PGI

Plains Grains Inc.

2010 Hard Red Winter Wheat Regional Quality Survey

PGI

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

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.

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 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 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 2010 hard red winter (HRW) wheat crop began with generally favorable planting conditions in all regions. All states had good planting conditions with emergence ratings very close to the 5 year average throughout the fall of 2009. This was particularly true in the southern plains (Texas and Oklahoma) where emergence and tillering (stem development) provided rapid ground cover and good root development at the surface. The result of these excellent conditions was timely planting, emergence and development of the crop in all production areas going into the winter months. The favorable conditions continued in the spring with wide-spread (fair to excellent) crop condition ratings of over 90 % in all areas by early April and continued until harvest. These very good growing conditions (cool with good moisture) tended to be a hindrance to crop maturity. Reports from northeast Colorado, the Nebraska Panhandle and Montana indicated an average harvest date from 2 to 3 weeks behind normal. The overall growing conditions proved to be a blessing and a curse for the 2010 crop. The cool and damp weather during grainfill was a major factor, resulting in significantly higher than normal test weights, kernel size and mill yield for most areas. However, those same conditions were not conducive to accumulation of protein in grain.

Samples and Methods

Sample collection and analysis were conducted jointly by the USDA ARS Hard Red Winter Wheat Quality Lab, Manhattan, Kansas, and Plains Grains, Inc., a private non-profit company established to provide quality information on HRW. A total of 468 samples were collected from grain elevators when at least 30% of the local harvest had been completed in the eight states of Texas, Oklahoma, Colorado, Kansas, Nebraska, South Dakota, Wyoming and Montana. The area sampled represents about 80% of HRW production. Official grade and non-grade factors were determined on each sample. The samples were formed into 112 composites based on 41 production areas and the three protein ranges of <11.5%, 11.5% - 12.5%, and >12.5%. Milling, dough functionality and bake tests were run on each of the composites. For each protein range, the results were then mathematically aggregated to represent Gulf-tributary, PNW-tributary, and overall results. The analytical methods used to define the reported parameters are described in the Analysis Methods section of this booklet.

Wheat Grade and Non-Grade Data

Seventy-one percent of all individual samples graded US #1 and ninety-two percent of all individual samples grading US # 2 or better. The average dockage of 2010 HRW crop was 0.6%, equaling the 5-year average. Damaged kernels and shrunken & broken kernels were equal to the 5-year average while foreign material and total defects increased slightly over the 5-year average. Kernel characteristics, including test weight, thousand kernel weight and kernel diameter, are very good, which is consistent with the weather conditions of adequate moisture, cool temperatures and little heat stress that prevailed during the maturity phase of the crop. An average test weight of 61 lbs/ bu. (80.2 kg/ hl) is above the five-year average and is higher than the 2009 average. The average thousand kernel weight of 29.4 g is below the 5-year average of 29.5 g, but slightly lower than the 2009 average of 30.1 g. Kernel diameter of 2.61 mm is slightly above the 5-year average, but slightly below the 2009 average. Above-average kernel characteristics prevailed across the entire production region again in 2010 as they did in 2009. However, the growing conditions that favored large kernel size and high test weight tended to not be conducive to accumulating wheat protein, which overall is over a half a percent below the five-year average, again similar

Crop Production Review and Analysis

to 2009. The distribution of wheat protein differed by tributary with Gulf tributary samples split by, 29% in the < 11.5% protein category, 47% in the 11.5% – 12.5% category and 24% in the > 12.5% category; PNW tributary samples were, 57% in the < 11.5% protein category, 29% in the 11.5% – 12.5% category and 14% in the > 12.5% category. Average falling number for the 2010 crop is 401 seconds, comparable to 2009 and the five-year average and indicative of sound wheat.

Flour and Baking Data

The Buhler laboratory mill flour yield reflects the outstanding kernel characteristics with an overall average of 70.9%, this is well above the five-year average of 70.0%; the Gulf average of 70.5% is higher than the 5-year average of 70.3%; the PNW average of 71.9% is slightly below 2009, but well above the 5-year average 70.1%. Flour yields were very similar to 2009. Flour ash percentages and flour color results support proper setting of the mill. Flour protein content averaged 10.1%, which reflects a slightly elevated loss of protein in the milling process compared with previous values and is a full percentage point below the 5-year average. Gulf flour protein content was 10.2%, down one-half of a percent from 2009 and eight tenths of a percent lower than the 5-year average. PNW flour protein content was 9.9% a half of a percent lower than 2009 (10.4%) and over 1% lower than the 5-year average of 11.1%. Farinograph absorption (56.3%) is significantly below the 2009 level of 57.2% and 2% below the 5-year average of 58.3%. However, the farinograph stability (12.0 minutes) is well above the 5-year average of 10.7 minutes, but below the 2009 average of 13.1 minutes. The average W value of 232 is similar to the 2009 value and below the five-year average of 257. Loaf volume averages just over 800 cc, comparable to the 2009 crop but significantly below the five-year average of 836 cc.

Summary

The 2010 HRW crop can be characterized as clean and sound with very good milling properties, but with below average protein content and with end-product qualities consistent with the lower protein values.

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 "2010 Crop Analysis" link.

Hard Red Winter Wheat Production Charts

English Units

Hard Winter Wheat Production (1,000 bu.)

	2003	2004	2005	2006	2007	2008	2009	2010	Average
Colorado	77,000	45,900	52,800	39,900	94,000	57,000	98,000	105,750	71,294
Kansas	480,000	314,500	380,000	291,200	283,800	356,000	369,600	360,000	354,388
Montana	67,340	66,830	92,250	82,560	83,220	94,380	89,540	93,600	83,715
Nebraska	83,720	61,050	68,640	61,200	84,280	73,480	76,800	64,070	71,655
Oklahoma	179,400	164,500	128,000	81,600	98,000	166,500	77,000	120,900	126,988
South Dakota	61,490	56,250	63,360	41,400	95,040	103,950	64,260	63,700	68,681
Texas	96,600	108,500	96,000	33,600	140,600	99,000	61,250	127,500	95,381
Wyoming	3,915	3,510	4,350	3,645	3,250	3,780	5,016	4,640	4,013
Regional Total	1,049,465	821,040	885,400	635,105	882,190	954,090	841,466	940,160	876,115

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

Hard Winter Wheat Harvested Acres (1,000 Acres)

	2003	2004	2005	2006	2007	2008	2009	2010	Average
Colorado	2,200	1,700	2,200	1,900	2,350	1,900	2,450	2,350	2,131
Kansas	10,000	8,500	9,500	9,100	8,600	8,900	8,800	8,000	8,925
Montana	1,820	1,630	2,050	1,920	2,190	2,420	2,420	1,950	2,050
Nebraska	1,820	1,650	1,760	1,700	1,960	1,670	1,600	1,490	1,706
Oklahoma	4,600	4,700	4,000	3,400	3,500	4,500	3,500	3,900	4,013
South Dakota	1,430	1,250	1,440	1,150	1,980	1,890	1,530	1,300	1,496
Texas	3,450	3,500	3,000	1,400	3,800	3,300	2,450	3,750	3,081
Wyoming	135	145	135	135	125	135	132	145	136
Regional Total	25,455	23,075	24,085	20,705	24,505	24,715	22,882	22,885	23,538

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

Hard Winter Wheat Yield (bu/ac)

