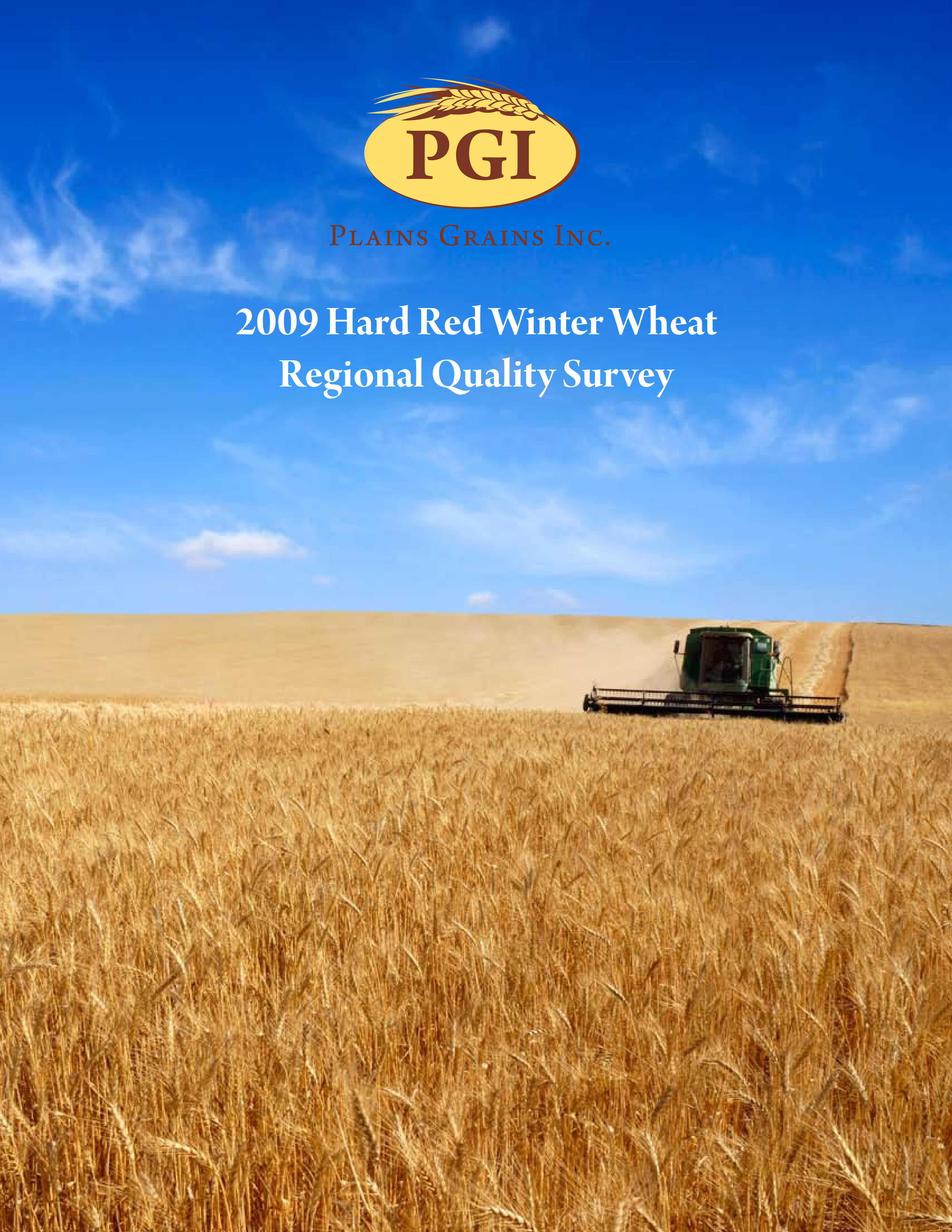
Plains Grains Inc.

2009 Hard Red Winter Wheat Regional Quality Survey



PGI

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Colorado Wheat Administrative Committee
www.coloradowheat.org

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

Kansas Wheat Commission
www.kswheat.com

South Dakota Wheat Commission
www.sdwheat.org

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

Texas Wheat Producers Board and Association
www.texaswheat.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.

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 and Wyoming.

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 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.

Crop Production Review and Analysis

Weather and Harvest

Planting conditions for the 2009 HRW crop were variable across the region with generally drier conditions prevailing in the southern areas (Texas and Oklahoma) and near normal moisture conditions at planting from Kansas and Colorado northward to Montana. Planting was finished in most areas during the average date range determined for maximum grain production. Plant emergence and development was slow in the southern parts of the region, again due to dry conditions, but were near normal in the remainder of the production area. The extremely dry conditions in Texas and Oklahoma persisted into the spring when an area from south central Kansas, through Oklahoma and into Texas suffered a late freeze in April. The freeze event had varying degrees of damage to the crop depending on multiple factors including stage of crop development, condition of crop (stress due to drought), fertility level, planting date and variety planted. Drought stricken southern areas did begin receiving moisture in May which was too late to make a significant difference in production as compared to average. The late season moisture did increase weed pressure and delayed many areas from beginning harvest on time. By late May, into June, a high pressure system had formed over Oklahoma and began pushing weather systems into eastern Colorado, western Kansas, eastern Wyoming and across southern Nebraska. The overall result to these areas was a delay in harvest that was significantly behind the 5-year average caused by cool wet weather. With the exception of a few localized areas (Texas Panhandle) there was very little disease or insect damage to report with this crop.

Samples and Methods

Sample collection and analysis were conducted in a collaborative effort between USDA ARS Hard Red 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. 468 samples were collected from grain elevators when at least 30% of the local harvest was completed in 8 states from Texas to Montana. Official grade and non-grade parameters were determined on each sample. 108 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 test were run on each of the composites. Results by protein ranges were then segregated by export region and reported by tributary and overall. Sampling is targeted at testing over 80% of the Hard Red Winter Wheat production in the 8 states of Texas, Oklahoma, Colorado, Kansas, Nebraska, South Dakota, Wyoming and Montana. 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 2009 HRW official grade averaged 66% Grade #1 (Gulf tributary averaging 64% and PNW tributary averaging 90%) when considering all protein levels. This was a very clean crop with the average dockage levels of 0.5% being well below last year's average of 0.6% (and the 5-year average) of 0.7%. Total defects of 1.4% are also below the 5-year average of 1.7% and last year's average. Foreign material, shrunken & broken and wheat ash levels are consistent with the 5-year average. Kernel characteristics of this crop are very good including test weight, thousand kernel weight and kennel diameter. This is consistent with the weather conditions that prevailed during the maturity phase of the crop, adequate moisture, cool temperatures and little stress. Test weight was above the 5-year average at over 60 lbs/ bu. (79 kg/hl) and comparable with the 2008 crop. Thousand kernel weight was significantly above the 2008 crop and 5-year average of 28.9g, averaging 31.2g. Kernel diameter was

Crop Production Review and Analysis

also significantly above the 2008 crop and the 5-year average of 2.24mm, averaging over 2.65mm. The kernel characteristics are uniform across the production region, but more pronounced in PNW region and less pronounced in the southern part of the testing area. The crop protein averaged more than a half a percent below the 5-year average across the testing area, this is a major issue with the 2009 HRW crop, quantity of protein. Protein level percentage splits were consistent across the testing region and tributaries with approximately 35% of samples being in the < 11.5% protein category, 45% in the 11.5% – 12.5% category and 20% in the < 12.5% category. Average falling number for this crop was 406 seconds, comparable to the 5-year average and indicative of sound wheat.

