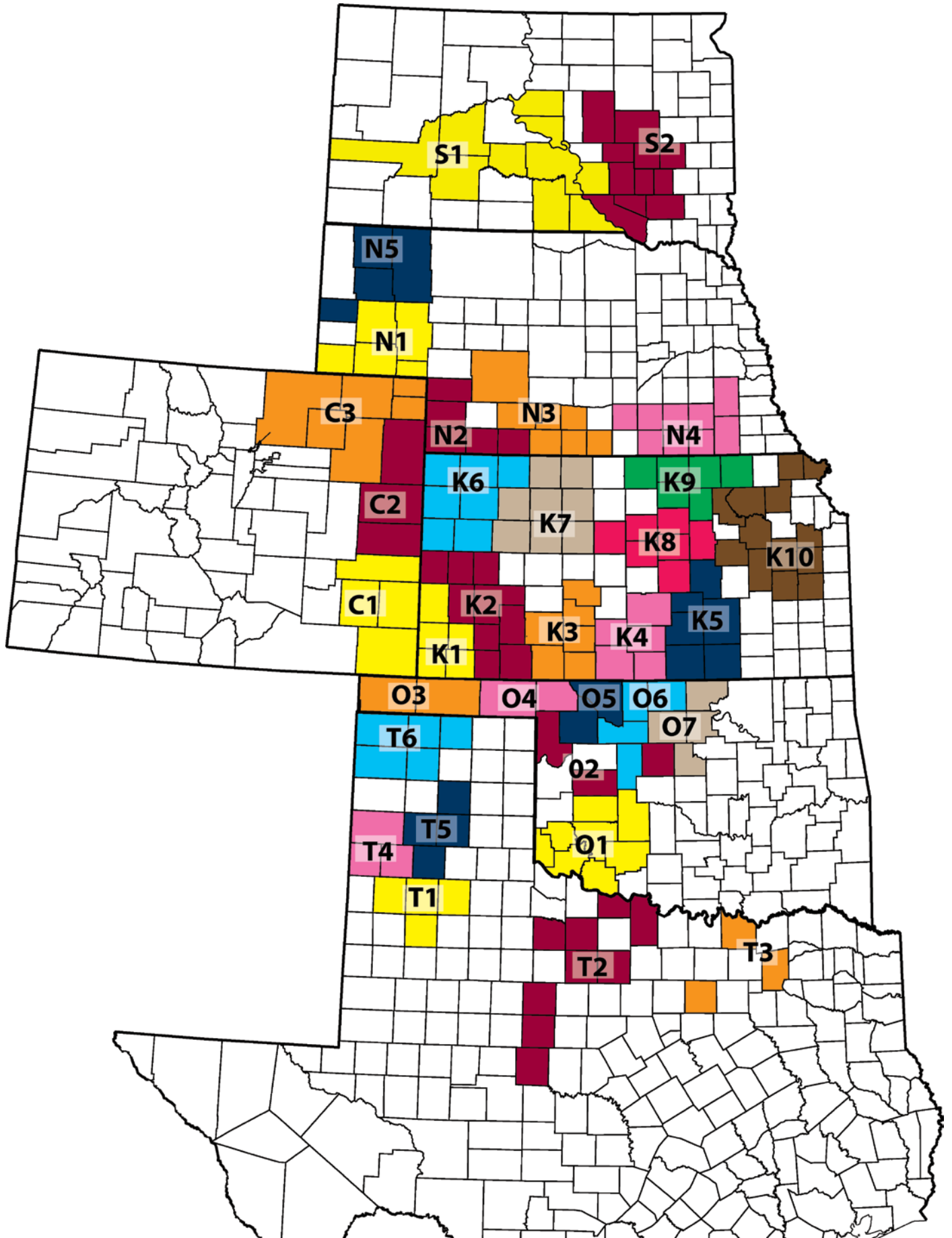


The image features a close-up, low-angle shot of several wheat stalks. The stalks are dark silhouettes against a bright, glowing sunset sky. The sun is positioned behind the stalks, creating a strong backlighting effect that illuminates the scene with warm orange and yellow tones. The wheat heads are prominent, with their awns clearly visible. The overall composition is artistic and evocative of a rural landscape at dusk.