	2003	2004	2005	2006	2007	2008	2009	2010	Average
Colorado	35	27	24	21	40	30	40	45	33
Kansas	48	37	40	32	33	40	42	45	40
Montana	37	41	45	43	38	39	37	48	41
Nebraska	46	37	39	36	43	44	48	43	42
Oklahoma	39	35	32	24	28	37	22	31	31
South Dakota	43	45	44	36	48	55	42	49	45
Texas	28	31	32	24	37	30	25	34	30
Wyoming	27	26	30	27	26	28	38	32	29
Regional Total	38	35	36	30	37	38	37	41	36

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

Hard Red Winter Wheat Production Charts

Metric Units

Hard Winter Wheat Production (MMT)

	2003	2004	2005	2006	2007	2008	2009	2010	Average
Colorado	2.10	1.25	1.44	1.09	2.56	1.55	2.67	2.88	1.94
Kansas	13.06	8.56	10.34	7.93	7.72	9.69	10.06	9.80	9.65
Montana	1.83	1.82	2.51	2.25	2.27	2.57	2.44	2.55	2.28
Nebraska	2.28	1.66	1.87	1.67	2.29	2.00	2.09	1.74	1.95
Oklahoma	4.88	4.48	3.48	2.22	2.67	4.53	2.10	3.29	3.46
South Dakota	1.67	1.53	1.72	1.13	2.59	2.83	1.75	1.73	1.87
Texas	2.63	2.95	2.61	0.91	3.83	2.69	1.67	3.47	2.60
Wyoming	0.11	0.10	0.12	0.10	0.09	0.10	0.14	0.13	0.11
Regional Total	28.56	22.35	24.10	17.29	24.01	25.97	22.90	25.59	23.85

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

Hard Winter Wheat Harvested Acres (1,000 ha)

	2003	2004	2005	2006	2007	2008	2009	2010	Average
Colorado	880	680	880	760	940	760	980	940	853
Kansas	4,000	3,400	3,800	3,640	3,440	3,560	3,520	3,200	3,570
Montana	728	652	820	768	876	968	968	780	820
Nebraska	728	660	704	680	784	668	640	596	683
Oklahoma	1,840	1,880	1,600	1,360	1,400	1,800	1,400	1,560	1,605
South Dakota	572	500	576	460	792	756	612	520	599
Texas	1,380	1,400	1,200	560	1,520	1,320	980	1,500	1,233
Wyoming	54	58	54	54	50	54	53	58	54
Regional Total	10,182	9,230	9,634	8,282	9,802	9,886	9,153	9,154	9,415

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

Hard Winter Wheat Yield (tons/ha)

	2003	2004	2005	2006	2007	2008	2009	2010	Average
Colorado	2.38	1.84	1.63	1.43	2.72	2.04	2.72	3.06	2.23
Kansas	3.27	2.52	2.72	2.18	2.25	2.72	2.86	3.06	2.70
Montana	2.52	2.79	3.06	2.93	2.59	2.65	2.52	3.27	2.79
Nebraska	3.13	2.52	2.65	2.45	2.93	2.99	3.27	2.93	2.86
Oklahoma	2.65	2.38	2.18	1.63	1.91	2.52	1.50	2.11	2.11
South Dakota	2.93	3.06	2.99	2.45	3.27	3.74	2.86	3.33	3.08
Texas	1.91	2.11	2.18	1.63	2.52	2.04	1.70	2.31	2.05
Wyoming	1.84	1.77	2.04	1.84	1.77	1.91	2.59	2.18	1.99
Regional Total	2.58	2.37	2.43	2.07	2.49	2.58	2.50	2.78	2.48

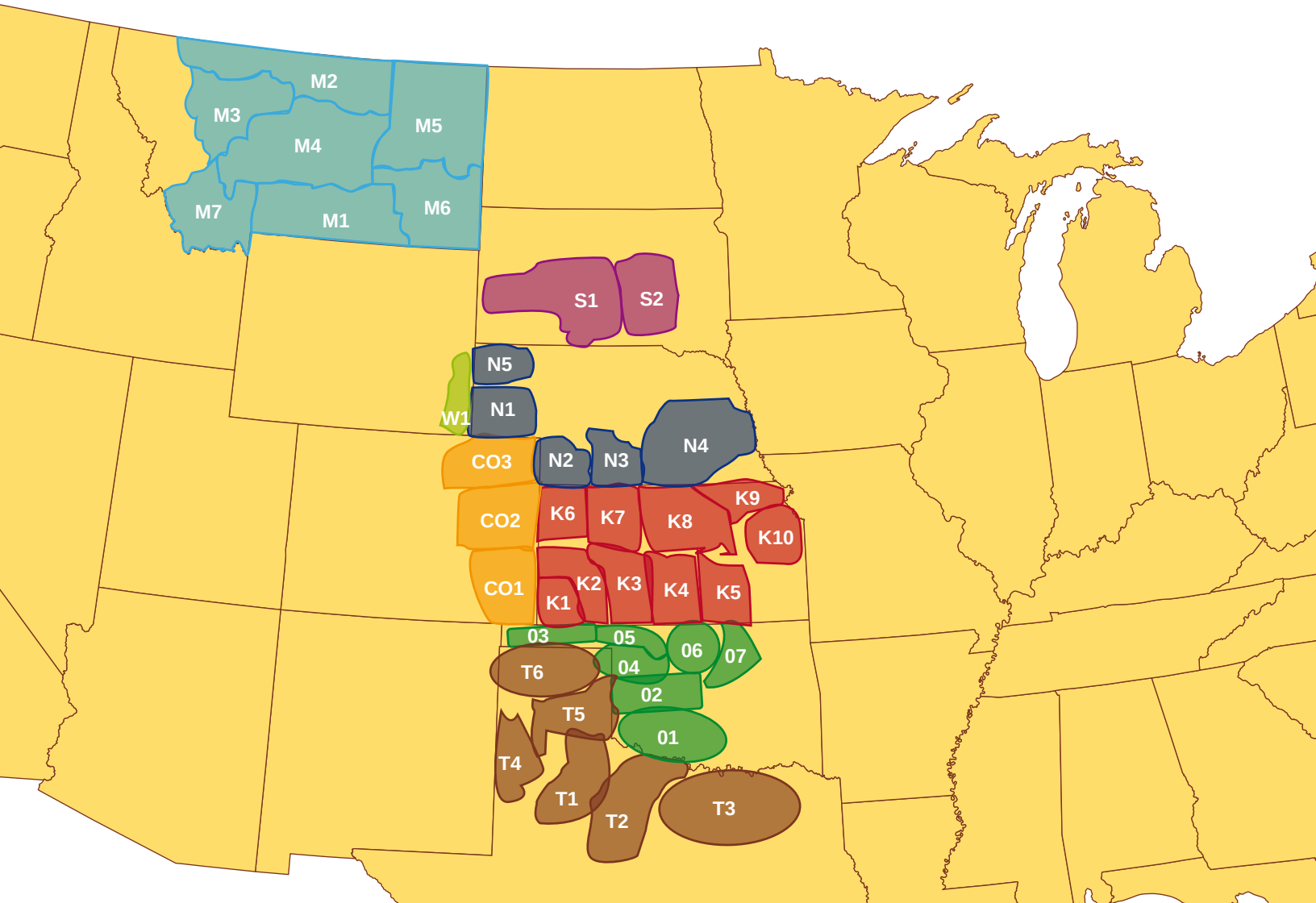
*** Some data derived from Crop Production report issued by USDA NASS updated September 30, 2010.*

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.