Flour and Baking Data

The Buhler flour yield overall averaged 1.4% (71.0%) above the 5-year average extraction of 69.6%, with the PNW averaging 2.6% (72.2%) above the 5-year average extraction. Flour ash percentages and flour color results support proper setting of the mill. The extraction rate is consistent with the reported outstanding kernel characteristics above (thousand kernel weight, test weight and kernel diameter). Protein loss during flour conversion is averaging 1.4% (when wheat is converted to 14% mb). Flour protein contents averaged 10.5%, with 60% of the samples falling below that value. This is likely due to the slightly elevated loss of protein in the wheat conversion to flour. Gluten index values averaged 97.4, although the southern part of the sampling area tended to have the greater bulk of samples that were lower. "Gluten strength" (considering alveograph, extensograph and farinograph data combined) is good, but several individual composite samples had farinograph development times that were unacceptable (short mix times). The W value, 229 (10-4 J) is well below the 2008 crop 240 (10-4 J) and significantly below the 5-year average of 273 (10-4 J). The major concern with the quality of the crop is water absorption (WA) for farinograph which was 56.9%, compared to 60% in 2008 and a 5-year average of 58.7%. Farinograph development time and stability, 5.3 minutes and 13.1 minutes respectively, are better than the 2008 average and the stability time is better than the 5-year average. In contrast are the loaf volumes, as a whole, averaged just over 800 cc., this is comparable to the 2008 crop, but significantly lower than the 5-year average of 442cc. Wheat protein had to exceed 12.5% before a significant number of samples exceed 850 cc. This crop is not one of protein quality, but rather one of protein quantity.

Summary

This year's crop can quite simply be characterized as one in which we saw above average kernel sizes and weights (a high extraction crop) and undesirable protein content (volume).

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/ALL%20DATA%20SUMMARY%202009.xls**, or you can visit www.plainsgrains.org and select the "2009 Crop Analysis" link.

Hard Red Winter Wheat Production Charts

English Units

Hard Winter Wheat Production (1,000 bu.)

	2002	2003	2004	2005	2006	2007	2008	2009	Average
Colorado	36,300	77,000	45,900	52,800	39,900	87,750	55,900	98,000	61,694
Kansas	270,600	480,000	314,500	380,000	291,200	288,000	356,000	369,600	343,738
Montana	21,840	67,340	66,830	94,500	82,560	83,220	94,380	89,540	75,026
Nebraska	50,160	83,720	61,050	68,640	61,200	86,000	73,500	76,800	70,134
Oklahoma	103,600	179,400	164,500	128,000	81,600	116,100	166,500	77,000	127,088
South Dakota	20,100	61,940	56,250	65,560	41,400	81,000	104,000	64,260	61,814
Texas	78,300	96,600	108,500	96,000	33,600	144,000	99,000	61,250	89,656
Wyoming	2,375	3,915	3,510	4,350	N/A	N/A	4,286	5,016	3,909
Regional Total	583,275	1,049,915	821,040	889,850	631,460	886,070	953,566	841,466	833,057

*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2009.*

Hard Winter Wheat Harvested Acres (1,000 Acres)

	2002	2003	2004	2005	2006	2007	2008	2009	Average
Colorado	1650	2200	1700	2200	1900	2250	1936	2450	2036
Kansas	8200	10000	8500	9500	9100	9000	8900	8800	9000
Montana	780	1820	1630	2100	1920	2190	2420	2420	1910
Nebraska	1520	1820	1650	1760	1700	2000	1670	1600	1715
Oklahoma	3700	4600	4700	4000	3400	4300	4500	3500	4088
South Dakota	670	1430	1250	1490	1150	1800	3420	1530	1593
Texas	2700	3450	3500	3000	1400	4000	3300	2450	2975
Wyoming	125	145	135	145	N/A	N/A	146	132	138
Regional Total	19345	25465	23065	24195	20570	25540	26292	22882	23454

*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2009.*

Hard Winter Wheat Yield (bu/ac)

	2002	2003	2004	2005	2006	2007	2008	2009	Average
Colorado	22	35	27	24	21	39	31	40	30
Kansas	33	48	37	40	32	32	40	42	38
Montana	28	37	41	45	43	38	39	37	37
Nebraska	33	46	37	39	36	42	44	48	41
Oklahoma	28	39	35	32	24	27	37	22	31
South Dakota	30	43	45	44	36	45	50	42	42
Texas	29	28	31	32	24	36	30	25	29
Wyoming	19	27	26	30	N/A	N/A	29	38	28
Regional Total	28	38	35	36	31	37	38	37	35

*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2009.*

Hard Red Winter Wheat Production Charts

Metric Units

Hard Winter Wheat Production (MMT)

	2002	2003	2004	2005	2006	2007	2008	2009	Average
Colorado	0.99	2.10	1.25	1.44	1.09	2.39	1.52	2.67	1.68
Kansas	7.37	13.06	8.56	10.34	7.93	7.84	9.69	10.06	9.36
Montana	0.59	1.83	1.82	2.57	2.25	2.27	2.57	2.44	2.04
Nebraska	1.37	2.28	1.66	1.87	1.67	2.34	2.00	2.09	1.91
Oklahoma	2.82	4.88	4.48	3.48	2.22	3.16	4.53	2.10	3.46
South Dakota	0.55	1.69	1.53	1.78	1.13	2.20	2.83	1.75	1.68
Texas	2.13	2.63	2.95	2.61	0.91	3.92	2.69	1.67	2.44
Wyoming	0.06	0.11	0.10	0.12	N/A	N/A	0.12	0.14	0.11
Regional Total	15.88	28.58	22.35	24.22	17.19	24.12	25.95	22.90	22.65

*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2009.*

Hard Winter Wheat Harvested Acres (1,000 ha)

	2002	2003	2004	2005	2006	2007	2008	2009	Average
Colorado	644	858	663	858	741	878	755	956	794
Kansas	3,198	3,900	3,315	3,705	3,549	3,510	3,471	3,432	3,510
Montana	304	710	636	819	749	854	944	944	745
Nebraska	593	710	644	686	663	780	651	624	669
Oklahoma	1,443	1,794	1,833	1,560	1,326	1,677	1,755	1,365	1,594
South Dakota	261	558	488	581	449	702	1,334	597	621
Texas	1,053	1,346	1,365	1,170	546	1,560	1,287	956	1,160
Wyoming	49	57	53	57	N/A	N/A	57	51	54
Regional Total	7,545	9,931	8,995	9,436	8,022	9,961	10,254	8,924	9,134

*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2009.*

Hard Winter Wheat Yield (tons/ha)

	2002	2003	2004	2005	2006	2007	2008	2009	Average
Colorado	1.48	2.35	1.82	1.61	1.41	2.62	2.08	2.69	2.02
Kansas	2.22	3.23	2.49	2.69	2.15	2.15	2.69	2.82	2.55
Montana	1.88	2.49	2.76	3.03	2.89	2.55	2.62	2.49	2.49
Nebraska	2.22	3.09	2.49	2.62	2.42	2.82	2.96	3.23	2.76
Oklahoma	1.88	2.62	2.35	2.15	1.61	1.82	2.49	1.48	2.08
South Dakota	2.02	2.89	3.03	2.96	2.42	3.03	3.36	2.82	2.82
Texas	1.95	1.88	2.08	2.15	1.61	2.42	2.02	1.68	1.95
Wyoming	1.28	1.82	1.75	2.02	N/A	N/A	1.95	2.55	1.88
Regional Total	1.88	2.55	2.35	2.42	2.08	2.49	2.55	2.49	2.35

