2006
Hard Red Winter
Wheat Quality Report

Wheat Quality Report

Wheat supplies approximately 20 percent of food calories for the world's population and wheat or wheat flour is the major ingredient in many favorite food items found all across the world. Wheat has the ability to produce such a widely diverse range of end-use products because each class of wheat has distinct characteristics that lead to a unique end-use functionality. The most common class produced in the U. S is hard red winter (HRW) wheat. HRW wheat is known as 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 is commonly used as an improver for blending. HRW wheat accounts for about 40 percent of total U.S. wheat production and is grown primarily in the Great Plains.

Hard Red Winter Wheat Production Overview

The 2006 winter wheat planted acreage is up 2 percent from 2005. Of the 41.4 million acres of winter wheat planted, 29.7 million acres were HRW. While the National Agricultural Statistics Service's (NASS) Acreage Report shows an overall increase in planted acres of winter wheat, harvested acreage is down from the previous crop year due mostly to the drought conditions in the Great Plains region that extends from Texas to South Dakota. Total winter wheat production is forecast at 1.28 billion bushels, 660 million of which is HRW. In Oklahoma, acres planted to wheat increased a corresponding 2 percent from 2005, with planted acres estimated at 5.8 million in the state. However, acres harvested for grain are down 22 percent from last year at 3.1 million.

Harvest progressed ahead of normal in the 2006 crop year in all HRW wheat producing states except Montana due to the drought conditions across the region, which accelerated crop development and maturation. In Oklahoma, late-developing wheat in the major-producing areas was helped by rainfall during June.

Beginning stocks for 2006/07 are up 19 million bushels from 2005, which partially offsets 270 million fewer bushels produced in this crop year. Net results show 250 million fewer bushels of HRW supplies in 2006/07. Projected HRW domestic use for 2006/07 is down 46 million bushels year-to-year as food use and feed and residual use are down 12 million bushels and 36 million bushels, respectively. Projected ending stocks for 2006/07 are 134 million bushels, 79 million bushels less than 2005/06.

Data in this segment is derived from the Wheat Outlook issued by the Economic Research Service through USDA. For the most current Wheat Outlook information, visit www.nass.usda.gov.

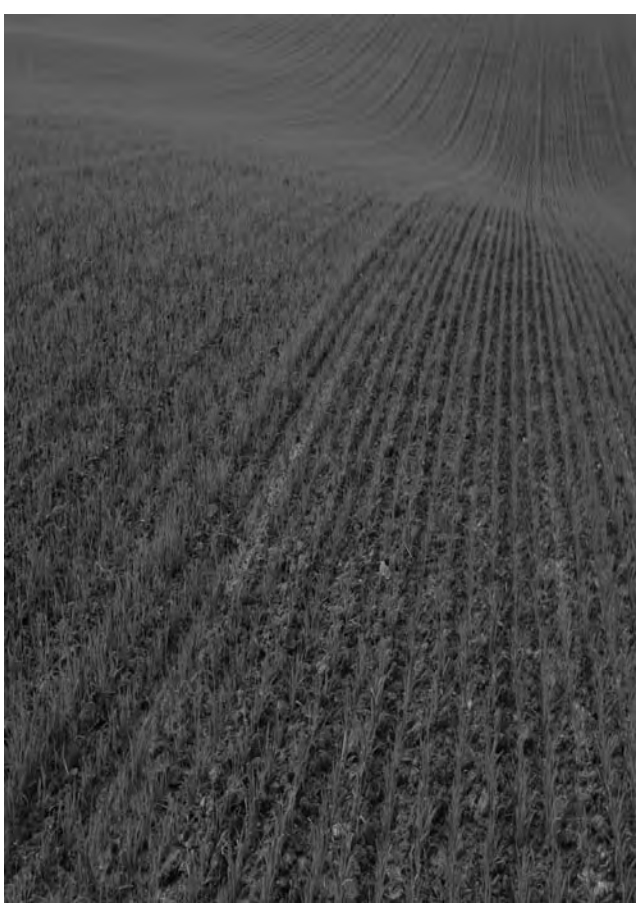
Regional Production Conditions

From Texas toMontana, much of the HRW production region was hit by warm temperatures and drought. The drought reduced overall production by 25%, although the southern states suffered bigger losses.

Much of **Texas** had record high temperatures and record low rainfall. In the High Plains, or the northwest part of Texas, the drought resulted in many fields not having adequate moisture to emerge after planting. Much of what did emerge was so thin that field were abandoned or grazed out. The north central part of Texas, called the Blacklands, had adequate moisture to produce a crop, if it was seeded before October 31. Fields planted after that date were able to emerge, but did not have enough cold days to vernalize and produce grain. Overall, harvested acres were 1.4 million, down 53% from 2005 and production is only 36% of the 10 year production average. (Publication Text)

Oklahoma saw a similar situation. A few areas across the state saw some rain in September and early October, but the majority did not receive significant rainfall until April. Fields emerging in September and October had adequate moisture for emergence and growth in the fall and early winter months that allowed grazing. Although there was enough moisture for initial grazing, the dry conditions did not allow for re-growth during or after grazing and yields on grazed fields were much less than nongrazed wheat. Overall the Oklahoma crop is 50% below the 10 year production average. (Publication Text)

In **Kansas**, conditions were very uneven and overall the state experienced a mild, but dry winter. Some areas started out with above average moisture, while others were contrastingly dry. By April, the western third of the state was 40% behind normal rainfall. A late freeze further injured the crops in that area. In May and June, the state received scattered rainfall and hail storms allowing some areas to benefit from the moisture, while others were hurt by the hail. Although parts of Kansas were hit hard by the drought, production still came in at 81% of the 10 year production average. (Publication Text)



Colorado also suffered from serious drought. The state received significant moisture in October which resulted in the mid-March crop rating from USDA NASS being mostly fair to good. However, hot, dry conditions depleted the soil of moisture and by July, Colorado was experiencing one of the lowest yielding crops since 1968. The overall yield ended up 43% below the 10 year production average. (**2006 Colorado Winter Wheat Variety Performance Trial Results** *Jerry Johnson and Scott Haley (July 2006)* ***Performance Trial Results Help Colorado Wheat Producers Make Better Variety Decisions)***

Nebraska had adequate moisture for seeding in September and early October. However, the state received little moisture from September through late March and crop conditions began to decline. In late March and early April, precipitation was received in the form of snow and rain and much of Nebraska saw adequate moisture in early spring, with a majority of the crop rating fair or good. In May, some areas received rain, but hot and windy weather stressed the crop and conditions began declining. By harvest, half of the crop was very poor to poor, but the 2006 crop was able to produce 97% of the 10 year production average. (NASS NE Field Office)

Regional Production Conditions

South Dakota began planting in early September in very dry conditions. Precipitation did not come until later in the fall, delaying germination. Delayed germination and continued dry weather led to little fall growth. There was some snowfall in December, and at mid-February, the crop was 17% very poor/poor and 70% fair to good. Conditions did not improve and precipitation was below normal with many areas having the record driest January to June. By harvest time in July, very poor/poor had increased to 51% and fair to good was only 46%. The 2006 crop is 19% below the 10 year production average. (South Dakota State University Cooperative Extension, NASS SD Field Office)

Montana was the only state that did not experience a drought. Planting began with dry conditions in September, but in mid-October there was significant rainfall across the state. Montana received good precipitation through the winter, with fair, good, and excellent crop conditions ratings from USDA totaling 88% or higher through winter. Early spring brought dryer conditions, but still more than half the state had adequate moisture. Montana had wet weather at the end of April, and although that was the last really wet month, growing conditions for wheat were very favorable, with 91% of the crop being rated fair or better at harvest. Montana's production was equal to that of last year, which is 82% above the 10 year production average. (NASS, MT Field Office)

Disease and Insects

The Texas and Oklahoma Panhandles and southern Kansas attributed the largest portion of disease problems to wheat streak mosaic and high plains virus. These viruses hit already stressed plants and resulted in the destruction of many fields. This was a common problem in Texas, Oklahoma and Kansas and it did not highly impact the other states. Last year, the HRW region was hit hard by leaf rust and stripe rust. These diseases flourish in cool, moist conditions, thus, both types of rust were well below normal. Texas, Kansas, and Colorado had localized problems with greenbugs and a variety of aphids, but overall damage sustained from insects was minimal. Oklahoma suffered significant losses to the armyworm and Hessian fly in the fall of 2005 and the Hessian fly and greenbugs in the spring of 2006.