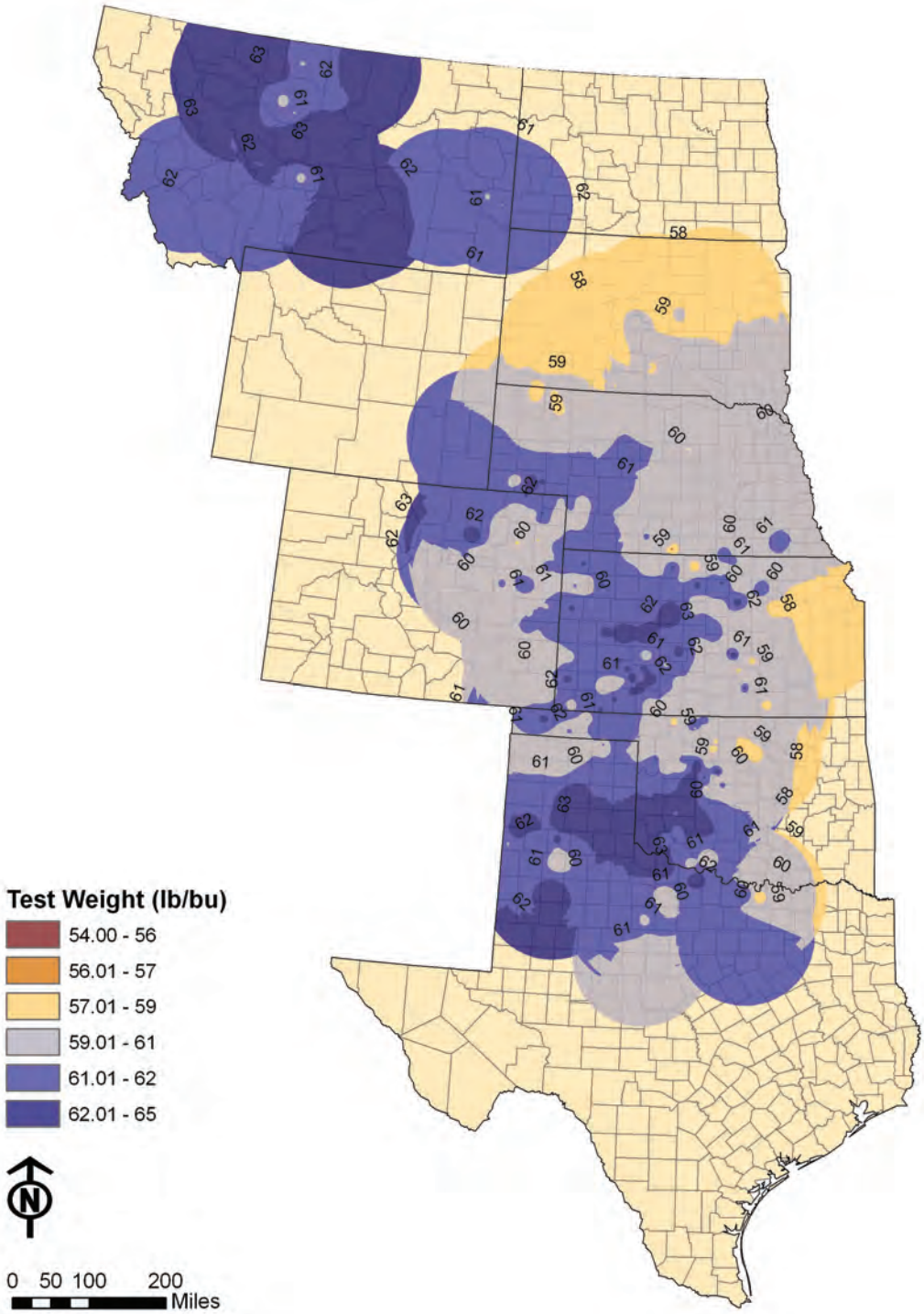
Foreign material is all matter other than wheat that remains in the sample after the removal of dockage and shrunken and broken kernels.

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.

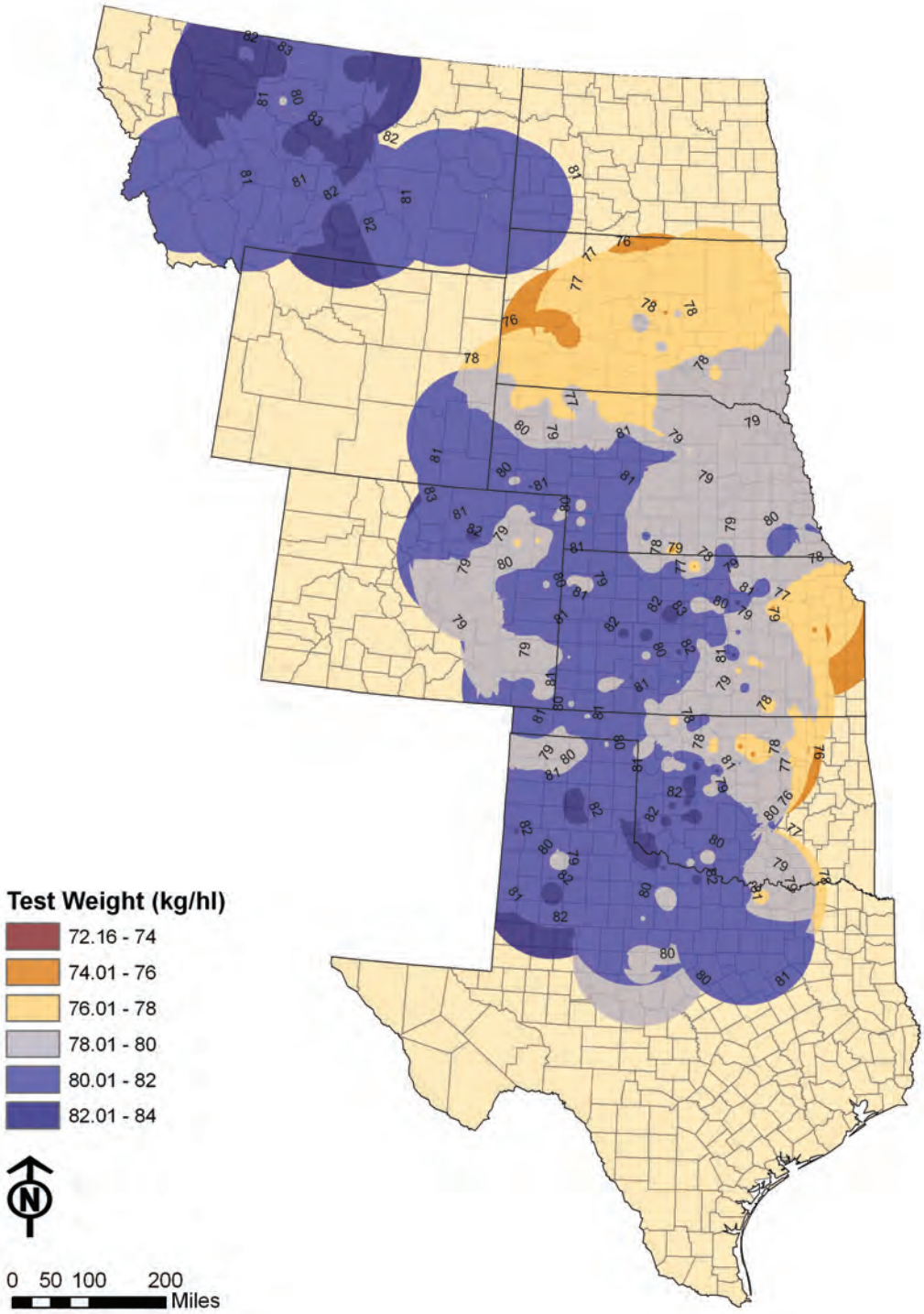
Damaged kernels are kernels, pieces of wheat kernels, and other grains that are badly ground-damaged, badly weatherdamaged, diseased, frost-damaged, germdamaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged.