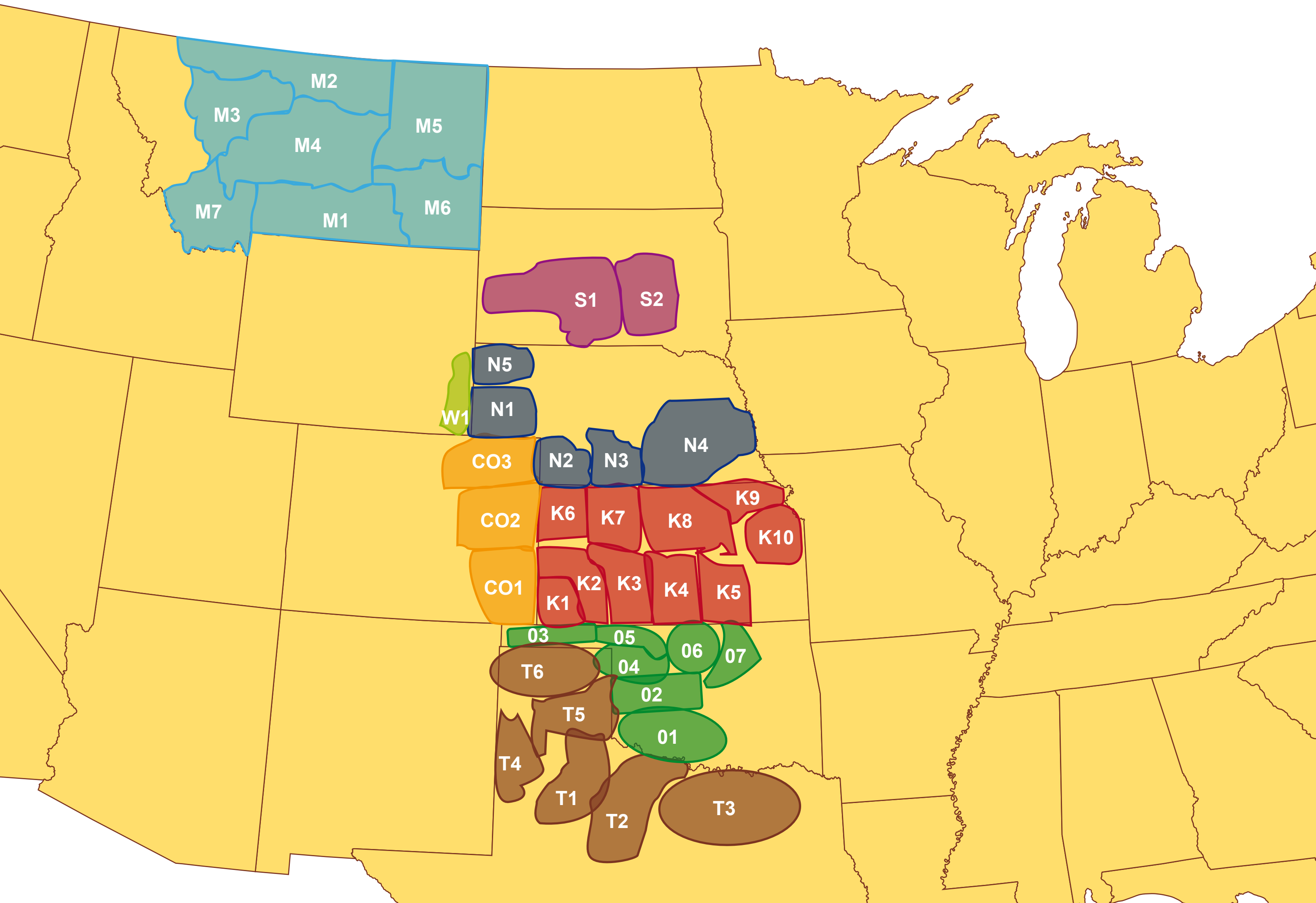
*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2009.*

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.

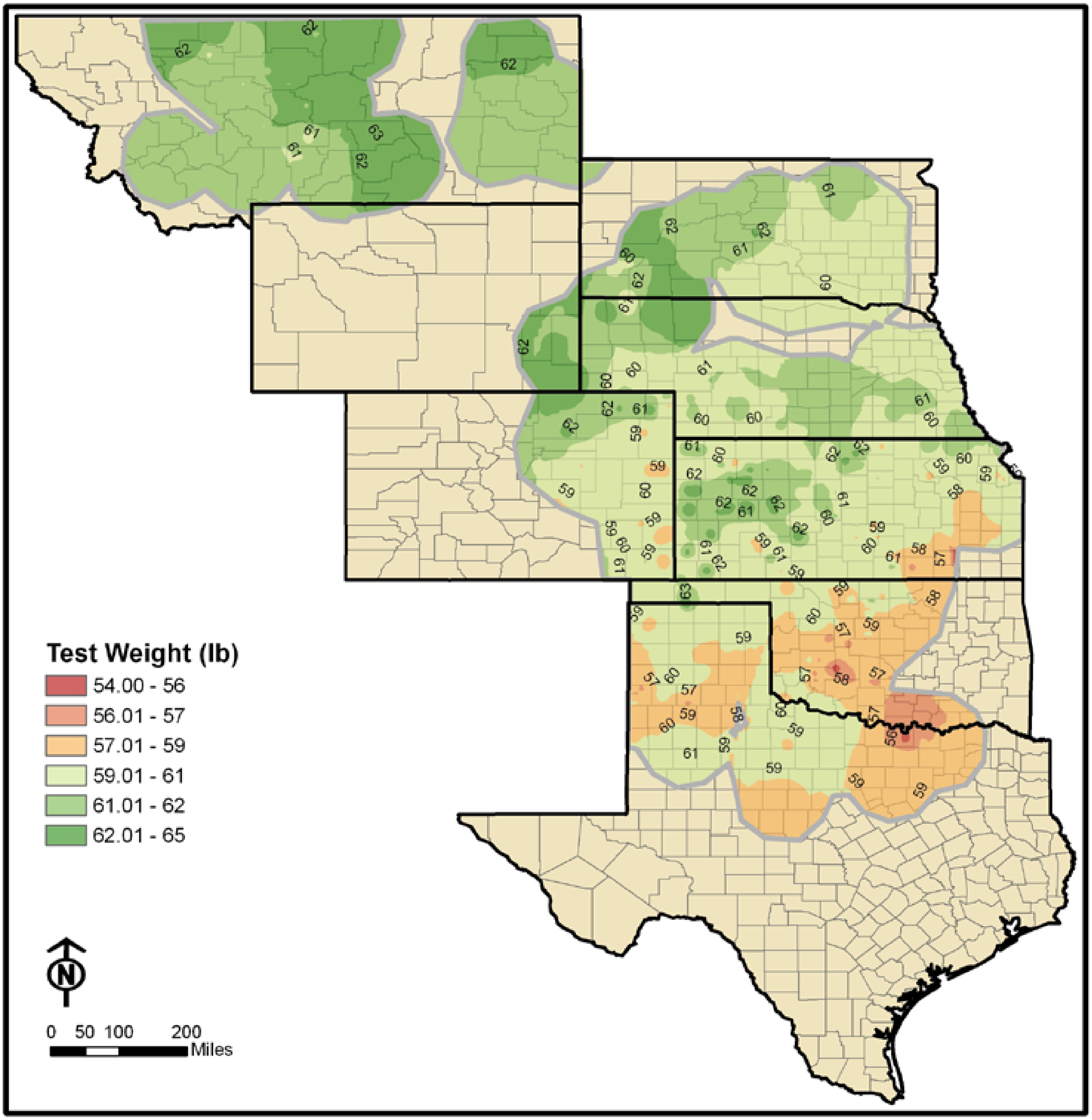
Foreign material is all matter other than wheat that remains in the sample after the removal of dockage and shrunken and broken kernels.

