
	O02	13.4	1.5	403	11.4	85
	O03	14.6	1.5	392	10.5	77
	O04	13.1	1.4	376	9.1	84
	O05	12.5	1.5	403	10.1	85
	O06	13.6	1.5	396	9.8	84
	O07	12.7	1.6	396	10.0	87
Pacific Northwest	PNW01	11.5	1.3	382	9.3	77
	PNW02	11.5	1.3	361	9.5	74
	PNW03	10.4	1.4	367	9.6	72
South Dakota	SD01	12.3	1.7	432	11.2	63
	SD02	12.5	1.7	419	11.7	64
Texas	T01	14.1	1.6	392	8.6	81
	T02	12.8	1.5	407	11.0	80
	T03	13.3	1.6	408	12.2	68
	T04	14.2	1.6	401	8.3	81
	T05	14.1	1.5	406	9.4	83
	T06	14.0	1.6	398	9.1	80
Wyoming	W01	11.0	1.5	382	11.1	72

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	68.4	40.7	9.8	0.46	97.3	92.75	-2.74	9.95
	C02	69.6	47.8	9.7	0.43	97.4	92.63	-2.86	10.10
	C03	69.6	54.8	10.0	0.44	98.3	92.69	-2.74	10.25
Kansas	K01	69.5	63.5	12.8	0.47	90.6	92.13	-2.28	10.91
	K02	69.8	65.5	12.4	0.45	92.4	92.06	-2.12	10.42
	K03	70.0	64.0	12.2	0.41	89.7	92.18	-2.31	10.98
	K04	69.9	63.3	11.8	0.42	92.2	92.40	-2.27	10.39
	K05	69.7	65.2	11.4	0.44	96.7	92.57	-2.23	9.75
	K06	70.4	59.2	10.7	0.43	96.8	92.73	-2.62	10.14
	K07	69.3	61.6	10.9	0.46	92.6	92.46	-2.54	9.88
	K08	70.3	56.7	11.3	0.48	93.8	92.33	-2.60	10.16
	K09	69.9	54.0	11.1	0.46	95.0	92.37	-2.71	10.46
	K10	71.3	53.7	11.0	0.43	91.7	92.19	-2.69	10.03
Montana	M1	72.2	51.5	9.9	0.38	97.2	92.87	-2.81	10.40
	M2	71.0	62.0	10.2	0.40	97.6	92.87	-2.97	11.12
	M3	70.0	65.1	10.0	0.41	97.7	92.75	-2.78	10.81
	M4	71.7	66.1	10.9	0.39	97.7	93.06	-2.98	11.07
	M5	71.8	56.3	9.9	0.40	96.1	92.96	-2.88	10.59
	M6	70.7	54.5	9.1	0.35	97.6	93.19	-3.07	11.08
	M7	69.8	51.8	10.0	0.40	97.7	92.96	-2.93	10.76
Nebraska	N01	70.6	47.1	9.6	0.41	97.2	92.91	-2.79	10.68
	N02	70.9	47.9	10.1	0.42	98.9	92.68	-2.82	10.16
	N03	71.2	48.8	11.0	0.44	97.3	92.48	-2.66	9.80
	N04	70.6	54.3	11.0	0.44	97.0	92.52	-2.67	9.95
	N05	71.6	44.9	9.7	0.43	96.5	92.70	-2.73	10.68
North Dakota	ND01	71.7	66.2	10.7	0.40	96.9	92.64	-2.84	10.72
	ND02	69.8	66.1	11.3	0.45	97.5	92.53	-2.63	9.97
Oklahoma	O01	71.6	56.9	11.6	0.50	99.1	91.89	-1.72	10.69
	O02	70.1	65.2	11.9	0.49	98.5	91.88	-1.84	10.80
	O03	70.3	61.4	13.1	0.46	75.6	92.17	-2.33	11.23
	O04	71.0	52.1	11.6	0.47	96.6	91.88	-1.77	10.74
	O05	69.1	59.5	11.1	0.44	96.9	92.17	-1.80	10.70
	O06	69.1	67.9	12.1	0.42	93.4	91.99	-1.79	10.72