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	1	60.4	79.5	0.0	2.1	2.2
	C02	1	61.3	80.6	0.1	1.5	1.7
	C03	1	60.7	79.8	0.2	1.5	1.8
Kansas	K01	1	61.8	81.3	0.2	1.1	1.4
	K02	1	62.3	81.9	0.2	1.1	1.4
	K03	1	61.5	80.9	0.4	0.9	1.4
	K04	1	61.1	80.4	0.2	1.0	1.3
	K05	3	59.8	78.7	1.0	0.9	3.2
	K06	1	61.4	80.7	0.2	1.0	1.3
	K07	1	61.9	81.4	0.2	0.9	1.2
	K08	1	61.2	80.5	0.0	1.2	1.3
	K09	1	60.6	79.7	0.2	1.6	1.9
	K10	3	57.7	76.0	0.2	1.1	1.5
Montana	M1	1	62.2	81.8	0.0	1.9	1.9
	M2	1	62.2	81.8	0.0	1.1	1.1
	M3	1	62.2	81.8	0.2	1.0	1.3
	M4	1	62.1	81.7	0.0	1.4	1.6
	M5	1	61.8	81.3	0.0	1.1	1.1
	M6	1	61.9	81.4	0.4	1.3	2.0
	M7	1	60.9	80.1	0.2	2.1	2.3
Nebraska	N01	1	61.7	81.1	0.2	1.3	1.7
	N02	1	61.3	80.6	0.0	1.4	1.6
	N03	1	60.2	79.2	1.0	1.1	2.3
	N04	1	60.1	79.1	0.8	0.9	1.7
	N05	2	59.3	78.0	0.6	0.8	1.8
Oklahoma	O01	1	62.3	81.9	0.3	1.2	1.5
	O02	1	62.2	81.8	0.2	1.0	1.4
	O03	1	61.6	81.0	0.1	0.8	1.0
	O04	1	60.5	79.6	0.1	1.3	1.6
	O05	1	60.5	79.6	0.2	0.9	1.2
	O06	2	59.7	78.6	0.4	1.2	2.2
	O07	2	59.5	78.3	0.8	1.4	2.8
South Dakota	SD01	2	59.1	77.8	0.1	0.9	1.2
	SD02	2	59.5	78.3	1.6	0.9	2.6
Texas	T01	1	61.4	80.7	0.2	0.7	1.0
	T02	1	62.0	81.5	0.0	0.9	1.0
	T03	1	62.0	81.5	0.4	0.9	1.3
	T04	1	62.0	81.5	0.0	0.6	0.7
	T05	1	62.6	82.3	0.1	0.9	1.1
	T06	1	60.8	80.0	0.1	1.0	1.3
Wyoming	W01	1	61.9	81.4	0.1	0.8	1.1

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	55.9	42.3	1.8	26.4	2.48
	C02	0.1	57.6	41.0	1.4	27.5	2.52
	C03	0.1	56.6	41.6	1.8	28.3	2.56
Kansas	K01	0.1	53.6	44.8	1.6	27.6	2.54
	K02	0.1	59.1	39.4	1.5	30.4	2.66
	K03	0.1	66.2	32.6	1.1	31.1	2.66
	K04	0.1	66.2	32.4	1.4	29.9	2.66
	K05	1.3	66.5	31.7	1.8	28.5	2.63
	K06	0.1	64.0	34.6	1.4	27.6	2.53
	K07	0.1	67.6	31.2	1.2	30.9	2.67
	K08	0.1	63.4	35.1	1.5	30.7	2.67
	K09	0.1	64.8	33.7	1.5	30.5	2.67
	K10	0.2	61.5	36.9	1.6	28.1	2.58
Montana	M1	0.0	68.0	31.5	0.5	30.9	2.59
	M2	0.0	57.5	41.4	1.1	30.7	2.62
	M3	0.1	59.1	39.6	1.2	30.0	2.59
	M4	0.2	63.1	35.5	1.3	31.9	2.66
	M5	0.0	71.3	27.9	0.8	33.5	2.70
	M6	0.3	68.2	30.8	1.0	31.3	2.62
	M7	0.0	59.3	39.3	1.4	28.7	2.51
Nebraska	N01	0.2	61.7	37.1	1.1	28.0	2.52
	N02	0.2	58.0	40.0	2.0	27.6	2.49
	N03	0.2	65.2	33.4	1.3	25.4	2.46
	N04	0.0	60.7	37.6	1.7	28.7	2.60
	N05	0.4	65.9	32.6	1.6	28.2	2.55
Oklahoma	O01	0.0	57.7	40.8	1.5	30.8	2.66
	O02	0.2	62.3	36.1	1.6	30.2	2.68
	O03	0.1	58.5	40.6	0.9	29.7	2.60
	O04	0.2	57.5	41.0	1.5	28.5	2.58
	O05	0.1	55.6	42.3	2.1	28.5	2.58
	O06	0.6	61.3	36.8	1.9	28.9	2.63
	O07	0.6	55.8	42.3	1.9	28.2	2.61
South Dakota	SD01	0.2	62.0	36.7	1.3	30.2	2.61
	SD02	0.1	70.7	28.5	0.7	30.5	2.62
Texas	T01	0.1	60.5	38.0	1.5	29.5	2.61
	T02	0.1	62.8	35.7	1.6	30.8	2.64
	T03	0.0	59.4	38.4	2.2	29.8	2.60
	T04	0.1	59.1	40.3	0.6	30.1	2.62
	T05	0.1	57.0	41.0	2.1	31.6	2.66
	T06	0.2	58.4	40.4	1.2	30.2	2.64
Wyoming	W01	0.2	61.0	37.5	1.6	27.7	2.53

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.