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.

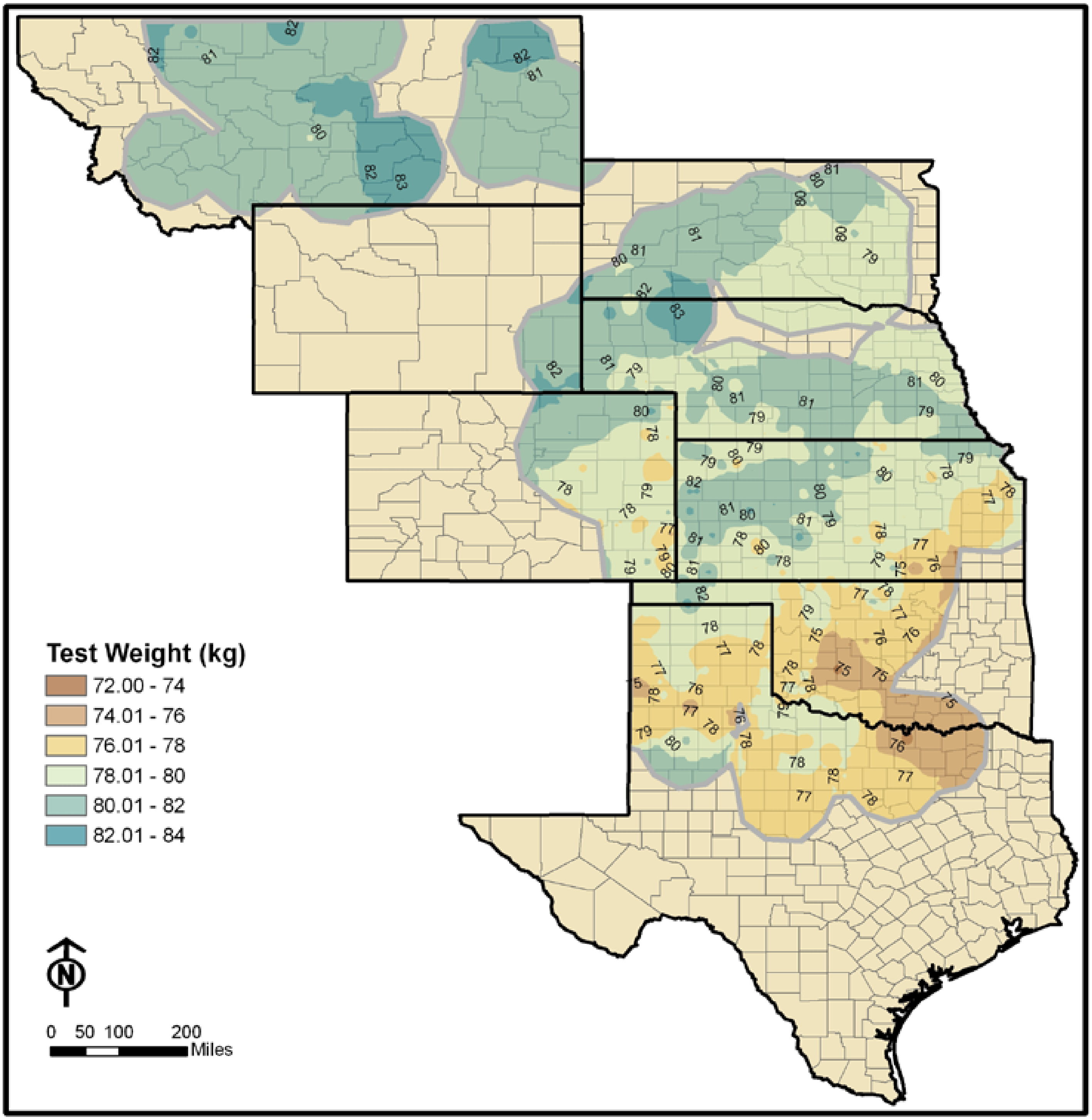
Damaged kernels are kernels, pieces of wheat kernels, and other grains that are badly ground-damaged, badly weatherdamaged, diseased, frost-damaged, germdamaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged.

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	59.1	77.8	0.2	0.9	1.3
	C02	2	59.6	78.5	0.2	0.7	1.1
	C03	1	60.9	80.1	0.1	0.7	0.9
Kansas	K01	1	60.8	80.0	0.1	1.1	1.2
	K02	1	60.8	80.0	0.1	1.0	1.2
	K03	1	60.8	80.0	0.2	1.2	1.4
	K04	2	59.6	78.4	0.2	1.4	1.6
	K05	2	59.3	78.1	0.5	1.0	1.6
	K06	1	60.9	80.1	0.1	0.6	0.8
	K07	1	60.9	80.1	0.1	0.8	0.9
	K08	1	60.7	79.8	0.1	1.9	1.9
	K09	1	60.7	79.9	0.2	0.9	1.1
	K10	2	59.9	78.9	0.8	0.7	1.5
Montana	M1	1	62.6	82.3	0.0	1.0	1.0
	M2	1	62.3	81.9	0.0	0.9	0.9
	M3	1	61.8	81.2	0.0	1.1	1.2
	M4	1	62.0	81.5	0.0	1.0	1.0
	M5	1	61.8	81.3	0.0	0.6	0.7
	M6	1	60.9	80.1	0.0	1.1	1.2
	M7	1	61.5	80.8	0.0	1.3	1.3
Nebraska	N01	1	60.5	79.6	0.2	1.2	1.4
	N02	1	60.4	79.4	0.2	0.7	0.9
	N03	1	60.9	80.1	0.1	0.6	0.7
	N04	1	60.9	80.1	0.2	0.6	0.8
	N05	1	62.0	81.6	0.2	1.4	1.6
Oklahoma	O01	2	58.1	76.5	0.2	1.3	1.7
	O02	2	58.6	77.1	0.2	1.6	1.9
	O03	1	60.4	79.5	0.1	1.1	1.2
	O04	2	58.8	77.4	0.1	1.6	1.8
	O05	2	59.0	77.6	0.0	1.3	1.4
	O06	2	58.6	77.1	0.3	1.6	2.7
	O07	2	58.4	76.9	0.1	2.3	2.9
South Dakota	SD01	1	61.1	80.4	0.3	0.9	1.4
	SD02	1	60.3	79.3	1.2	0.8	1.9
Texas	T01	2	58.9	77.5	0.2	1.2	1.6
	T02	2	59.1	77.8	0.2	0.8	1.1
	T03	3	57.8	76.1	0.3	1.6	1.9
	T04	2	58.2	76.6	0.3	1.0	1.3
	T05	2	59.0	77.7	0.3	1.4	1.8
	T06	1	60.0	78.9	0.2	1.8	2.0
Wyoming	W01	1	62.5	82.2	0.1	0.8	1.0