2006 Hard Red Winter Wheat Quality Survey of the Great Plains

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

Figure 1. Collection areas.



Purpose of the Survey

The prosperity of hard red winter (HRW) wheat production in the United States depends largely on maintaining a competitive advantage within existing wheat markets, while continually striving to develop new marketing opportunities. To achieve these goals, new HRW wheat varieties must continually be developed, which will provide superior agronomic performance as well as desirable end-use characteristics. Additionally, the quality of the HRW wheat produced each year in the United States must be publicized as soon after harvest as possible, as domestic and international HRW wheat buyers rely on this information to make purchasing decisions.

The Wheat Quality Laboratory in the Department of Grain Science and Industry at Kansas State University plays an instrumental role in reaching both of these objectives. First, the laboratory supports the development of new wheat varieties by providing extensive milling and baking evaluations of experimental wheat lines being developed at Kansas State University. Secondly, a HRW wheat quality survey was initiated this year in order to facilitate marketing opportunities in domestic and overseas markets.

The results of this survey were publicized weekly through the International Grains Program in the Department of Grain Science and Industry. This publication was prepared to provide a final reporting of this HRW wheat quality survey.

Description of Survey

Beginning with the 2006 HRW wheat harvest, HRW wheat samples were collected across the Great Plains region of the United States. The states included in this survey were Texas, Oklahoma, Kansas, Colorado, Nebraska, and South Dakota. The samples were collected from grain elevators located in predetermined production regions in each state (Figure 1). The production regions were defined according to areas that contribute to key rail loading facilities. The number of samples collected in a given production region was based on the average annual production in that particular region. The goal in collecting samples based on average production and defining production regions in this manner was to most accurately estimate wheat quality at regional terminals for export customers.

After collection, the samples were shipped to the Wheat Quality Laboratory in the Department of Grain Science and Industry at Kansas State University. The samples were subdivided and a representative subsample was sent to the Kansas Grain Inspection Service for official grade information. The remaining portion of each sample was retained at Kansas State University to determine additional physical and chemical characteristics.

Subsequently, the individual samples were grouped according to state, production region, and protein level. In the six states surveyed, there were a total of 33 production regions and four composite protein levels. The four composite protein levels were less than 11.5 percent (low), 11.5 to 12.5 percent (medium), 12.5 to 13.5 percent (high), and greater than 13.5 percent (strong). Additionally, an overall composite for each production region was evaluated. The composite samples received more intensive testing with milling yield, flour and dough quality, and baking properties being characterized.

Survey Results

The survey results are presented in the subsequent tables. Measurements of the individual samples are presented either as grading criteria (Table 1) or non-grade criteria (Tables 2 and 3). Measurements of the composite samples are presented by each state, and the quality criteria are grouped as flour quality analyses (Tables 4 through 9), dough quality analyses (Tables 10 through 15), and baking quality analyses (Tables 16 through 21). The values are weighted based on the regional production statistics reported by the National Agricultural Statistics Services. Descriptions of the wheat quality tests and wheat grading procedures can be found in earlier Kansas State University Extension publications (Herrman et al., 1996; Herrman and Reed, 2000).

Literature Cited

- Herrman, T., R. Bequette, P. McCluskey, J. Pedersen, J. Ponte, and J. Shroyer. 1996. *Quality Oriented Marketing of Hard Winter Wheat: A Description of Quality Evaluation Techniques*. MF-2119, Cooperative Extension Service. Kansas State University, Manhattan.
- Herrman, T. and C. Reed. 2000. *Wheat Grading Procedures*. EP-98, K-State Research and Extension. Kansas State University, Manhattan.