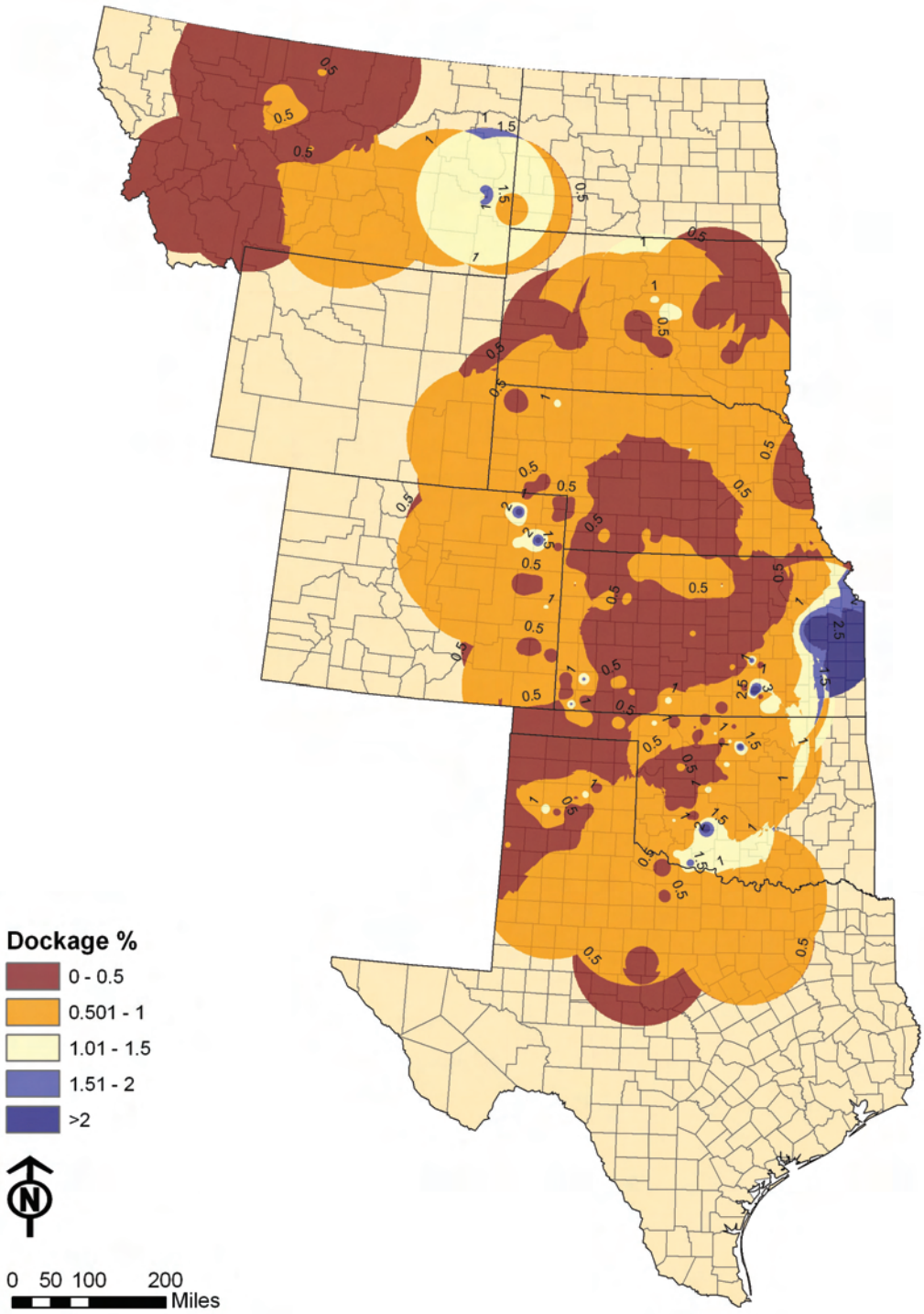
Falling number is an index of enzyme activity in wheat or flour and is expressed in seconds. Falling numbers above 300 are desirable, as they indicate little enzyme activity and a sound quality product. Falling numbers below 300 are indicative of more substantial enzyme activity and sprout damage.

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.

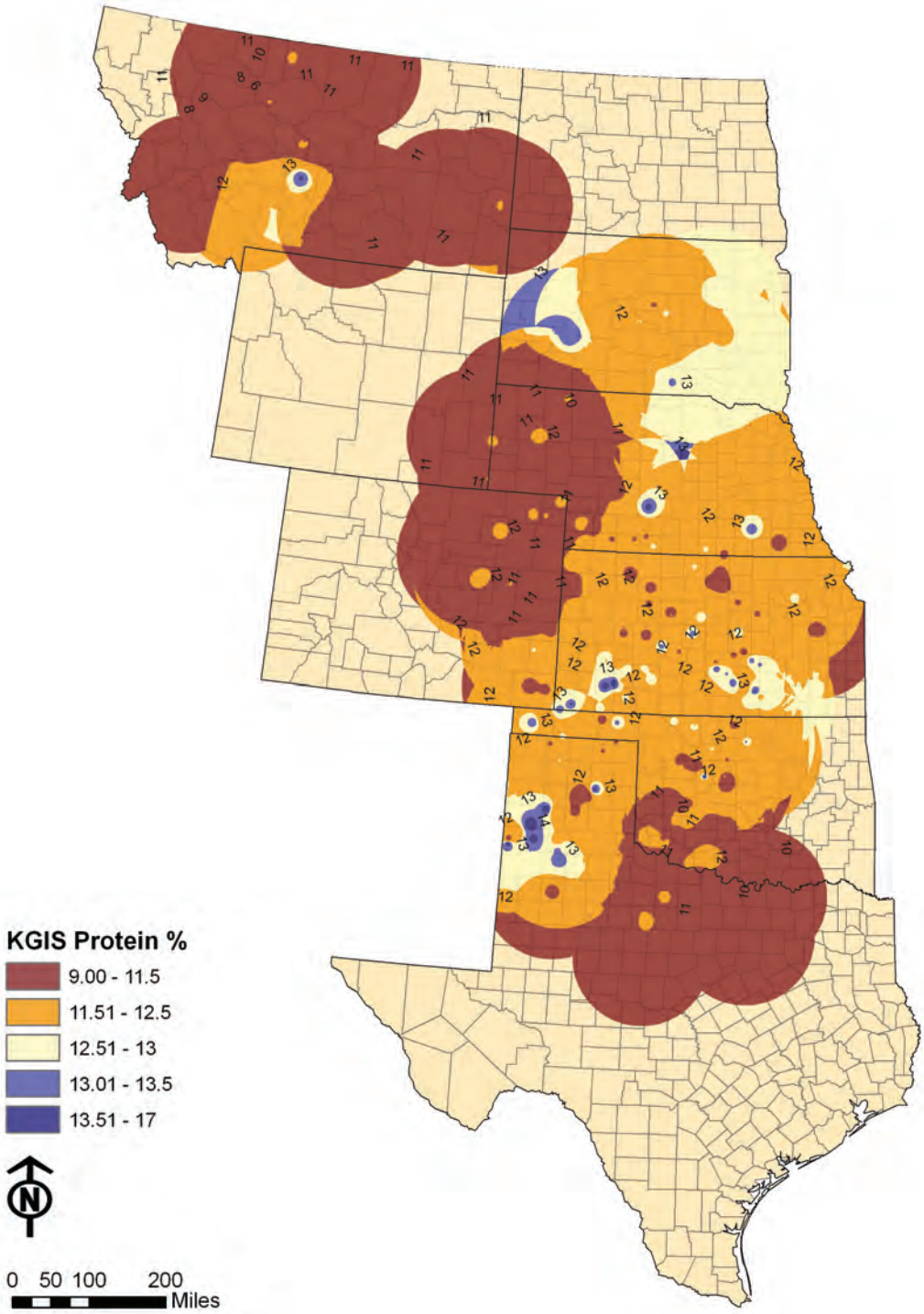
Kernel Size is a measure of the percentage by weight of large, medium and small kernels in a sample. Large kernels or more uniform kernel size may help improve milling yield.