Kernel Quality Data

Location		Foreign Material (%)	Kernel Size Large (%)	Kerenel Size Med (%)	Kernel Size Small (%)	SKCS Wt (mg)	SKCS Diam (mm)
Colorado	C01	0.1	71.1	28.1	0.8	32.4	2.68
	C02	0.3	77.0	22.4	0.6	33.9	2.73
	C03	0.1	78.8	20.6	0.6	35.1	2.76
Kansas	K01	0.0	55.1	43.0	1.9	28.9	2.57
	K02	0.1	61.0	37.7	1.3	30.4	2.64
	K03	0.0	61.4	37.4	1.2	30.1	2.65
	K04	0.0	68.4	30.3	1.2	31.0	2.70
	K05	0.0	67.2	31.5	1.3	30.7	2.68
	K06	0.0	71.9	27.4	0.7	33.4	2.74
	K07	0.0	73.2	26.0	0.8	32.6	2.72
	K08	0.0	65.8	32.8	1.5	30.9	2.66
	K09	0.0	72.5	26.7	0.8	32.4	2.73
	K10	0.0	71.4	27.8	0.8	32.2	2.73
Montana	M1	0.0	70.4	28.9	0.7	33.0	2.70
	M2	0.0	49.8	48.9	1.2	29.2	2.58
	M3	0.0	50.5	47.9	1.6	28.8	2.56
	M4	0.0	63.9	35.3	0.9	32.2	2.69
	M5	0.0	69.6	30.0	0.5	32.6	2.67
	M6	0.1	71.7	27.5	0.7	31.4	2.65
	M7	0.0	66.6	32.5	0.9	32.0	2.66
Nebraska	N01	0.1	69.9	29.0	1.1	32.7	2.69
	N02	0.0	74.8	24.4	0.8	33.0	2.73
	N03	0.0	75.8	23.5	0.7	33.9	2.77
	N04	0.0	72.0	27.2	0.8	33.3	2.75
	N05	0.0	67.9	30.9	1.2	32.7	2.70
Oklahoma	O01	0.3	57.8	40.5	1.6	29.5	2.63
	O02	0.2	55.2	42.6	2.1	27.8	2.57
	O03	0.0	50.5	47.8	1.7	28.0	2.56
	O04	0.1	52.2	45.3	2.5	27.5	2.55
	O05	0.0	56.1	42.2	1.7	27.9	2.58
	O06	0.8	55.7	41.7	2.6	27.5	2.57
	O07	0.5	53.6	43.7	2.7	27.4	2.58
South Dakota	SD01	0.2	69.3	30.0	0.6	33.5	2.73
	SD02	0.0	75.1	24.3	0.6	34.4	2.77
Texas	T01	0.1	58.7	39.8	1.5	28.6	2.57
	T02	0.1	64.1	35.1	0.8	31.7	2.69
	T03	0.0	66.3	32.3	1.4	30.0	2.56
	T04	0.1	56.7	41.8	1.5	28.4	2.57
	T05	0.1	55.8	42.4	1.8	28.6	2.57
	T06	0.0	52.1	45.6	2.4	28.0	2.55
Wyoming	W01	0.1	77.1	22.1	0.8	35.3	2.81

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.

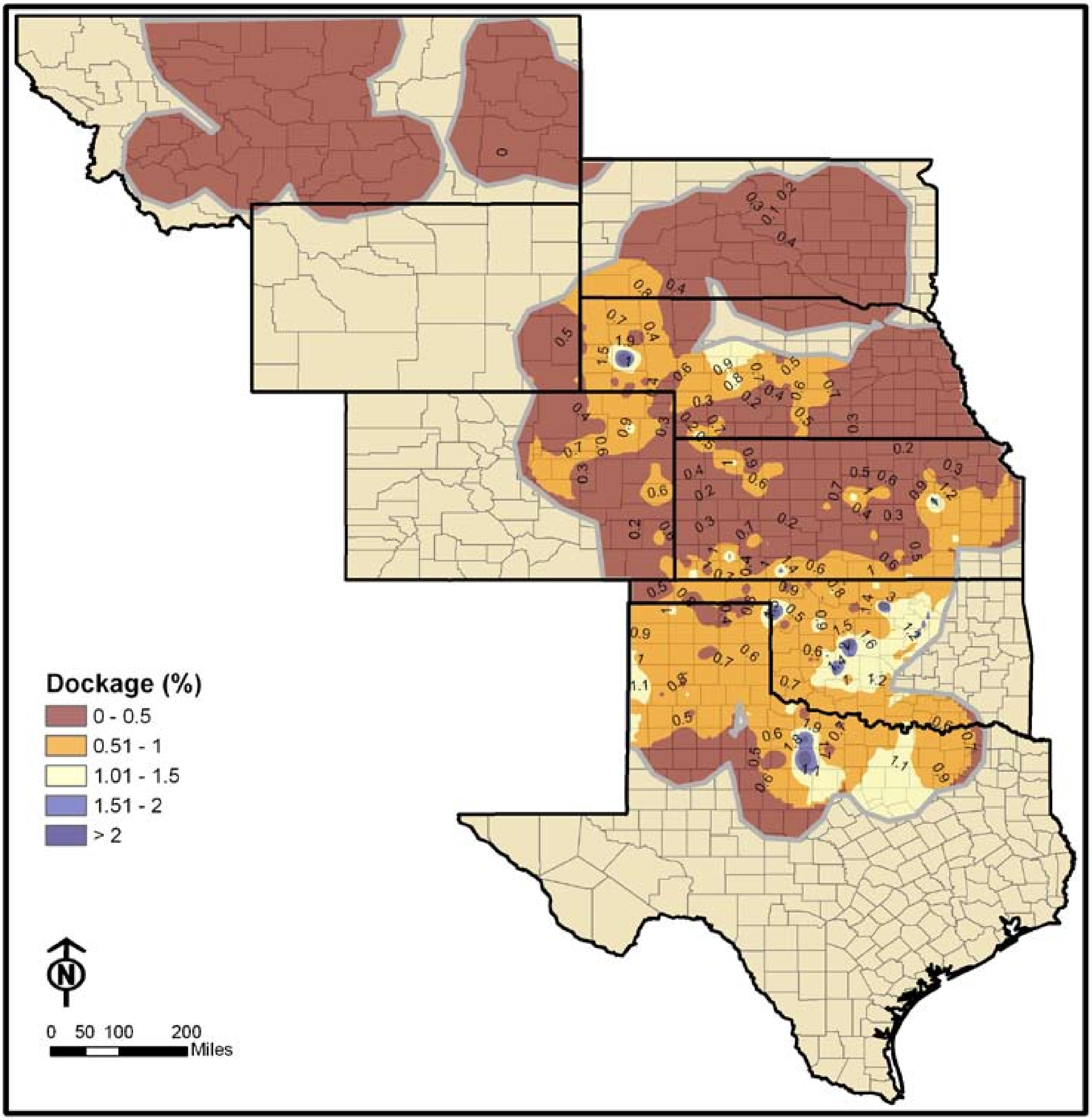
Falling number is an index of enzyme activity in wheat or flour and is expressed in seconds. Falling numbers above 300 are desirable, as they indicate little enzyme activity and a sound quality product. Falling numbers below 300 are indicative of more substantial enzyme activity and sprout damage.

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.