Table 1. *Hard red winter wheat grade data for the 2006 crop year^{1,2}*

State and Crop Reporting Area ³	Test weight		Damaged Kernels, %	Foreign Material, %	Shrunken/broken kernels, %	Total defects, %	U.S. grade
	Lbs/Bu	Kg/hl					
Texas							
T1	59.7	78.5	0.1	0.3	1.6	2.0	2
T2	61.7	81.1	0.3	0.1	1.1	1.4	1
T3	58.1	76.5	0.2	0.0	1.7	2.0	2
T4	58.7	77.3	0.5	1.1	1.4	2.9	2
T5	57.9	76.3	0.2	0.0	1.4	1.7	2
T6	57.9	76.3	0.2	0.1	2.4	2.6	2
Oklahoma							
O1	61.2	80.6	0.1	0.1	1.4	1.6	1
O2	62.0	81.5	0.0	0.3	1.2	1.5	1
O3	59.0	77.7	0.1	0.3	1.5	1.9	2
O4	60.3	79.4	0.1	0.0	1.5	1.6	1
O5	60.8	80.0	0.1	0.1	1.7	2.0	1
O6	61.6	81.0	0.1	0.2	1.1	1.4	1
O7	61.5	80.9	0.2	0.3	1.1	1.6	1
Kansas							
K1	59.3	78.1	0.1	0.0	1.6	1.7	2
K2	58.2	76.6	0.2	0.0	1.1	1.3	2
K3	59.9	78.8	0.2	0.0	1.1	1.3	2
K4	61.1	80.4	0.2	0.1	0.7	1.0	1
K5	61.0	80.2	0.2	0.0	0.7	0.9	1
K6	58.2	76.6	0.4	0.0	0.7	1.2	2
K7	57.3	75.5	0.4	0.0	1.0	1.4	3
K8	60.4	79.4	0.1	0.1	1.1	1.3	1
K9	59.7	78.5	0.1	0.1	0.8	1.0	2
K10	60.2	79.3	0.1	0.0	0.8	0.9	1
Colorado							
C1	59.6	78.4	0.2	0.0	1.3	1.5	2
C2	58.3	76.8	0.1	0.0	1.0	1.2	2
C3	58.9	77.5	0.1	0.1	1.9	2.0	2
Nebraska							
N1	58.5	77.0	0.1	0.0	1.6	1.8	2
N2	60.1	79.1	0.1	0.0	1.2	1.4	1
N3	59.9	78.8	0.1	0.0	0.9	1.0	2
N4	60.2	79.2	0.1	0.0	0.9	1.1	1
N5	59.4	78.2	0.1	0.0	0.9	1.1	2
South Dakota							
S1	61.6	81.0	0.1	0.1	1.0	1.1	1
S2	60.7	79.8	0.1	0.0	1.7	1.9	1

¹ Based on individual samples

² Values weighted based on 2005 production (NASS, 2006)