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.

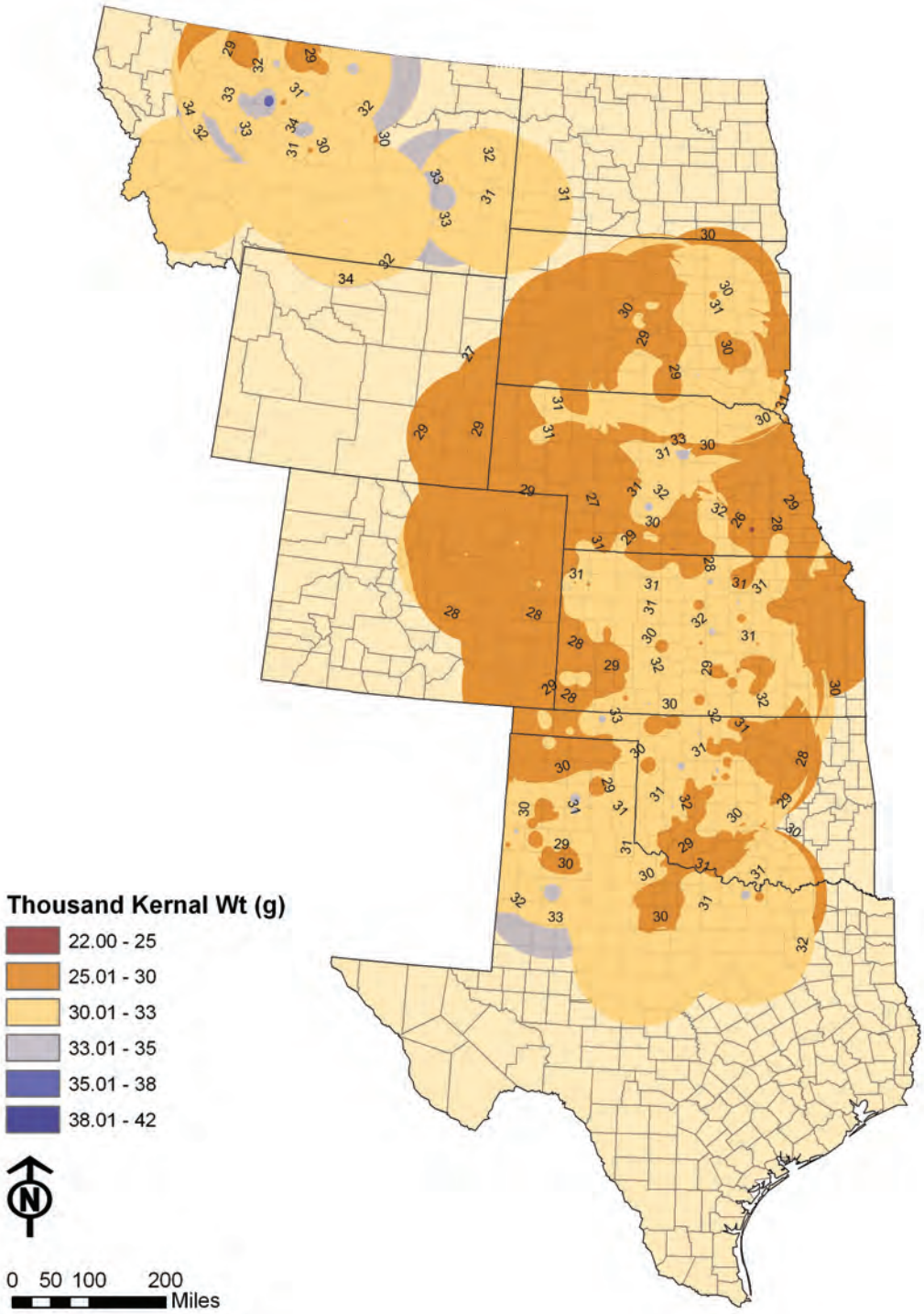
Dockage (%)



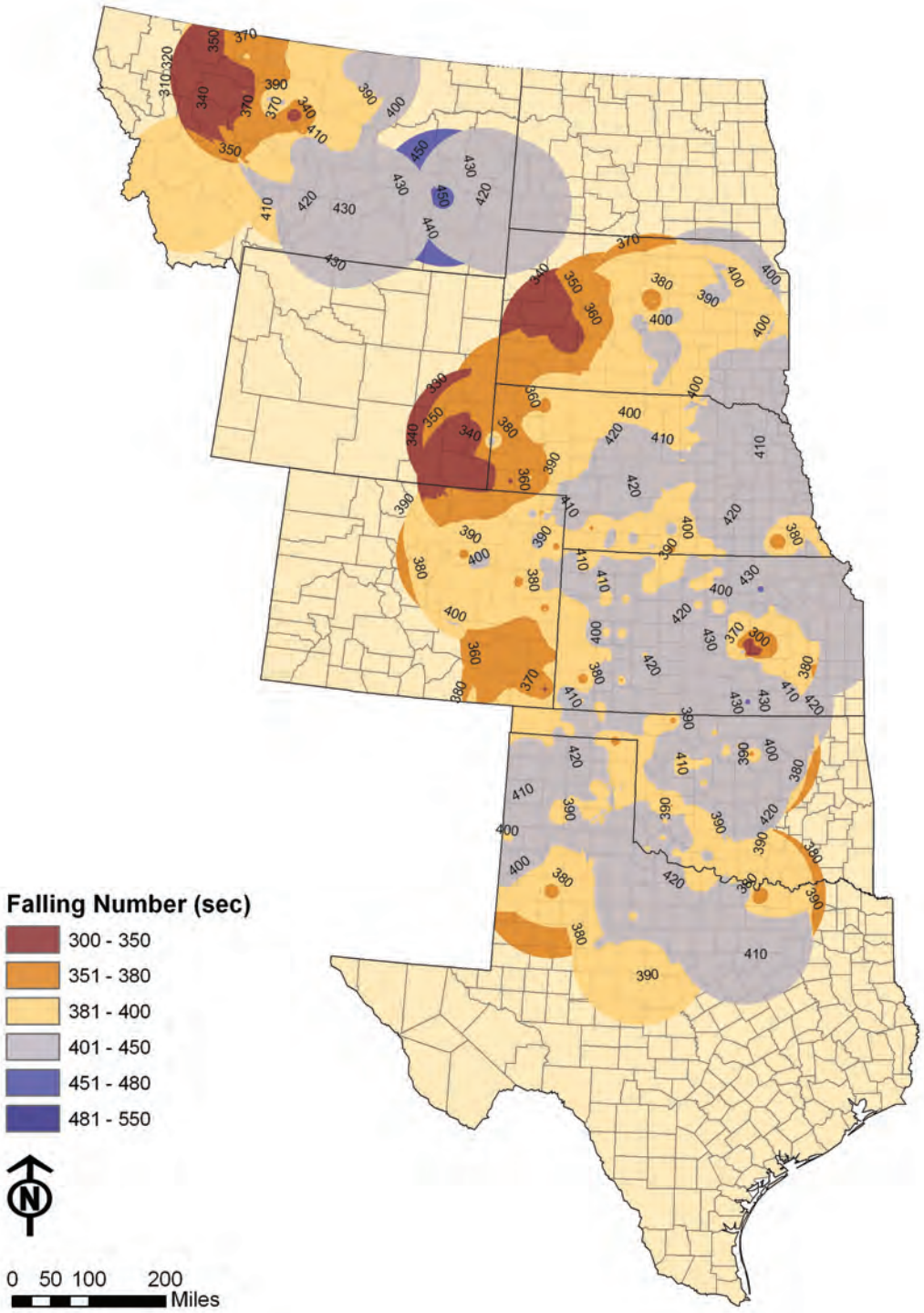
Protein (%)