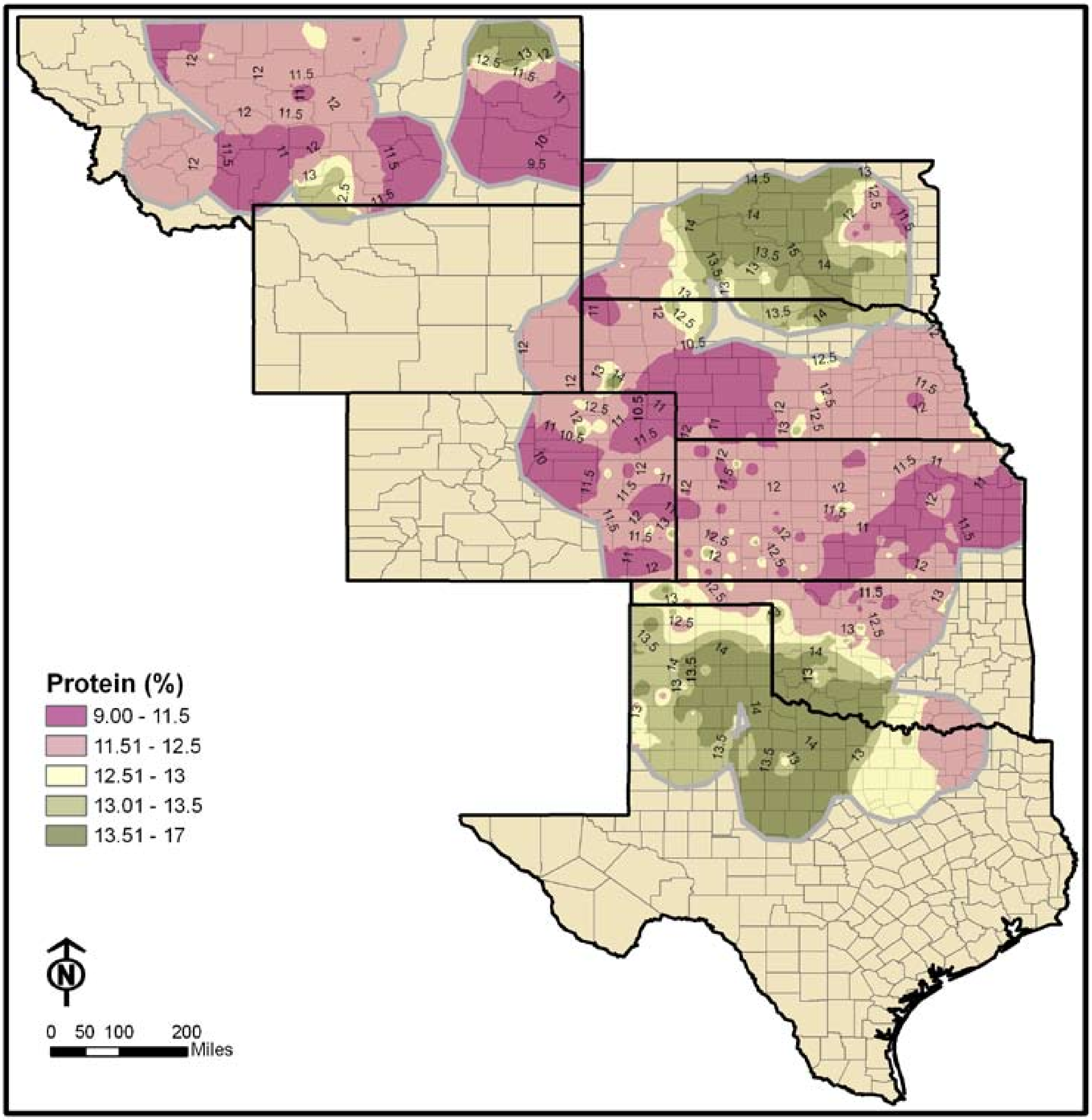
Kernel Size is a measure of the percentage by weight of large, medium and small kernels in a sample. Large kernels or more uniform kernel size may help improve milling yield.

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 (%)

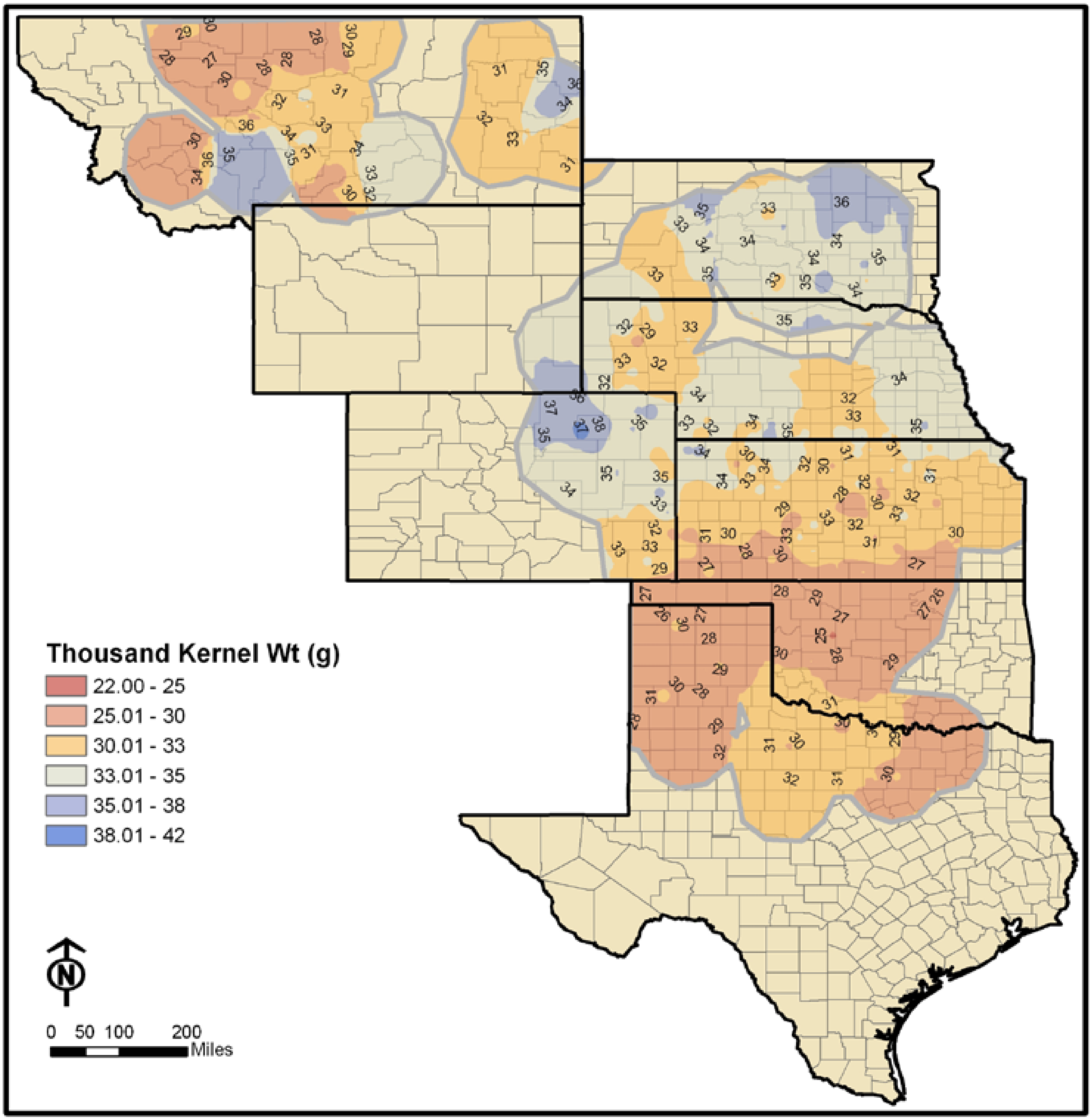


Protein (%)