Hard Red Winter Wheat Production Charts

HRW Wheat Production (1,000 bu.)								
State	2000	2001	2002	2003	2004	2005	2006	95-'05 Average
Oklahoma	142,800	122,100	103,600	179,400	164,500	128,000	71,300	141,973
Colorado	68,150	66,000	36,300	77,000	45,900	52,800	42,000	73,473
Kansas	347,800	328,000	270,600	480,000	314,500	380,000	300,800	371,891
Montana	44,550	19,140	21,840	67,340	66,830	94,500	94,500	51,917
Nebraska	59,400	59,200	50,160	83,720	61,050	68,640	68,640	70,588
South Dakota	53,760	11,840	20,100	61,490	56,250	65,560	39,600	48,665
Texas	66,000	108,800	78,300	96,600	108,500	96,000	35,000	98,455
Wyoming	4,080	2,880	2,375	3,915	3,510	4,350	N/A	4,822
Regional Total	786,540	717,960	583,275	1,049,465	821,040	889,850	651,840	861,784

** Data derived from Crop Production report issued by USDA NASS updated July 12, 2006.*

HRW Harvested Acres (1,000 Acres)								
State	2000	2001	2002	2003	2004	2005	2006	95-'05 Average
Oklahoma	4,200	3,700	3,700	4,600	4,700	4,000	3,100	4,518
Colorado	2,350	2,000	1,650	2,200	1,700	2,200	2,000	2,241
Kansas	9,400	8,200	8,200	10,000	8,500	9,500	9,400	9,436
Montana	1,350	870	780	1,820	1,630	2,100	1,950	1,415
Nebraska	1,650	1,600	1,520	1,820	1,650	1,760	1,650	1,782
South Dakota	1,280	370	670	1,430	1,250	1,490	1,100	1,220
Texas	2,200	3,200	2,700	3,450	3,500	3,000	1,400	3,195
Wyoming	170	120	125	145	135	145	N/A	169
Regional Total	22,600	20,060	19,345	25,465	23,065	24,195	20,600	23,977

** Data derived from Crop Production report issued by USDA NASS updated July 12, 2006.*

HRW Wheat Yield (bu/ac)								
State	2000	2001	2002	2003	2004	2005	2006	95-'05 Average
Oklahoma	34	33	28	39	35	32	23	32
Colorado	29	33	22	35	27	24	21	32
Kansas	37	40	33	48	37	40	32	39
Montana	33	22	28	37	41	45	40	36
Nebraska	36	37	33	46	37	39	34	40
South Dakota	42	32	30	43	45	44	36	39
Texas	30	34	29	28	31	32	25	31
Wyoming	24	24	19	27	26	30	N/A	28
Regional Avg	33	32	28	38	35	36	30	34

** Data derived from Crop Production report issued by USDA NASS updated July 12, 2006.*

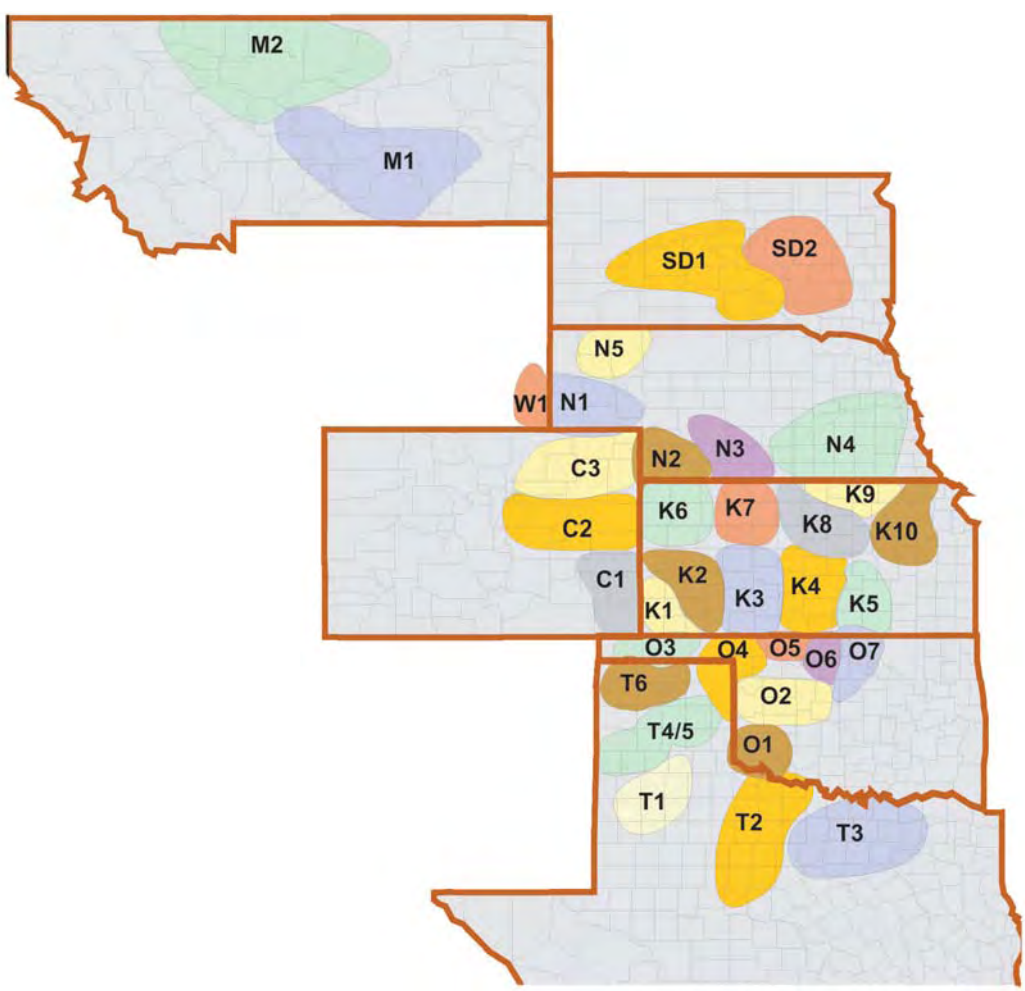
Survey Methodology

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 has a different approach for compositing survey samples. Historically, the U.S. HRW wheat crop quality survey has been performed on the basis of "crop reporting districts." The uniqueness of the data produced by PGI originates from the manner in which the crop is tested and defined. 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 CII Laboratory Services in Kansas City, Missouri, where they are analyzed and tested for more than 25 quality parameters that have proven important to foreign HRW wheat buyers. All quality testing data and maps in this publication have been provided by CII Laboratory Services.

PGI Plains Grains Inc.