³ Refer to area map of the Great Plains region

Table 2. *Hard red winter wheat non-grade data for the 2006 crop year^{1,2}*

State and Crop Reporting Area ³	Dockage (%)	Moisture (%)	Protein (%)		Ash (%)		Falling number (sec)	Wet Gluten (%)
			12% moisture basis	Dry matter basis	14% moisture basis	Dry matter basis		
Texas								
T1	1.2	10.6	13.0	14.7	1.59	1.85	395	31.2
T2	0.9	10.9	13.9	15.8	1.65	1.92	379	34.0
T3	2.0	12.3	12.5	14.2	1.67	1.94	350	29.7
T4	1.1	9.9	13.2	15.0	1.57	1.82	440	32.3
T5	0.6	9.5	15.1	17.1	1.61	1.87	407	38.4
T6	1.0	10.6	15.2	17.3	1.88	2.19	360	38.7
Oklahoma								
O1	0.6	11.4	14.0	15.9	1.62	1.88	383	34.6
O2	0.3	11.9	13.3	15.1	1.67	1.94	385	31.9
O3	0.8	10.0	15.2	17.2	1.84	2.14	393	37.7
O4	0.6	9.7	14.2	16.1	1.48	1.72	413	35.1
O5	2.1	11.2	12.9	14.6	1.56	1.81	437	30.5
O6	0.4	11.1	13.0	14.7	1.58	1.84	416	30.8
O7	0.4	12.0	13.2	15.1	1.62	1.89	404	32.4
Kansas								
K1	0.5	9.8	15.0	17.0	1.82	2.12	383	37.5
K2	0.6	10.5	14.8	16.8	1.82	2.12	399	37.1
K3	0.5	10.5	15.0	17.1	1.82	2.11	441	36.9
K4	0.3	11.0	13.8	15.7	1.67	1.95	434	34.1
K5	0.3	11.9	12.9	14.6	1.70	1.97	422	31.0
K6	0.4	11.9	14.5	16.5	1.70	1.97	414	37.4
K7	0.4	10.9	14.6	16.6	1.68	1.96	420	37.1
K8	0.3	11.3	13.1	14.9	1.62	1.89	423	33.0
K9	1.0	11.9	12.7	14.5	1.69	1.97	398	31.0
K10	0.5	12.7	12.2	13.8	1.66	1.93	408	28.6
Colorado								
C1	0.4	10.4	13.4	15.2	1.62	1.88	431	31.9
C2	0.7	13.5	13.4	15.3	1.58	1.83	404	34.1
C3	0.7	10.9	13.7	15.5	1.62	1.89	421	34.3
Nebraska								
N1	0.4	12.4	12.8	14.6	1.55	1.80	381	31.6
N2	0.3	11.3	13.7	15.6	1.65	1.92	397	32.9
N3	0.4	10.2	13.2	15.0	1.67	1.94	418	32.2
N4	0.4	11.4	12.4	14.1	1.79	2.08	424	30.1
N5	0.2	11.9	13.6	15.5	1.41	1.64	393	32.1
South Dakota								
S1	0.3	10.8	13.4	15.2	1.59	1.84	426	32.5
S2	0.8	10.8	13.0	14.7	1.56	1.81	409	31.6

¹ Based on individual samples

² Values weighted based on 2005 production (NASS, 2006)

³ Refer to area map of the Great Plains region

Table 3. *Hard red winter wheat non-grade data for the 2006 crop year^{1,2}*

State and Crop Reporting Area ³	1,000 Kernel Weight (g)	Kernel Size			Single Kernel		
		Large (%)	Medium (%)	Small (%)	Hardness	Weight (mg)	Diameter (mm)
Texas							
T1	27.1	56	43	1	80.0	27.8	2.17
T2	26.0	46	52	1	83.9	27.6	2.17
T3	25.3	54	44	2	45.2	27.3	2.02
T4	25.7	48	50	2	79.7	27.0	2.14
T5	25.3	52	47	1	78.8	26.7	2.14
T6	24.2	36	61	3	77.7	25.6	2.04
Oklahoma							
O1	27.1	51	48	1	88.1	27.8	2.18
O2	29.5	65	34	1	82.3	30.7	2.36
O3	26.1	45	53	2	78.2	27.4	2.14
O4	26.7	53	46	1	79.6	28.4	2.24
O5	28.7	66	33	1	76.6	30.1	2.34
O6	30.1	71	28	1	73.8	31.1	2.40
O7	31.1	76	23	1	76.4	31.6	2.41
Kansas							
K1	25.5	39	59	2	80.4	26.6	2.08
K2	25.9	42	56	1	74.6	27.1	2.13
K3	28.0	59	40	1	73.3	29.8	2.27
K4	31.3	74	25	1	69.1	32.3	2.44
K5	33.5	80	19	1	66.0	34.0	2.51
K6	26.0	47	52	1	70.1	27.5	2.17
K7	26.6	53	46	1	66.1	28.1	2.21
K8	30.5	70	29	1	63.9	31.5	2.33
K9	30.8	68	31	1	58.5	31.5	2.32
K10	32.7	77	22	1	62.0	33.9	2.46
Colorado							
C1	27.1	47	52	1	72.0	28.4	2.14
C2	27.9	53	46	1	67.2	29.3	2.20
C3	23.7	33	64	3	71.1	26.0	2.04
Nebraska							
N1	24.0	30	67	3	61.2	25.3	1.94
N2	27.2	57	42	1	63.9	29.2	2.25
N3	27.3	51	48	1	62.0	28.5	2.21
N4	29.8	63	37	1	59.3	30.2	2.29
N5	24.9	40	58	2	65.1	26.7	2.07
South Dakota							
S1	27.6	48	51	1	70.9	29.3	2.22
S2	28.4	56	42	2	66.1	29.5	2.23