KGIS 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	1.47	400	9.7	71.3
	C02	10.9	1.46	405	9.4	67.3
	C03	11.4	1.54	419	10.6	67.5
Kansas	K01	12.6	1.46	406	10.1	75.6
	K02	12.4	1.52	430	10.2	72.9
	K03	12.1	1.44	423	10.4	67.5
	K04	12.0	1.51	430	10.5	65.2
	K05	12.5	1.62	366	10.9	68.9
	K06	11.6	1.38	400	12.2	68.1
	K07	11.6	1.58	418	11.4	69.8
	K08	11.8	1.59	421	11.7	66.8
	K09	11.7	1.59	432	11.7	60.8
	K10	11.9	1.71	384	11.9	60.4
Montana	M1	11.0	1.46	438	10.9	74.1
	M2	10.9	1.35	366	11.3	72.7
	M3	11.3	1.39	366	10.7	72.4
	M4	11.0	1.45	399	11.5	68.3
	M5	11.2	1.47	397	11.1	69.2
	M6	11.6	1.49	393	11.4	68.9
	M7	11.8	1.50	400	11.4	72.3
Nebraska	N01	10.6	1.37	349	11.2	68.7
	N02	11.6	1.40	425	11.6	62.1
	N03	11.9	1.66	418	11.9	60.6
	N04	12.0	1.60	382	12.3	61.9
	N05	10.9	1.58	360	12.2	58.8
Oklahoma	O01	11.7	1.51	383	11.4	82.1
	O02	11.6	1.49	421	12.0	84.7
	O03	11.8	1.46	423	10.8	72.8
	O04	12.2	1.53	423	11.0	73.8
	O05	12.4	1.67	409	12.0	70.9
	O06	12.1	1.53	430	12.4	76.1
	O07	12.3	1.56	426	12.6	73.5
South Dakota	SD01	12.2	1.64	387	11.0	55.5
	SD02	12.3	1.68	413	11.6	55.2
Texas	T01	12.6	1.49	412	10.6	78.8
	T02	11.2	1.47	410	11.5	78.5
	T03	11.3	1.44	408	11.5	75.5
	T04	12.9	1.60	406	9.4	77.4
	T05	11.9	1.51	422	10.6	77.1
	T06	11.9	1.53	426	10.4	71.6
Wyoming	W01	11.0	1.34	357	11.8	72.9

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	70.6	47.6	9.7	0.39	97.7	92.95	-1.78	10.01
	C02	70.9	53.0	9.3	0.39	97.4	93.01	-1.94	10.54
	C03	70.4	56.7	9.8	0.39	99.0	92.80	-1.94	10.44
Kansas	K01	71.4	62.3	11.3	0.45	95.5	92.34	-1.74	10.90
	K02	70.8	60.8	10.8	0.41	98.8	92.80	-1.73	10.39
	K03	71.9	55.9	10.4	0.38	96.6	92.65	-1.71	10.39
	K04	70.9	51.8	10.3	0.40	97.2	92.57	-1.75	9.90
	K05	69.2	51.5	10.5	0.46	97.1	92.27	-1.70	10.07
	K06	71.6	52.7	9.8	0.42	98.3	92.66	-1.82	10.50
	K07	71.2	49.2	9.8	0.43	97.2	92.71	-1.78	10.22
	K08	71.0	52.1	10.1	0.41	97.5	92.79	-1.82	10.23
	K09	71.2	47.0	9.9	0.41	98.1	92.67	-1.83	10.08
	K10	69.0	47.5	10.0	0.45	98.8	92.45	-1.79	10.16
Montana	M1	71.1	56.0	9.7	0.40	97.9	92.86	-1.81	10.52
	M2	71.4	59.5	9.7	0.38	99.2	93.01	-1.84	9.84
	M3	72.4	61.9	9.7	0.39	98.8	92.93	-1.88	10.35
	M4	71.9	55.7	9.8	0.40	99.2	93.07	-2.25	10.74
	M5	72.0	57.1	9.9	0.39	98.9	93.12	-2.20	10.49
	M6	71.6	51.6	10.3	0.39	97.0	93.13	-2.15	10.36
	M7	70.6	64.8	10.9	0.41	98.3	92.88	-2.13	10.42
Nebraska	N01	70.7	48.6	8.9	0.40	98.9	92.72	-2.04	10.63
	N02	71.3	52.1	9.7	0.38	97.9	92.60	-1.94	10.67
	N03	67.3	50.6	10.1	0.37	98.8	92.74	-1.85	10.20
	N04	70.0	53.0	10.3	0.40	98.5	92.43	-1.72	10.09
	N05	71.0	44.8	9.3	0.39	98.0	92.84	-1.89	9.77
Oklahoma	O01	71.2	51.2	10.0	0.45	98.5	92.40	-1.89	11.35
	O02	71.0	46.5	9.9	0.44	97.3	92.16	-1.83	11.42
	O03	69.9	56.6	10.0	0.45	96.3	92.54	-1.74	10.55
	O04	70.8	50.5	10.8	0.42	95.4	92.25	-1.66	10.48
	O05	71.7	55.7	10.6	0.47	96.5	92.02	-1.71	10.50
	O06	70.4	50.8	10.4	0.47	97.5	91.69	-1.80	11.09
	O07	70.3	48.2	10.6	0.46	97.3	91.84	-1.94	11.52
South Dakota	SD01	73.2	59.0	10.6	0.41	98.8	92.65	-1.83	9.98
	SD02	72.9	56.4	10.7	0.41	97.8	92.64	-1.76	9.96
Texas	T01	70.0	55.0	10.9	0.42	98.1	92.49	-1.71	10.86
	T02	70.2	49.4	9.6	0.41	98.7	92.40	-1.91	10.98
	T03	70.7	44.4	9.6	0.41	98.5	92.60	-1.91	10.56
	T04	69.5	47.8	11.2	0.43	82.0	92.71	-1.83	10.84
	T05	69.9	56.5	10.4	0.43	96.9	92.58	-1.79	10.75
	T06	69.9	55.1	10.1	0.44	97.7	92.41	-1.69	10.50
Wyoming	W01	69.4	46.8	9.1	0.39	99.2	92.56	-1.98	10.74

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.