Wheat 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.

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 of total)	0.2	0.2	0.5	1.0	3.0
Total	2.0	4.0	7.0	10.0	15.0
Foreign Material	0.4	0.7	1.3	3.0	5.0
Shrunken and Broken Kernels	3.0	5.0	8.0	12.0	20.0
Total*	3.0	5.0	8.0	12.0	20.0
WHEAT OF OTHER CLASSES**					
Contrasting Classes	1.0	2.0	3.0	10.0	10.0
Total***	3.0	5.0	10.0	10.0	10.0
Stones	0.1	0.1	0.1	0.1	0.1
MAXIMUM COUNT LIMITS OF:					
OTHER MATERIAL (1,000 gram sample):					
Animal Filth	1	1	1	1	1
Castor Beans	1	1	1	1	1
Crotalaria Seeds	2	2	2	2	2
Glass	0	0	0	0	0
Stones	3	3	3	3	3
Unknown Foreign Substance	3	3	3	3	3
Total****	4	4	4	4	4
INSECT-DAMAGED KERNELS (in 100 grams)	31	31	31	31	31

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

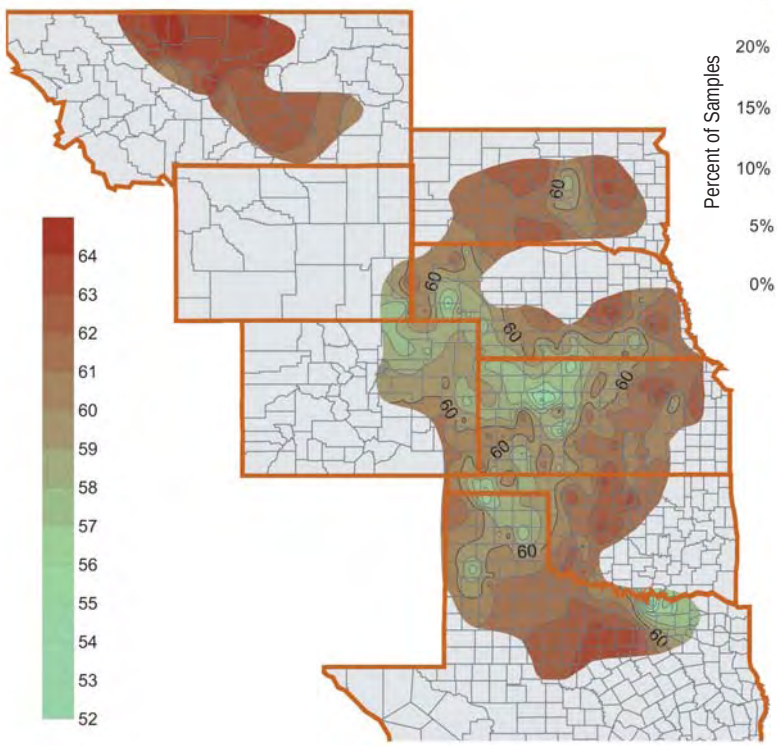
* Includes damaged kernels (total), foreign material, and shrunken and broken kernels.
**Unclassed wheat of any grade may contain not more than 10.0 percent of wheat of other classes.
***Includes contrasting classes.
****Includes any combination of animal filth, castor beans, crotalaria seeds, glass,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

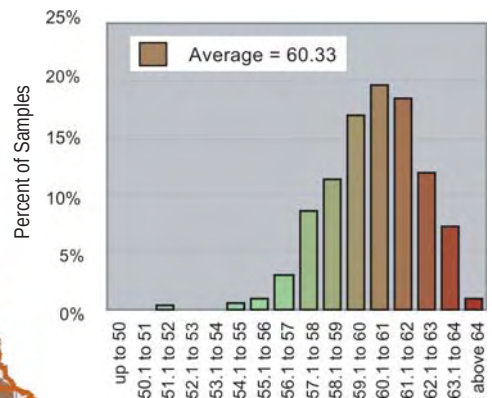
Wheat Grading Data

	Test Weight		Damaged Kernels Total	Foreign Material	Shrunken/ Broken Kernels	Total Defects	Wheat of Other Class	Wheat of Other Classes	Grade
	LBS/BU	KG/HL	%	%	%	%	%	%	US #
Texas									
T1	60.6	79.7	0.1	1.3	1.4	2.8	0.0	0.0	3
T2	61.6	81.0	0.2	0.0	1.6	1.8	0.0	0.0	1
T3	60.0	78.9	0.1	0.0	1.3	1.4	0.0	0.0	2
T4/T5	59.2	77.9	0.2	0.3	1.5	2.0	0.0	0.0	2
T6	58.6	77.2	0.3	0.1	1.7	2.1	0.0	0.0	2
Oklahoma									
O1	61.4	80.7	0.1	0.1	1.2	1.4	0.0	0.0	1
O2	62.2	81.8	0.1	0.2	1.1	1.3	0.0	0.0	1
O3	59.0	77.7	0.3	0.2	1.0	1.6	0.4	0.0	2
O4	60.0	78.9	0.2	0.5	1.9	2.6	0.0	0.0	2
O5	61.8	81.3	0.1	0.3	1.4	1.8	0.0	0.0	1
O6	62.0	81.5	0.1	0.1	0.9	1.1	0.0	0.0	1
O7	61.7	81.2	0.2	0.1	0.9	1.2	0.0	0.0	1
Kansas									
K1	60.0	78.9	0.0	0.0	1.7	1.8	0.3	0.0	2
K2	59.4	78.2	0.0	0.1	1.0	1.1	0.0	0.0	2
K3	59.3	78.1	0.3	0.0	1.0	1.3	0.6	0.1	2
K4	61.1	80.4	0.2	0.1	0.7	0.9	0.0	0.0	1
K5	61.1	80.4	0.2	0.1	0.5	0.7	0.0	0.0	1
K6	58.2	76.6	0.5	0.1	0.8	1.3	0.0	0.0	2
K7	57.1	75.1	0.4	0.1	1.0	1.5	0.0	0.0	3
K8	60.5	79.6	0.1	0.1	1.4	1.6	0.0	0.0	1
K9	60.4	79.4	0.3	0.1	0.8	1.2	0.0	0.0	1
K10	61.7	81.2	0.1	0.0	0.8	0.9	0.0	0.0	1
Colorado									
C1	60.0	78.9	0.1	0.0	1.6	1.7	2.5	0.0	2
C2	59.1	77.7	0.2	0.1	1.4	1.7	0.8	0.0	2
C3	58.8	77.4	0.1	0.0	1.5	1.6	0.0	0.0	2
Nebraska									
N1	59.2	77.9	0.0	0.1	1.9	2.0	0.0	0.0	2
N2	59.0	77.7	0.2	0.0	1.1	1.3	0.4	0.0	2
N3	59.5	78.3	0.3	0.0	0.9	1.2	0.0	0.0	2
N4	60.8	80.0	0.2	0.1	0.6	0.9	0.0	0.0	1
N5	60.2	79.2	0.1	0.2	1.8	2.1	0.0	0.0	1
Wyoming									
W1	59.7	78.5	0.0	0.1	1.2	1.3	0.0	0.0	2
South Dakota									
SD1	61.8	81.2	0.2	0.1	1.3	1.5	0.0	0.0	1
SD2	61.6	81.0	0.2	0.0	1.1	1.2	0.0	0.0	1
Montana									
M1	62.4	82.1	0.0	0.0	1.4	1.4	0.0	0.0	1
M2	63.8	83.9	0.1	0.0	0.9	1.1	0.0	0.0	1