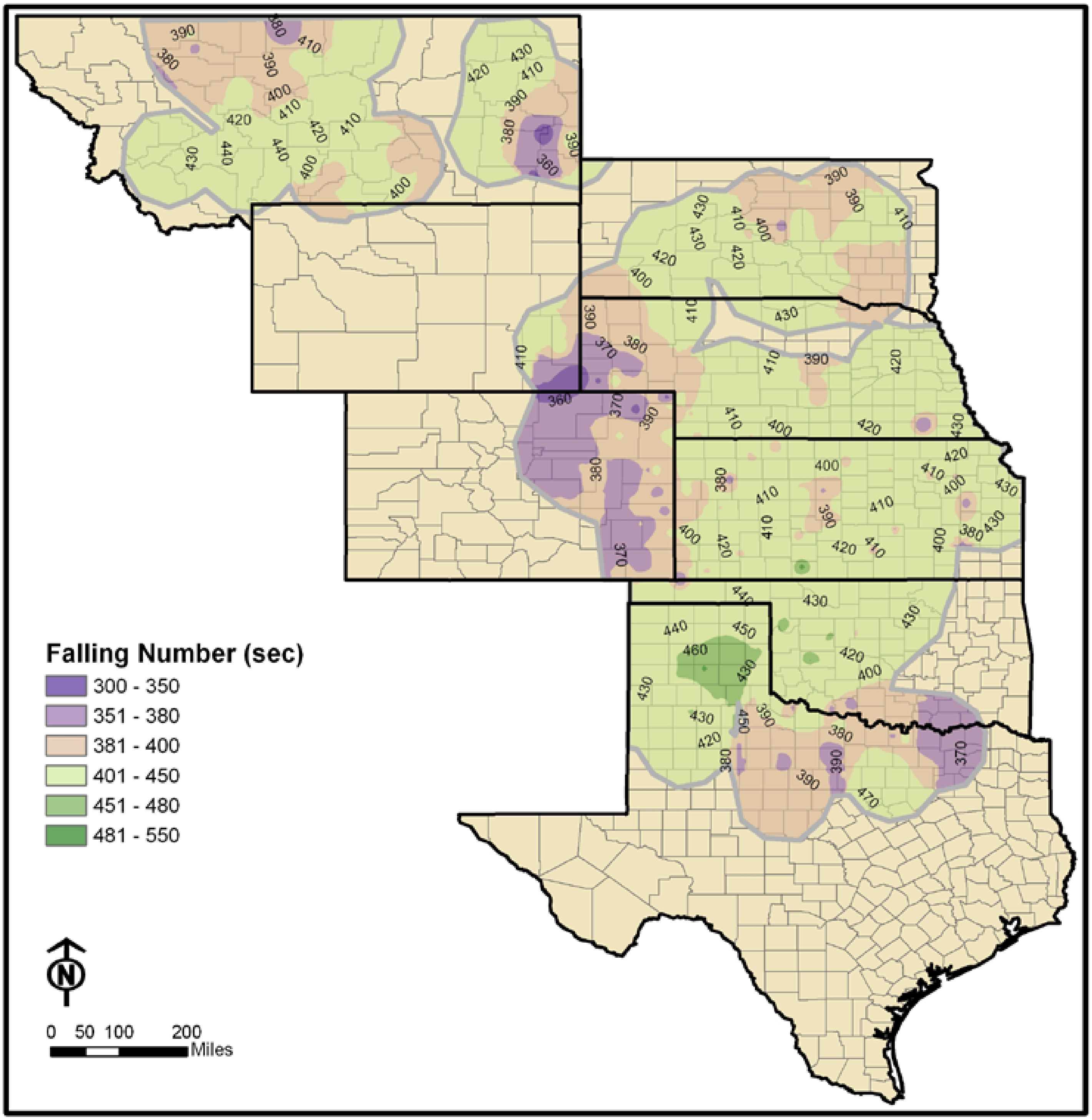


Protein (%)
9.00 - 11.5
11.51 - 12.5
12.51 - 13
13.01 - 13.5
13.51 - 17
N
0 50 100 200
Miles

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 Avg Hard
Colorado	C01	11.5	1.59	382	11.5	58.8
	C02	11.4	1.59	380	11.2	57.6
	C03	11.3	1.54	379	11.1	61.4
Kansas	K01	12.4	1.56	405	10.1	79.0
	K02	12.0	1.58	411	11.0	74.8
	K03	11.9	1.52	419	11.1	73.1
	K04	11.4	1.49	410	10.7	67.2
	K05	11.4	1.55	417	10.9	64.8
	K06	11.8	1.54	406	12.1	68.8
	K07	11.6	1.53	408	11.7	68.2
	K08	11.9	1.52	411	10.6	70.9
	K09	11.9	1.55	418	11.8	66.1
	K10	11.4	1.61	418	11.5	61.4
Montana	M1	12.0	1.41	403	11.0	76.5
	M2	11.9	1.36	389	11.5	80.9
	M3	12.0	1.35	387	11.4	77.8
	M4	11.5	1.37	410	11.1	71.3
	M5	12.5	1.45	403	11.6	64.8
	M6	10.9	1.41	399	10.7	61.1
	M7	12.0	1.37	414	10.2	72.1
Nebraska	N01	12.0	1.68	389	11.6	65.5
	N02	11.3	1.57	411	12.1	57.8
	N03	11.7	1.59	416	12.0	59.8
	N04	12.1	1.59	413	11.8	63.0
	N05	12.1	1.64	397	11.6	74.7
Oklahoma	O01	13.8	1.69	419	12.5	73.3
	O02	12.6	1.71	431	11.7	75.9
	O03	12.8	1.57	421	9.4	80.1
	O04	12.4	1.64	428	10.3	74.5
	O05	11.3	1.63	430	11.2	71.9
	O06	11.6	1.59	431	11.1	72.9
	O07	11.7	1.61	430	10.7	73.9
South Dakota	SD01	13.9	1.67	406	11.7	63.0
	SD02	13.2	1.67	405	11.9	57.8
Texas	T01	14.1	1.73	428	11.2	70.6
	T02	14.3	1.63	396	12.0	68.4
	T03	12.8	1.51	390	12.4	35.0
	T04	13.1	1.64	432	11.5	68.4
	T05	13.7	1.59	458	10.9	73.5
	T06	12.6	1.65	431	10.1	79.1
Wyoming	W01	12.2	1.58	353	12.2	72.1