	O07	69.9	62.3	11.2	0.44	99.0	92.01	-1.77	10.61
Pacific Northwest	PNW01	72.0	57.3	11.8	0.37	95.8	92.89	-2.93	12.37
	PNW02	72.9	48.3	9.9	0.42	90.5	92.76	-2.59	11.16
	PNW03	72.0	49.3	8.8	0.40	98.4	92.89	-2.39	10.00
South Dakota	SD01	71.3	54.0	11.0	0.44	98.3	92.56	-2.58	10.22
	SD02	72.0	50.3	11.2	0.44	96.2	92.42	-2.61	10.78
Texas	T01	69.4	59.8	12.8	0.45	87.5	91.98	-1.77	10.73
	T02	70.7	52.5	11.5	0.49	98.3	92.01	-1.57	10.31
	T03	68.7	60.7	12.4	0.48	87.8	92.32	-1.89	11.02
	T04	69.8	63.9	11.7	0.45	96.1	92.38	-1.81	9.79
	T05	67.3	64.9	12.5	0.45	91.2	92.06	-2.32	11.29
	T06	69.4	61.1	12.5	0.43	85.3	92.34	-2.36	11.03
Wyoming	W01	70.7	54.9	9.8	0.41	97.7	92.70	-2.86	11.05

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" elates 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)	Devlopmt Time (min)	Stability (min)	MTI (BU)
Colorado	C01	62	100	194	0.6	55.5	2.5	11.0	19
	C02	76	96	245	0.8	55.3	5.5	14.0	26
	C03	75	95	254	0.8	55.9	2.2	15.5	14
Kansas	K01	74	82	218	0.9	60.5	8.4	15.7	20
	K02	81	91	264	0.9	59.4	7.3	17.8	11
	K03	89	92	289	1.0	59.2	8.3	18.6	16
	K04	73	85	231	0.9	57.3	8.7	18.2	10
	K05	66	113	262	0.6	56.1	4.8	16.4	22
	K06	76	87	238	0.9	57.6	6.8	18.1	24
	K07	72	95	250	0.8	56.4	5.9	18.2	22
	K08	55	117	219	0.5	56.8	5.8	13.7	25
	K09	62	119	249	0.5	56.2	4.0	14.5	23
	K10	67	110	253	0.6	56.3	3.4	12.1	25
Montana	M1	81	87	268	0.9	57.5	3.0	14.5	13
	M2	68	107	262	0.6	56.1	5.5	13.2	31
	M3	77	83	247	0.9	57.2	3.0	10.8	23
	M4	81	106	312	0.8	57.2	6.7	14.9	27
	M5	63	123	264	0.5	54.7	4.0	11.4	28
	M6	80	75	243	1.1	55.8	2.7	15.6	21
	M7	85	87	282	1.0	56.9	3.0	11.6	20
Nebraska	N01	66	99	214	0.7	55.4	5.3	14.5	25
	N02	69	90	220	0.8	55.3	2.7	11.0	20
	N03	64	109	234	0.6	56.1	4.0	11.1	31
	N04	63	108	244	0.6	55.9	4.0	14.3	17
	N05	72	88	214	0.8	56.4	4.9	11.5	31
North Dakota	ND01	51	115	202	0.4	54.5	3.4	11.3	29
	ND02	56	123	247	0.5	55.4	4.7	12.8	32
Oklahoma	O01	94	82	274	1.2	60.8	5.3	12.9	30
	O02	89	92	288	1.0	60.1	5.4	14.1	24
	O03	83	74	225	1.1	61.1	8.4	17.7	19
	O04	95	77	259	1.2	60.6	5.5	11.3	25
	O05	105	90	334	1.2	61.1	4.4	12.0	29
	O06	89	112	345	0.8	61.0	4.8	14.0	30
	O07	95	86	297	1.1	59.9	5.5	12.5	35
Pacific Northwest	PNW01	81	103	279	0.8	59.7	5.2	10.2	32
	PNW02	86	93	268	0.9	58.6	5.2	9.0	36