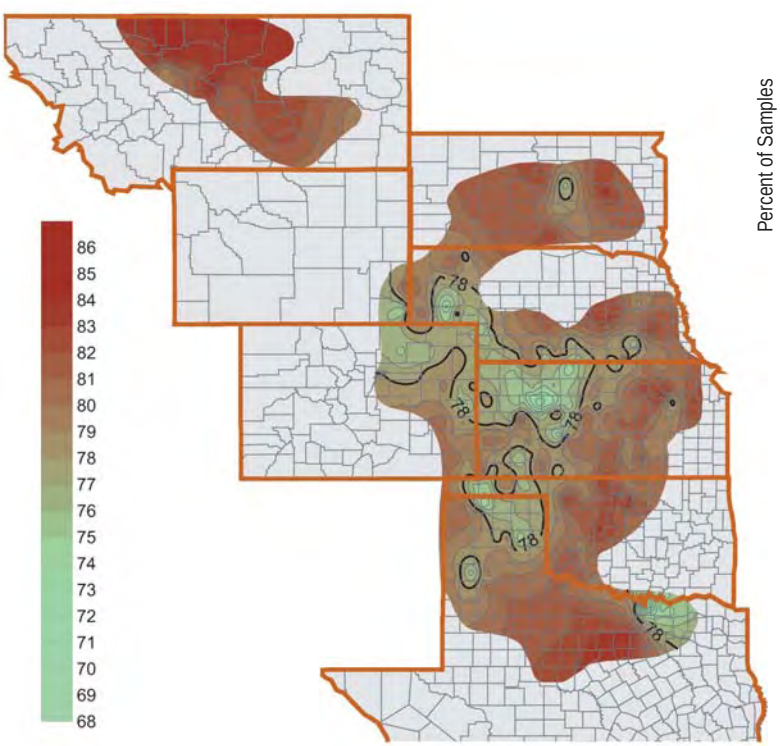
Wheat Characteristics

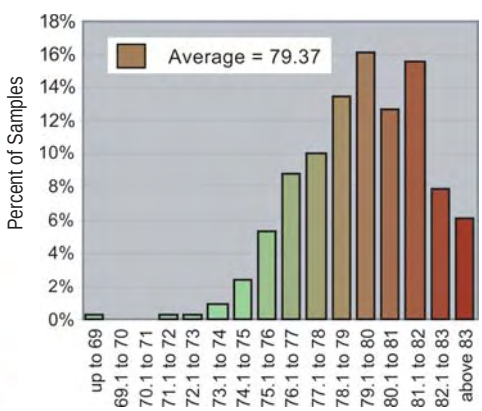
Test Weight (lb/bu)





Test Weight (kg/hl)



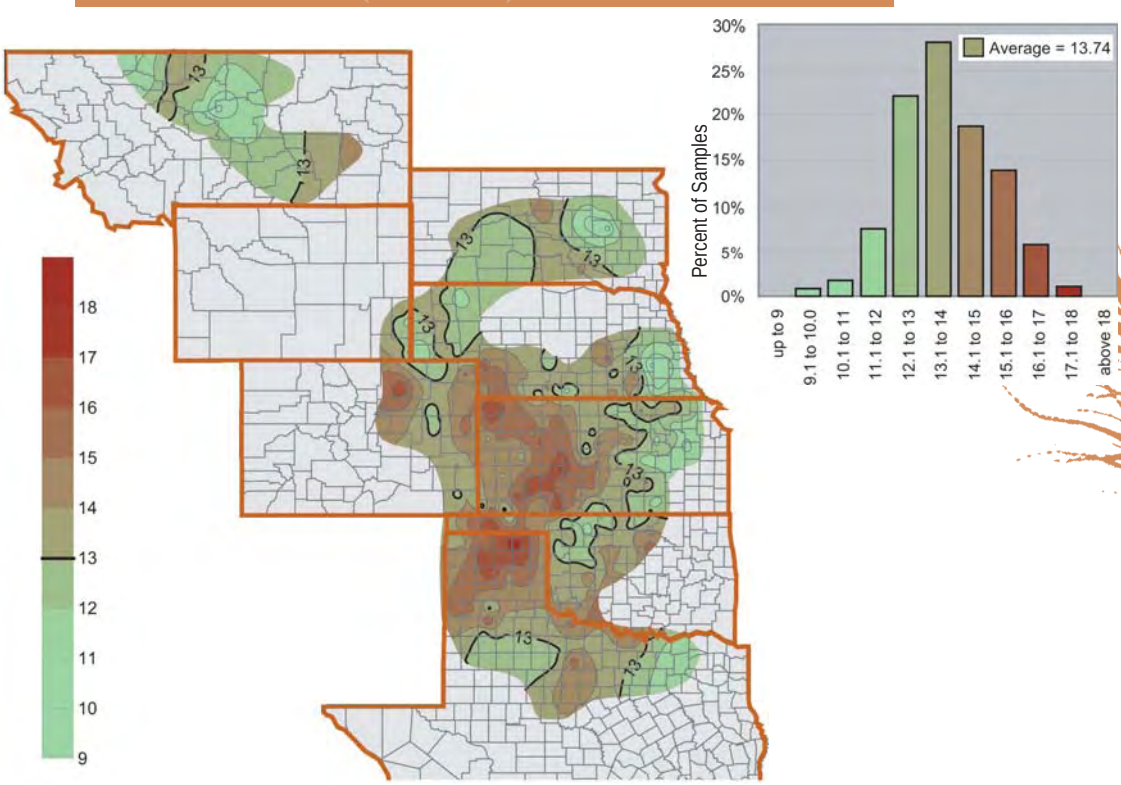


Wheat Characteristics

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, thousant-kernel weight (TKW), and falling number.

- *Moisture content* is an indicator of grain condition and storability. Moisture content is often standardized (12 or 14 percent moisture basis) for other tests that are affected by moisture content.
- *Protein content* relates to many important processing properties, such as water absorption and gluten strength, and to finished product attributes such as texture and appearance. Higher protein dough usually absorbs more water and takes longer to mix. HRW wheat generally has a medium to high protein content, making it most suitable for all-purpose flour and chewy-texture breads.
- *Ash content* also indicates milling performance and how well the flour seperates from the bran. 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. Millers tend to prefer larger berries, or at least berries with a consistent size.
- *Falling number* is an index of enzyme activity in wheat or flour and is expressed in seconds. Falling numbers above 300 are desireable, as they indicate little enzyme activity and a sound quality product; whereas falling numbers below 300 are indicative of more substantial enzyme activity and sprout-damage.