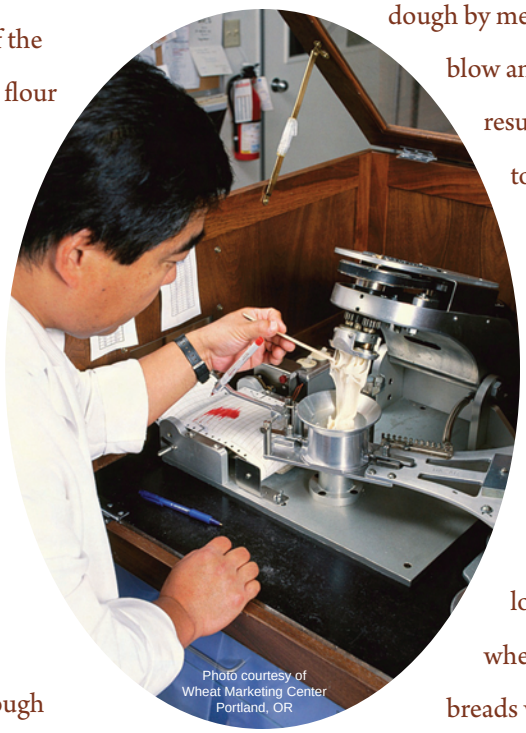


Photo courtesy of
Wheat Marketing Center
Portland, OR

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	70	88	211	0.8	55.5	5.3	11.8	31
	C02	75	82	220	0.91	54.9	2.5	9.8	23
	C03	76	71	201	1.07	56.1	5.7	11.6	29
Kansas	K01	86	80	258	1.08	56.7	6.5	16.6	17
	K02	78	102	275	0.76	56.7	5.3	14.4	22
	K03	73	77	206	0.95	56.3	6.0	11.1	39
	K04	67	72	186	0.93	55.9	3.4	11.0	24
	K05	74	89	244	0.83	56.1	5.0	11.0	34
	K06	68	95	229	0.72	55.5	5.0	10.9	33
	K07	71	80	206	0.89	55.5	4.8	10.7	29
	K08	76	88	247	0.86	55.9	5.4	13.3	27
	K09	62	97	219	0.64	54.4	2.9	10.8	20
	K10	63	77	193	0.82	54.7	2.0	7.2	52
Montana	M1	92	71	254	1.3	57.6	2.3	13.1	12
	M2	91	83	288	1.1	56.5	3.0	14.8	13
	M3	83	88	274	0.94	57.0	2.4	13.7	15
	M4	88	83	273	1.06	57.5	2.5	10.3	18
	M5	91	93	310	0.98	58.5	3.0	12.9	15
	M6	77	93	240	0.83	58.0	5.2	11.3	27
	M7	77	101	283	0.76	58.2	5.2	13.1	27
Nebraska	N01	70	85	209	0.82	54.7	2.2	9.0	30
	N02	68	78	200	0.87	55.0	2.9	11.1	16
	N03	62	80	191	0.77	54.1	3.2	11.4	20
	N04	63	86	198	0.73	55.1	4.5	12.0	25
	N05	62	83	184	0.75	54.2	1.9	9.5	27
Oklahoma	O01	87	92	277	0.95	58.5	5.7	11.1	33
	O02	94	65	229	1.45	58.9	4.7	10.9	31
	O03	75	69	199	1.09	57.4	3.8	10.7	25
	O04	67	83	197	0.81	56.6	6.8	14.2	25
	O05	75	77	215	0.97	57.6	5.0	12.4	23
	O06	82	78	234	1.05	57.2	4.8	10.3	31
	O07	83	91	270	0.91	56.6	6.3	12.8	31
South Dakota	SD01	58	107	226	0.54	55.0	4.5	11.3	30
	SD02	56	105	211	0.53	55.0	3.9	10.1	31
Texas	T01	91	75	252	1.21	58.4	5.8	16.2	21
	T02	86	94	281	0.91	57.6	5.8	12.7	27
	T03	65	82	193	0.79	57.1	5.5	11.6	31
	T04	77	79	201	0.97	59.9	5.7	11.9	30
	T05	79	81	229	0.98	58.8	4.7	14.8	12
	T06	76	87	242	0.87	56.5	3.5	12.6	18
Wyoming	W01	86	66	210	1.3	56.9	2.3	9.8	16

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	5.1	59.3	770	5.5	7.0	dull
	C02	5.0	58.7	745	4.8	5.5	dull
	C03	5.1	60.7	770	4.0	7.0	slightly yellow
Kansas	K01	5.0	60.6	900	6.3	7.0	dull
	K02	5.4	62.3	865	7.0	7.0	dull
	K03	4.5	61.0	830	5.5	7.0	slightly yellow
	K04	4.9	60.3	795	7.0	7.0	dull
	K05	5.0	60.7	825	7.0	7.0	creamy
	K06	6.0	61.1	820	5.5	7.0	dull
	K07	5.0	61.0	825	7.0	7.0	dull
	K08	5.6	61.5	800	6.3	7.0	dull
	K09	5.5	59.6	825	7.0	7.0	dull
	K10	6.9	60.6	800	4.8	7.0	dull
Montana	M1	6.3	61.6	785	6.3	7.0	slightly yellow
	M2	6.5	60.9	765	5.5	7.0	dull
	M3	7.0	61.7	775	4.0	5.5	dull
	M4	6.1	61.2	780	6.3	7.0	dull
	M5	6.0	61.7	800	4.0	7.0	dull
	M6	4.1	59.0	805	4.8	7.0	dull
	M7	5.0	60.9	825	4.0	7.0	dull
Nebraska	N01	5.5	58.9	765	4.8	7.0	dull
	N02	5.0	59.9	800	7.7	7.0	dull
	N03	4.8	59.9	825	5.5	7.0	slightly yellow
	N04	5.5	60.4	800	5.5	7.0	dull
	N05	5.5	59.3	780	7.0	7.0	dull
Oklahoma	O01	5.3	60.1	775	6.3	7.0	slightly yellow
	O02	6.0	60.6	750	5.5	7.0	slightly yellow
	O03	5.8	60.0	850	7.0	7.0	dull
	O04	4.0	60.7	850	6.3	7.0	dull
	O05	4.8	62.9	850	7.0	7.0	dull
	O06	5.3	60.4	805	4.0	7.0	slightly yellow
	O07	5.0	61.0	845	6.3	5.5	dull
South Dakota	SD01	6.0	60.4	885	4.0	5.5	dull
	SD02	6.4	61.6	850	6.3	7.0	dull
Texas	T01	5.3	59.8	880	6.3	7.0	dull
	T02	6.3	60.0	825	5.3	7.0	slightly yellow
	T03	5.0	59.9	760	7.0	7.0	slightly yellow
	T04	3.6	61.2	895	6.3	7.0	dull
	T05	5.0	60.8	850	4.0	7.0	slightly yellow
	T06	5.5	61.0	815	5.5	5.5	slightly yellow
Wyoming	W01	5.3	58.2	735	4.0	7.0	dull

Methods

The harvest samples were evaluated using these methods:

Grade: Official U.S. Standards for Grain.

Dockage: Official USDA procedure using the Carter Dockage Tester.

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

Moisture: DJ Gac 2100.

Protein: NIRT method

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

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

Kernel Size Distribution: Cereal Foods World (Cereal Science Today) 5:71-71, 75 (1960). Wheat is sifted with a RoTap sifter using a Tyler No. 7 screen (2.82 mm) and a Tyler No. 9 Screen (2.00 mm).

Kernels retained on the No. 7 screen are classified as "Large." Kernels passing through the No. 7 screen and retained on the No. 9 screen are "Medium." Kernels passing through the No. 9 screen are "Small".

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

Extraction: Samples cleaned and tempered according to AACC Method 26-10A. All were milled with

identical mill settings on a Buhler laboratory mill as follows: AACC Method 26-21A.

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

Falling Number: AACC Method 56-81B.

Wet Gluten & Gluten Index: AACC Method 38-12Farinograph: 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.