	PNW03	96	67	244	1.4	60.0	2.0	7.5	38
South Dakota	SD01	65	99	231	0.7	56.2	5.7	15.9	23
	SD02	61	98	214	0.6	55.8	4.8	12.6	29
Texas	T01	86	61	205	1.4	62.1	7.1	16.8	12
	T02	85	77	236	1.1	61.4	4.9	13.5	22
	T03	93	65	216	1.4	62.2	7.8	16.0	16
	T04	80	90	264	0.9	58.2	6.4	20.0	13
	T05	92	80	262	1.2	61.7	8.2	17.8	10
	T06	90	83	262	1.1	60.8	8.5	17.6	18
Wyoming	W01	85	97	286	0.9	57.6	7.2	16.6	23

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	4.1	59.5	695	4.0	5.5	Dull
	C02	4.8	59.3	715	3.8	5.5	Dull
	C03	5.8	58.3	765	5.5	5.5	Dull
Kansas	K01	3.3	61.5	890	6.3	7.0	Dull
	K02	3.8	62.4	925	7.0	7.0	Dull
	K03	3.8	62.9	825	4.8	7.0	Slightly Yellow
	K04	4.5	62.6	865	5.5	7.0	Slightly Yellow
	K05	5.1	62.0	855	7.8	7.0	Creamy
	K06	4.8	62.2	840	6.8	7.0	Creamy
	K07	4.8	61.1	810	4.8	5.5	Dull
	K08	4.4	61.1	820	4.8	5.5	Creamy
	K09	4.8	60.9	825	6.3	7.0	Dull
	K10	5.9	61.1	810	5.5	5.5	Dull
Montana	M1	6.6	60.7	760	3.3	5.5	Dull
	M2	5.8	60.1	790	4.0	5.5	Dull
	M3	7.4	61.4	750	4.8	7.0	Dull
	M4	5.5	61.3	900	5.5	7.0	Creamy
	M5	6.0	59.5	775	3.3	7.0	Creamy
	M6	7.5	59.6	780	6.3	7.0	Creamy
	M7	5.0	60.1	790	4.8	7.0	Creamy
Nebraska	N01	5.0	58.9	715	4.8	5.5	Slightly Yellow
	N02	5.0	60.5	680	3.8	5.5	Dull
	N03	4.1	59.4	690	2.5	5.5	Dull
	N04	4.5	61.3	765	4.8	5.5	Dull
	N05	4.4	58.6	735	4.8	5.5	Dull
North Dakota	ND01	6.0	60.6	850	6.3	7.0	Dull
	ND02	6.4	61.3	860	7.0	7.0	Creamy
Oklahoma	O01	4.6	64.7	870	4.8	7.0	Dull
	O02	5.5	63.5	875	4.0	7.0	Dull
	O03	3.5	61.2	905	4.8	7.0	Slightly Yellow
	O04	3.5	63.0	875	3.3	7.0	Dull
	O05	4.9	63.9	810	4.8	7.0	Dull
	O06	4.8	63.8	885	4.0	7.0	Dull
	O07	6.0	63.6	810	5.5	7.0	Dull
Pacific Northwest	PNW01	4.0	60.6	770	3.3	7.0	yellow
	PNW02	4.5	60.3	775	4.0	7.0	Dull
	PNW03	6.5	60.2	735	5.5	7.0	Creamy
South Dakota	SD01	5.0	61.6	800	4.0	7.0	Dull
	SD02	4.8	61.3	750	4.0	5.5	Dull
Texas	T01	3.6	62.4	900	5.5	7.0	Dull
	T02	4.5	62.7	895	5.5	7.0	Dull
	T03	2.9	62.3	910	3.3	7.0	Dull
	T04	4.8	61.2	920	6.3	7.0	Creamy
	T05	3.8	62.6	930	5.5	7.0	Dull
	T06	3.5	62.1	945	5.5	7.0	Slightly Yellow
Wyoming	W01	5.0	60.5	845	5.5	7.0	Slightly Yellow

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 38-12Farinograph: 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.