Wheat Protein (12% mb)



Wheat Characteristics

Wheat Non-Grade Data

	Dockage	Moisture	Protein 12% mb	Wheat Ash 14% mb	Thousand Kernel Weight	Falling Number
	%	%	%	%	g	sec
Texas						
T1	1.0	9.5	14.4	1.49	25.5	445
T2	0.7	12.3	13.0	1.48	32.0	347
T3	2.1	11.5	13.0	1.51	23.9	330
T4/T5	0.8	9.6	15.0	1.62	29.3	402
T6	0.9	10.3	15.7	1.78	24.0	359
Oklahoma						
O1	0.8	11.9	13.8	1.49	25.7	383
O2	0.4	11.5	13.3	1.55	25.3	394
O3	0.8	10.6	15.1	1.63	20.5	354
O4	0.7	10.0	15.4	1.58	25.8	404
O5	0.7	11.3	12.1	1.42	28.8	406
O6	0.3	11.0	13.3	1.43	30.7	382
O7	0.4	11.4	13.1	1.47	30.4	388
Kansas						
K1	0.7	9.7	14.0	1.63	26.4	360
K2	0.4	11.1	14.8	1.69	25.1	362
K3	0.3	10.8	14.9	1.51	27.4	370
K4	0.6	12.2	13.9	1.47	32.8	395
K5	0.3	12.0	12.9	1.61	34.4	360
K6	0.4	11.5	15.1	1.46	26.3	443
K7	0.5	9.8	14.6	1.67	25.8	426
K8	0.3	11.4	13.0	1.51	30.4	404
K9	0.6	10.9	13.9	1.69	28.7	414
K10	0.4	12.1	11.6	1.58	33.2	405
Colorado						
C1	0.6	9.9	13.8	1.49	26.4	375
C2	0.9	11.5	14.1	1.56	25.9	392
C3	0.5	11.9	14.3	1.48	23.7	402
Nebraska						
N1	0.5	13.0	12.2	1.43	24.5	337
N2	0.5	10.0	14.7	1.48	25.2	388
N3	0.3	11.4	12.7	1.51	28.7	422
N4	0.5	12.0	13.3	1.65	28.3	385
N5	1.0	11.4	12.6	1.52	25.3	380
Wyoming						
W1	0.6	12.8	12.8	1.45	23.2	354
South Dakota						
SD1	0.4	10.5	13.4	1.50	28.3	418
SD2	0.6	11.1	12.4	1.59	26.7	419
Montana						
M1	0.6	8.9	13.2	1.46	26.6	403
M2	0.4	9.5	12.0	1.46	31.3	383

Kernel Characteristics

♦ *Single Kernel Characteristic System (SKCS)* test is a measurement of the weight, electrical current, and force need to crush the wheat kernels. Parameters reported included kernel weight, kernel diameter, moisture content, and kernel hardness.

Kernel Quality Data

	Kernel Distribution Small	Kernel Distribution Medium	Kernel Distribution Large	SKCS			
				Kernel Weight	Kernel Diameter	Kernel Moisture	Kernel Hardness
	%	%	%	mg	mm	%	
Texas							
T1	1	44	55	28.7	2.23	8.8	77
T2	2	59	39	27.1	2.12	12.7	82
T3	2	40	58	27.5	2.09	12.5	50
T4/T5	2	49	49	29.5	2.28	9.8	75
T6	3	58	39	26.2	2.06	10.9	76
Oklahoma							
O1	1	54	45	27.8	2.16	12.8	87
O2	1	52	47	27.9	2.21	12.3	86
O3	1	47	52	28.8	2.16	11.6	76
O4	2	53	45	27.5	2.20	10.0	74
O5	1	32	67	31.4	2.39	12.0	75
O6	0	26	74	33.4	2.48	12.6	77
O7	1	28	71	32.4	2.42	12.8	78
Kansas							
K1	1	51	48	27.4	2.14	9.8	78
K2	1	55	44	27.1	2.15	11.0	78
K3	1	46	53	24.8	2.09	10.7	78
K4	1	20	79	32.8	2.40	12.8	69
K5	0	19	81	34.1	2.55	12.9	70
K6	1	53	46	29.0	2.23	11.9	70
K7	1	50	49	28.2	2.21	10.5	65
K8	1	34	65	31.0	2.30	11.9	68
K9	1	38	61	31.1	2.33	11.0	59
K10	1	22	77	33.6	2.45	12.5	68
Colorado							
C1	2	53	45	29.2	2.20	10.2	75
C2	2	61	37	27.5	2.09	12.2	67
C3	3	69	28	24.4	1.96	12.5	72
Nebraska							
N1	2	64	34	27.7	2.08	13.5	64
N2	1	59	40	27.8	2.17	12.1	70
N3	1	35	64	28.8	2.21	11.8	62
N4	1	39	60	29.7	2.28	12.9	67
N5	2	60	38	26.6	2.04	12.8	66
Wyoming							
W1	2	75	53	25.6	2.01	13.6	72
South Dakota							
SD1	1	46	54	30.1	2.26	11.0	70
SD2	1	45	54	29.7	2.19	11.8	70
Montana							
M1	2	49	49	29.3	2.27	7.8	75
M2	1	36	63	31.6	2.36	9.5	73

**SKCS testing was done by Kansas State University's Wheat Quality Lab in the Depart of Grain Science and Industry*

Flour Characteristics

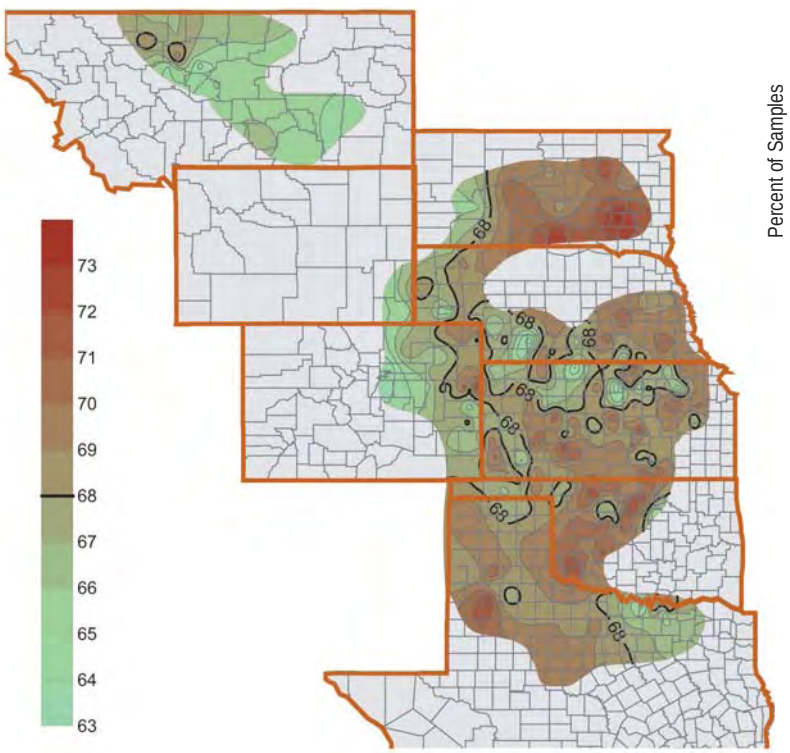
Flour is analyzed for indicators of milling efficiency and functionality properties. These include flour yield, flour ash, falling number and flour protein.

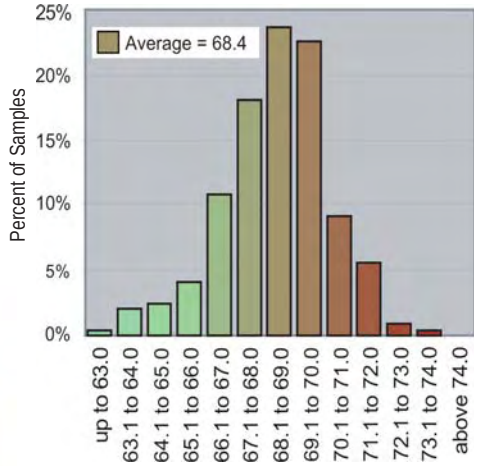
- *Flour yield* is expressed as a percentage and represents the portion of the wheat kernel that can be milled into flour, which is a significant indicator of milling profitability.
- Millers need to know the mineral content in wheat to achieve the desired ash levels in flour. *Ash content* is an indication 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.
- *Starch Damage* is a measurement of damaged starch granules, which may lead to greater capacity to absorb water and swell; therefore, damaged starch is a quality parameter that must be carefully controlled.
- *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.
- *Amylograph* measures flour starch properties and enzyme activity, which results from sprout damage that in turn leads to a lower peak viscosity. Peak viscosity is the maximum resistance to which the heated flour and water mixture must to be mixed.
- *Wet Gluten* data provides information regarding quantity and estimates the quality of wheat. Gluten relates to the elasticity and extensibility characteristics of flour dough.
- *Wet Gluten Index* is a measurement that indicates whether the gluten is weak, normal or strong. A very weak gluten would be represented by a gluten index of 0, whereas the strongest gluten index is 100.