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	70.5	49.2	10.0	0.46	98.10	92.93	-1.53	9.16
	C02	71.3	49.4	9.7	0.45	98.00	92.95	-1.65	9.40
	C03	71.9	48.8	9.6	0.43	96.10	92.88	-1.69	9.58
Kansas	K01	70.6	59.1	11.0	0.48	97.30	92.63	-1.65	10.37
	K02	71.1	55.4	10.5	0.50	96.20	92.54	-1.66	10.11
	K03	72.4	56.9	10.5	0.50	98.10	92.90	-1.74	10.07
	K04	71.6	50.4	9.9	0.46	98.60	92.69	-1.75	9.88
	K05	70.3	48.7	9.8	0.46	97.90	92.91	-1.80	10.03
	K06	71.0	54.2	10.0	0.47	97.20	92.75	-1.83	10.31
	K07	71.9	52.6	9.9	0.43	99.00	92.80	-1.75	10.04
	K08	71.6	53.5	10.1	0.44	98.50	92.75	-1.80	10.13
	K09	73.1	52.0	10.2	0.47	98.90	92.72	-1.68	9.76
	K10	72.7	46.8	9.8	0.48	98.80	92.59	-1.49	9.26
Montana	M1	70.9	56.8	10.3	0.41	96.00	93.15	-1.85	9.97
	M2	71.6	65.0	10.6	0.42	98.40	93.08	-1.86	10.19
	M3	72.6	64.4	10.5	0.42	98.60	92.58	-1.86	10.57
	M4	72.5	64.0	10.2	0.41	96.80	92.94	-1.76	9.93
	M5	73.0	68.3	11.0	0.40	96.50	92.72	-1.60	9.35
	M6	72.9	53.5	9.5	0.39	96.60	93.21	-1.81	9.44
	M7	72.8	68.1	10.5	0.40	98.30	92.71	-1.71	9.66
Nebraska	N01	71.7	51.8	10.4	0.45	96.30	92.61	-1.59	9.67
	N02	71.9	45.7	9.4	0.45	97.70	92.71	-1.73	10.26
	N03	71.9	47.5	9.9	0.44	98.10	92.85	-1.60	9.83
	N04	72.1	52.4	10.3	0.42	97.70	92.93	-1.46	9.36
	N05	71.7	55.8	10.3	0.43	98.10	92.43	-1.48	9.24
Oklahoma	O01	66.4	65.0	12.3	0.52	96.80	92.10	-1.52	9.92
	O02	66.9	61.4	10.9	0.53	95.90	92.22	-1.79	10.23
	O03	65.6	63.6	11.4	0.45	95.90	92.78	-1.92	10.93
	O04	66.6	54.7	10.7	0.45	98.60	92.79	-1.89	10.71
	O05	71.2	46.0	10.0	0.50	99.20	92.82	-1.79	10.32
	O06	71.5	47.6	10.3	0.53	99.60	92.40	-1.78	10.66
	O07	70.9	50.9	10.4	0.49	98.50	92.33	-1.66	10.37
South Dakota	SD01	73.5	69.7	12.1	0.44	97.40	92.78	-1.27	8.75
	SD02	73.4	66.2	11.4	0.42	97.90	92.72	-1.25	8.89
Texas	T01	65.7	63.3	12.1	0.47	91.60	92.44	-1.70	9.86
	T02	67.3	69.5	12.8	0.49	94.40	92.18	-1.58	9.43
	T03	64.5	64.3	11.8	0.49	94.20	92.55	-1.69	9.61
	T04	70.8	53.7	11.6	0.53	87.60	92.23	-1.67	9.79
	T05	66.0	66.9	12.1	0.43	94.70	92.30	-1.77	10.52
	T06	70.1	57.6	11.2	0.47	91.90	92.61	-1.83	10.68
Wyoming	W01	71.6	59.4	10.6	0.43	98.30	92.95	-1.46	9.34

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	64	104	211	0.62	56.2	5.2	11.9	28
	C02	61	86	175	0.71	56.2	2.0	9.6	18
	C03	61	80	159	0.76	57.0	4.8	9.5	33
Kansas	K01	65	114	242	0.57	58.5	5.5	14.4	22
	K02	71	103	239	0.69	57.2	5.2	11.3	34
	K03	62	111	222	0.56	57.3	6.2	11.1	38
	K04	63	110	238	0.57	55.5	4.3	12.7	23
	K05	65	88	214	0.74	54.7	5.5	15.3	19
	K06	79	85	233	0.93	58.0	5.3	13.4	22
	K07	72	108	263	0.67	56.4	4.5	14.4	20
	K08	69	107	248	0.64	56.2	4.5	15.2	16
	K09	65	102	227	0.64	56.5	5.7	13.1	35
	K10	60	91	191	0.66	55.3	2.2	9.5	25
Montana	M1	86	87	263	0.99	58.8	5.7	13.7	23
	M2	80	94	277	0.85	57.7	6.3	14.1	25
	M3	78	91	267	0.86	57.6	7.0	14.1	31
	M4	81	91	279	0.89	57.5	2.8	11.5	15
	M5	67	124	279	0.54	58.4	5.3	12.3	26
	M6	60	120	246	0.5	55.8	5.0	10.3	31
	M7	78	118	322	0.66	58.4	4.4	11.1	26
Nebraska	N01	55	106	181	0.52	56.7	5.2	10.1	36
	N02	64	96	217	0.67	55.4	2.0	10.3	19
	N03	64	93	212	0.69	55.7	5.5	11	32
	N04	72	84	230	0.86	56.4	4.5	13.4	23
	N05	71	107	258	0.66	57.2	6.8	11.7	38
Oklahoma	O01	73	125	305	0.58	59.2	6.2	16.8	13
	O02	70	108	253	0.65	58.0	6.3	15.3	21
	O03	74	91	234	0.81	58.7	8.0	15.7	21
	O04	57	91	196	0.63	56.4	4.5	12.9	23
	O05	65	95	213	0.68	55.8	6.2	14.8	27
	O06	54	101	184	0.53	56.1	6.0	11.4	36
	O07	67	105	242	0.64	56.1	6.2	12.5	30
South Dakota	SD01	63	105	240	0.6	57.1	5.7	13.8	22
	SD02	58	106	230	0.55	55.6	4.5	14	18
Texas	T01	61	107	223	0.57	59.1	7.4	15.3	23
	T02	82	114	337	0.72	59.2	8.9	17.6	9
	T03	80	99	284	0.81	57.9	7.0	18.6	11
	T04	70	113	231	0.62	59.5	5.7	11.2	30
	T05	64	108	243	0.59	59.3	7.7	18.1	20
	T06	70	108	239	0.65	58.4	5.4	12.3	26
Wyoming	W01	81	79	234	1.03	59.2	5.9	13.2	20

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 (0-6)	Crumb Texture (0-6)	Crumb Color
Colorado	C01	5.0	60.0	780	3.0	4	dull
	C02	4.9	59.5	765	2.0	3	slightly yellow
	C03	4.1	60.2	745	2.0	4	slightly yellow
Kansas	K01	4.5	61.5	825	3.8	4	creamy
	K02	4.9	60.6	745	4.0	4	dull
	K03	4.6	60.4	800	4.0	4	slightly yellow
	K04	5.4	59.5	775	4.2	4	slightly yellow
	K05	6.5	60.2	765	4.0	3	slightly yellow
	K06	5.0	61.0	780	4.0	4	dull
	K07	5.1	60.8	820	4.0	4	slightly yellow
	K08	5.3	59.7	805	3.5	4	slightly yellow
	K09	5.5	60.1	785	3.0	4	slightly yellow
	K10	6.0	59.3	785	3.5	4	dull
Montana	M1	4.9	62.3	800	4.0	4	dull
	M2	5.5	61.4	825	3.0	4	creamy
	M3	6.1	61.1	805	3.0	5	dull
	M4	6.0	62.9	780	3.0	4	dull
	M5	4.5	61.7	840	3.8	4	creamy
	M6	5.8	59.7	775	3.5	4	creamy
	M7	6.0	61.4	805	2.8	4	creamy
Nebraska	N01	4.5	59.4	810	4.0	4	creamy
	N02	5.5	58.0	710	3.5	4	slightly yellow
	N03	5.5	58.6	765	4.5	4	creamy
	N04	6.0	59.5	800	3.0	4	dull
	N05	5.1	60.5	780	3.5	4	creamy
Oklahoma	O01	5.8	62.0	870	4.0	4	dull
	O02	4.5	61.2	865	4.5	4	dull
	O03	4.3	61.1	870	4.0	5	slightly yellow
	O04	5.0	58.1	810	3.5	4	slightly yellow
	O05	5.3	59.8	840	4.2	4	slightly yellow
	O06	5.9	60.8	805	3.8	4	dull
	O07	4.9	60.6	795	3.8	4	dull
South Dakota	SD01	5.8	63.1	880	3.5	4	dull
	SD02	5.6	62.1	860	3.5	4	dull
Texas	T01	4.0	59.9	890	3.8	4	dull
	T02	5.6	63.8	975	3.2	4	dull
	T03	5.5	61.5	915	4.0	4	dull
	T04	3.8	60.1	830	3.5	4	dull
	T05	4.5	61.7	860	3.5	4	dull
	T06	4.4	60.9	855	4.0	4	slightly yellow
Wyoming	W01	5.1	61.6	755	2.5	4	creamy

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.