Flour Quality Data

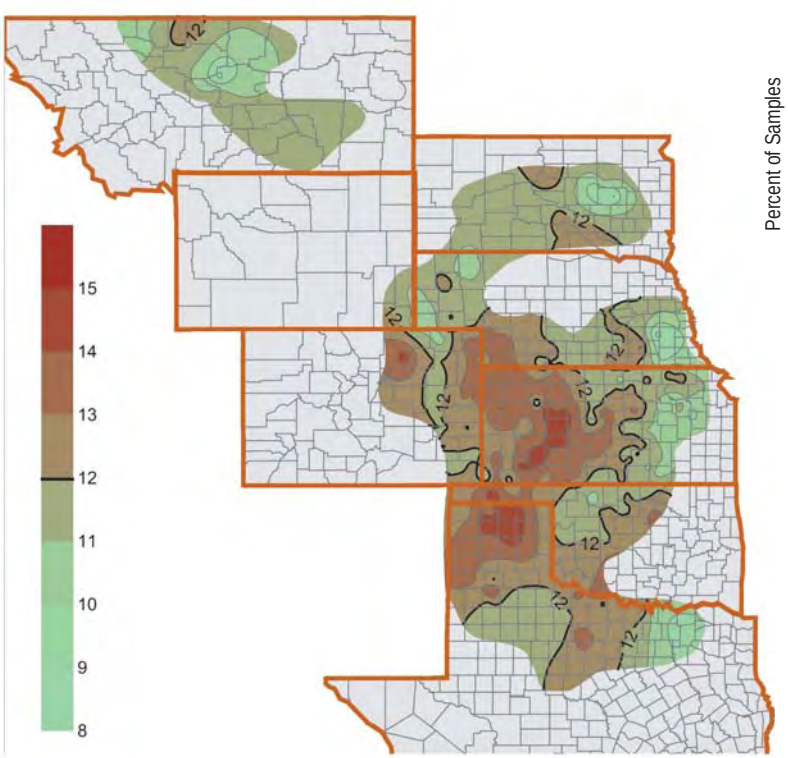
	Flour Yield	Flour Moisture	Protein 14% mb	Ash 14% mb	Starch Damage	Falling Number	Amylograph Peak	Wet Gluten	Gluten Index
	%	%	%	%	%	sec	bu	%	%
Texas									
T1	67.0	12.5	12.4	0.52	7.4	462	720	33.8	88.5
T2	69.0	12.1	12.0	0.50	6.2	402	700	33.7	93.4
T3	70.2	11.7	11.0	0.46	6.2	404	800	33.4	91.4
T4/T5	67.5	11.3	13.5	0.54	7.4	457	750	38.8	84.4
T6	66.5	11.7	13.5	0.56	7.4	479	810	40.4	86.0
Oklahoma									
O1	69.7	12.1	12.2	0.54	6.6	448	780	34.5	96.0
O2	69.5	11.8	12.0	0.50	8.7	413	660	35.0	90.3
O3	68.7	11.1	13.4	0.56	6.6	539	800	38.0	84.6
O4	68.2	11.8	13.6	0.56	7.4	444	770	39.8	77.0
O5	69.4	11.7	11.0	0.46	8.3	429	650	31.3	90.4
O6	68.6	12.1	11.7	0.50	7.4	374	640	33.7	93.7
O7	68.5	12.1	11.4	0.50	7.4	397	580	31.7	97.8
Kansas									
K1	66.5	12.2	12.5	0.52	7.4	404	780	36.7	81.0
K2	68.9	11.8	13.0	0.54	7.0	469	820	37.6	82.9
K3	69.6	12.4	13.2	0.53	7.0	477	800	39.0	89.3
K4	68.6	12.5	11.7	0.50	7.0	412	780	33.0	96.4
K5	67.3	12.9	12.0	0.54	9.1	453	710	32.3	96.4
K6	65.1	12.7	12.9	0.50	7.0	432	870	34.4	94.9
K7	67.0	12.7	12.9	0.48	6.6	494	970	35.1	94.7
K8	68.9	11.6	11.9	0.49	7.0	430	910	33.4	93.8
K9	66.9	12.6	12.6	0.45	7.4	428	980	34.0	97.5
K10	65.1.	11.7	10.2	0.47	7.0	380	930	27.7	99.1
Colorado									
C1	66.1	12.2	12.3	0.49	7.0	502	960	36.4	89.0
C2	63.3	12.3	11.7	0.41	7.0	456	840	32.9	92.5
C3	63.6	12.7	12.8	0.53	6.6	416	810	38.8	95.4
Nebraska									
N1	66.1	13.2	10.8	0.43	6.2	374	720	28.6	94.9
N2	66.7	12.0	12.4	0.50	6.2	558	840	35.1	96.1
N3	68.8	12.4	11.7	0.48	6.2	384	760	35.8	96.4
N4	68.5	13.2	11.6	0.48	7.0	468	910	32.7	97.0
N5	66.7	13.4	11.1	0.40	5.8	390	840	30.7	95.9
Wyoming									
W1	63.7	14.2	11.4	0.43	6.2	391	780	25.6	99.1
South Dakota									
SD1	67.1	12.9	12.0	0.43	6.6	446	840	34.4	91.1
SD2	68.9	13.2	10.7	0.44	5.3	405	770	27.5	99.4
Montana									
M1	66.9	12.6	11.9	0.45	6.2	520	840	26.5	99.3
M2	68.4	11.4	10.8	0.43	7.0	420	740	28.6	97.9

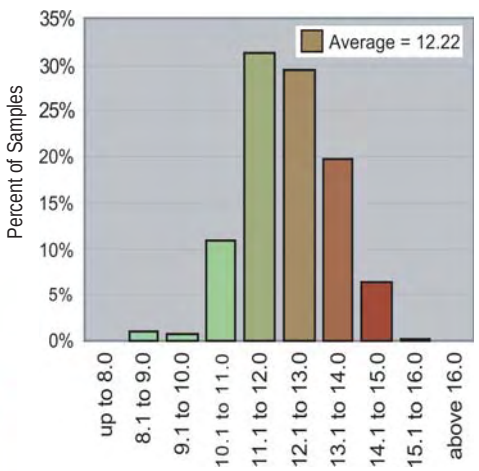
Flour Yield (%)





Flour Protein (14% mb)





Flour Characteristics

- *Zeleny Sedimentation* is determined by measuring the degree of sedimentation of flour in a lactic acid solution.
- *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), and b* ranges from +60 (yellow) to -60 (blue). A desirable flour will have high L* values and a* and b* will be close to 0.
- *Mixograph* measures the resistance of a dough to mixing with pins.

Flour Quality Data

		Minolta Color			Mixograph					
	Zeleny Sedimentation	L	a	b	Peak Time	Peak Height	Absorption	Band Width*	Curve Height*	Setting
	cc				min	cm	%	cm	cm	#
Texas										
T1	29.0	92.0	-2.5	8.8	3.0	6.1	65.0	0.8	5	12
T2	54.0	92.4	-2.9	9.0	4.5	6.1	69.0	1.0	5	12
T3	22.0	93.4	-2.7	8.4	2.8	5.0	66.0	0.8	4	12
T4/T5	44.0	91.8	-2.6	9.5	2.8	6.6	69.0	1.2	5	12
T6	54.0	91.8	-2.4	8.9	2.8	6.8	69.0	0.9	5	12
Oklahoma										
O1	57.0	92.4	-2.9	9.1	4.1	6.3	69.0	1.1	5	12
O2	49.0	92.5	-2.4	9.3	3.0	6.5	66.0	1.1	5	12
O3	55.0	91.8	-2.5	9.2	2.6	6.2	69.0	1.0	5	12
O4	40.0	92.1	-3.2	9.1	2.4	6.9	68.0	1.1	5	12
O5	30.0	92.4	-3.1	8.8	4.0	6.0	68.0	1.0	5	12
O6	38.0	92.3	-2.7	9.0	3.7	6.1	69.0	0.9	5	12
O7	39.0	92.4	-2.8	8.7	3.9	6.1	69.0	1.0	5	12
Kansas										
K1	47.0	92.0	-2.5	8.8	2.9	5.6	65.0	1.1	5	12
K2	63.0	92.3	-2.5	8.7	2.8	6.1	65.0	0.9	5	12
K3	63.0	92.3	-2.5	9.3	3.2	6.3	65.0	1.5	5	12
K4	58.0	92.1	-2.5	9.1	4.2	6.1	65.0	1.2	5	12
K5	51.0	93.1	-2.5	8.3	4.5	5.9	66.0	1.0	5	12
K6	59.0	92.4	-3.0	8.3	4.0	6.2	68.0	0.9	5	12
K7	47.0	92.6	-3.1	8.4	4.2	6.0	68.0	1.2	5	12
K8	N/A	92.3	-2.4	8.9	5.0	5.4	69.0	1.0	5	12
K9	51.0	92.7	-3.1	8.2	4.2	5.8	68.0	1.1	5	12
K10	34.0	92.6	-2.5	8.7	5.5	4.8	69.0	1.0	5	12
Colorado										
C1	38.0	92.7	-3.3	9.0	3.2	5.4	68.0	0.8	5	12
C2	47.0	92.7	-3.3	9.3	3.2	5.7	68.0	1.0	5	12
C3	50.0	92.2	-3.1	9.6	3.2	5.7	68.0	1.0	5	12
Nebraska										
N1	39.0	94.3	-2.6	8.8	6.0	4.8	68.0	1.2	5	12
N2	55.0	92.5	-3.0	8.2	3.6	6.1	68.0	1.2	5	12
N3	39.0	93.6	-2.5	8.3	5.8	5.1	68.0	1.0	5	12
N4	42.0	92.7	-3.1	8.1	4.7	5.9	68.0	1.2	5	12
N5	48.0	94.3	-2.7	9.1	6.0	5.0	68.0	1.5	5	12
Wyoming										
W1	43.0	94.3	-2.3	9.0	6.2	5.4	68.0	0.9	5	12
South Dakota										
SD1	42.0	92.6	-3.3	8.7	3.5	6.0	68.0	1.0	5	12
SD2	40.0	93.7	-1.7	8.9	6.0	5.0	64.0	1.4	5	12
Montana										
M1	38.0	92.6	-3.2	9.4	4.0	6.2	68.0	1.1	5	12
M2	40.0	92.9	-3.1	9.0	4.2	5.6	68.0	1.0	5	12

Dough Characteristics

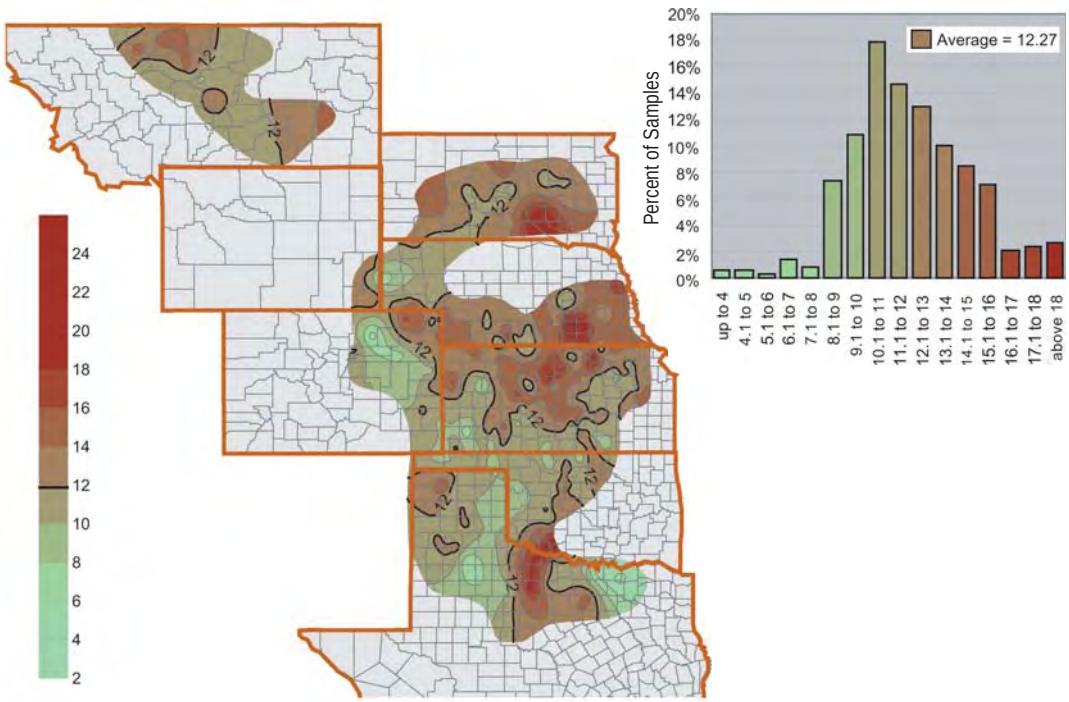
Farinograph results are used to determine dough strength and processing requirements. *Peak time* measures how long a flour must be mixed to reach the maximum consistency. *Stability* indicates the dough strength. *Absorption* measures the amount of water required for the flour to be optimally processed into the finished product. *Mixing Tolerance Index* is the difference in BU value at the top of the curve at peak time and the value at the top of the curve 5 minutes after the peak. *Alveograph* determines the gluten strength of dough by measuring the force required to blow and break a bubble of dough. "P" relates to the force required to blow the bubble of dough; "L" relates to the extensibility of the dough; "W" is a combination of dough strength and extensibility.

Physical Dough

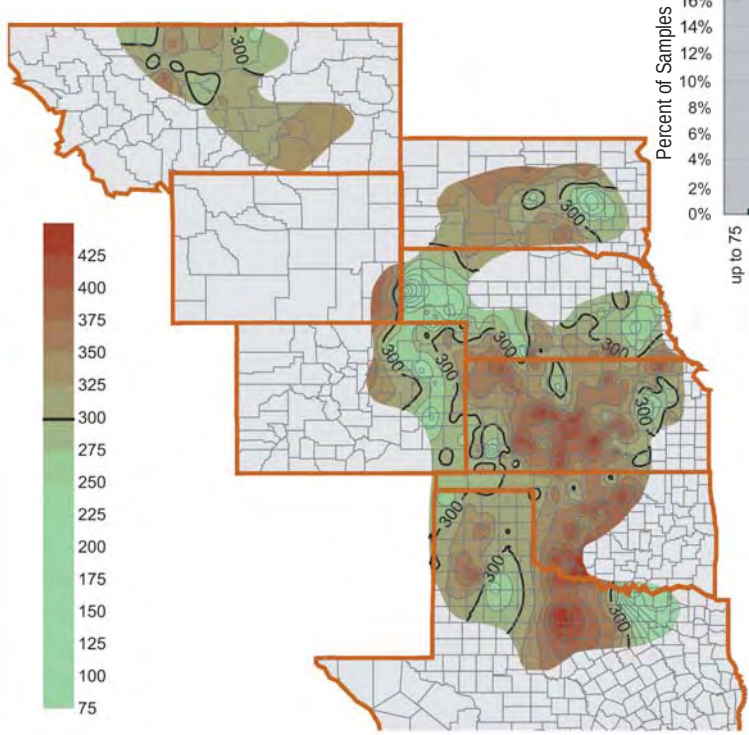
	Farinograph				Alveograph			
	Peak Time	Stability	Absorption	MTI	P	L	P/L	W
	min	min	%	bu	mm	mm		joulesX10^{-4}
Texas								
T1	5.5	8.5	61	40	93	111.0	0.84	292
T2	7.5	15.5	58	30	71	154.0	0.46	362
T3	4.0	5.5	55	75	50	169.0	0.30	213
T4/T5	6.0	9.0	60	40	83	117.0	0.71	307
T6	7.0	11.0	61	30	95	112.0	0.85	320
Oklahoma								
O1	8.5	14.0	61	40	110	125.0	0.88	423
O2	7.0	12.5	61	40	105	129.0	0.81	382
O3	6.5	10.0	61	30	87	100.0	0.87	286
O4	6.5	10.0	62	30	85	127.0	0.67	309
O5	6.5	11.5	59	30	125	100.0	1.25	379
O6	7.5	11.0	61	35	84	124.0	0.68	350
O7	6.5	11.0	59	35	94	103.0	0.91	321
Kansas								
K1	6.0	10.0	59	45	75	134.0	0.56	283
K2	6.5	11.5	59	35	79	143.0	0.55	331
K3	8.0	13.5	61	30	89	140.0	0.64	384
K4	7.0	12.0	59	30	89	126.0	0.71	347
K5	7.5	13.5	62	20	124	99.0	1.25	407
K6	6.5	12.0	60	20	86	135.0	0.64	345
K7	6.5	15.0	59	25	77	125.0	0.62	310
K8	7.0	13.5	57	40	78	104.0	0.75	267
K9	7.0	15.0	58	25	86	111.0	0.77	323
K10	6.0	10.0	56	40	90	101.0	0.89	283
Colorado								
C1	6.0	10.0	59	30	79	111.0	0.71	266
C2	6.5	11.0	57	35	82	94.0	0.87	242
C3	6.0	9.5	58	35	87	118.0	0.74	297
Nebraska								
N1	7.5	18.0	56	15	63	109.0	0.58	249
N2	7.0	13.5	57	30	80	113.0	0.71	289
N3	6.0	11.0	56	40	86	116.0	0.74	334
N4	7.0	13.5	57	30	84	104.0	0.81	295
N5	7.0	16.0	55	30	78	116.0	0.67	307
Wyoming								
W1	6.5	13.0	58	35	86	112.0	0.77	334
South Dakota								
SD1	8.0	16.0	58	20	76	123.0	0.62	325
SD2	8.5	18.5	55	15	78	122.0	0.64	349
Montana								
M1	6.5	14.0	58	20	91	107.0	0.85	328
M2	7.0	13.0	56	25	83	95.0	0.87	278

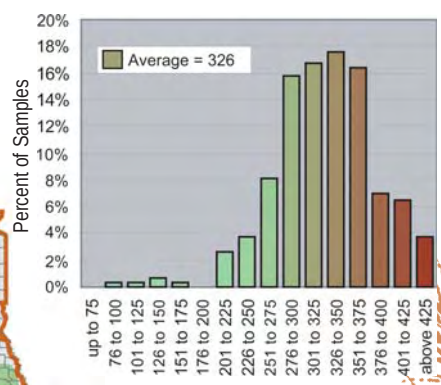
Dough Characteristics

Farinograph Stability (min)



Alveograph W Value





Baking Characteristics

Baking tests are the final laboratory testing method. Technicians evaluate loaves for their volume or size, and the interior appearance of the loaf such as crumb grain (cell size and shape) and crumb color. Other performance factors include dough absorption or bake absorption (the amount of water added to achieve a properly hydrated dough) and the optimum mixing time of the dough.

Baking Data

	Loaf Volume	Crumb Grain Score	Texture Score
	cc	(1-8)	(1-8)
Texas			
T1	850	6	6
T2	775	5	6
T3	815	4	5
T4/T5	935	5	6
T6	900	6	8
Oklahoma			
O1	750	7	7
O2	875	6	6
O3	850	6	6
O4	775	6	7
O5	775	8	7
O6	965	8	8
O7	835	6	7
Kansas			
K1	850	7	8
K2	900	7	7
K3	950	7	7
K4	850	6	7
K5	785	6	7
K6	850	7	7
K7	825	7	6
K8	835	8	8
K9	868	8	8
K10	750	6	6
Colorado			
C1	815	7	7
C2	935	7	7
C3	875	6	8
Nebraska			
N1	850	6	6
N2	835	7	7
N3	825	7	7
N4	725	6	6
N5	1000	6	7
Wyoming			
W1	900	7	7
South Dakota			
SD1	950	6	6
SD2	850	7	6
Montana			
M1	925	7	8
M2	900	8	8

Survey Analysis Methods

The harvest samples were evaluated using the same methods as described below.

Wheat and Grade Data

Grade: Official U.S. Standards for Grain.
Dockage: Official USDA procedure using the Carter Dockage Tester.
Moisture: HRW AACC 44-15A.
Test Weight:AACC 55-10; test weight is mathematically converted to hectoliter weight: kg/hl = lb/bu x 1.292 + 1.419.
Protein: AACC 46-30 (Combustion Nitrogen Analysis technique).
Ash: AACC 08-01 expressed on a 14% moisture basis.
1000 Kernel Weight: based on a 10-gram sample of clean wheat counted by an electronic counter.
Falling Number: AACC 56-81B. An average value is a simple mean of sample results.
Kernel Size Distribution: Cereal Foods World (Cereal Science Today) 5L3), 71 (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 palling through the No. 9 screen are “Small”.
Single Kernel Characterization: Peren method using Perten SKCS 4100.

Flour Data

Extraction: Samples were cleaned and tempered according to AACC Method 26-10A. All were milled with identical mill settings on a Buhler laboratory mill as described in the following procedures: AACC 26-21A.
Protein: AACC 46-30 (Combustion Nitrogen Analysis technique).
Ash: AACC 08-01, reported on a 14% moisture basis.
Starch Damage: AACC Method 76-30A.
Falling Number: AACC 56-81B.
Amylograph: AACC 22-10.
Wet Gluten: ICC 155 / AACC 3812.
Gluten Index: ICC 155 / AACC 3812

Dough Data

Farinograph: AACC 54-21 with 50-gram bowl. Absorption is reported on 14% moisture basis. Higher numbers indicate stronger protein flours.
Alveograph: AACC 54-30A.

Baking Data

HRW: 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 min., proofed and baked in “pup loaf” pans. Loaf volume is measured immediately after baking by rapeseed displacement.

Notes

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