¹ Based on individual samples² Values weighted based on 2005 production (NASS, 2006)³ Refer to area map of the Great Plains region

Table 4. Texas hard red winter wheat flour quality data for the 2006 crop year¹

Production Area Composite ³	Protein Level Composite ²			
	Medium	High	Strong	Overall
Extraction rate (%)				
T1	70.1	70.7	70.9	70.5
T2	71.5	72.0	71.5	71.8
T3	68.3	-	68.4	68.4
T4	67.5	66.7	-	-
T5	-	-	-	-
T6	-	-	72.8	-
Color L/a/b				
T1	90.5/-1.6/9.7	90.1/-1.6/10	90.6/-1.3/8.6	90.4/-1.5/9.4
T2	91.0/-1.8/9.4	90.4/-1.5/9.3	91.0/-1.6/9	90.7/-1.6/8.7
T3	92.1/-2.0/8.7	-	92.0/-1.8/8.5	92.3/-1.9/8.7
T4	89.6/-1.1/8.1	90.5/-1.5/9.3	-	-
T5	-	-	-	-
T6	-	-	90.0/-1.3/9.3	-
Protein (%) 14%/0% moisture basis				
T1	10.3/12.0	12.0/14.0	13.2/15.4	11.9/13.8
T2	10.0/11.7	11.7/13.6	12.9/15.0	12.4/14.4
T3	10.6/12.3	-	12.6/14.7	11.2/13.1
T4	11.3/13.2	11.6/13.5	-	-
T5	-	-	-	-
T6	-	-	15.5/18	-
Ash (%) 14%/0% moisture basis				
T1	0.67/0.77	0.59/0.68	0.53/0.62	0.55/0.64
T2	0.48/0.55	0.33/0.38	0.32/0.37	0.37/0.43
T3	0.45/0.52	-	0.47/0.54	0.45/0.53
T4	0.66/0.76	0.73/0.85	-	-
T5	-	-	-	-
T6	-	-	0.88/1.02	-
Wet gluten (%/index)				
T1	27.3/82.2	32.4/70.3	36.9/74.8	32.4/84.2
T2	26.4/96.6	32.7/92.2	35.5/89.8	33.1/94.2
T3	30.7/74.9	-	38.5/75.3	33.8/74.7
T4	28.7/68.8	31.3/76.7	-	-
T5	-	-	-	-
T6	-	-	45.4/59.1	-
Falling number (sec)				
T1	441	408	410	398
T2	368	383	368	397
T3	349	-	383	389
T4	372	374	-	-
T5	-	-	-	-
T6	-	-	430	-

¹ Based on samples composited by area and protein level² Protein levels: <11.5% (**Low**); 11.5-12.5% (**Medium**), 12.5-13.5% (**High**), and >13.5% (**Strong**).³ Refer to area map of the Great Plains region

Table 5. Oklahoma hard red winter wheat flour quality data for the 2006 crop year¹

Area Composite ³	Protein Level Composite ²			Overall
	Medium	High	Strong	
Extraction rate (%)				
O1	-	73.6	72.7	72.6
O2	-	74.6	71.7	71.7
O3	-	-	71.6	-
O4	-	71.6	70.6	72.7
O5	70.7	69.3	68.1	70.3
O6	71.9	72.2	72.3	73.1
O7	74.2	72.0	71.3	72.8
Color L/a/b				
O1	-	91.0/-1.7/9.1	90.9/-1.6/9.2	90.8/-1.6/9.2
O2	-	90.6/-1.4/8.8	90.0/-1.2/8.5	90.2/-1.3/8.7
O3	-	-	90.4/-1.3/8.9	-
O4	-	89.7/-1.1/8.8	90.2/-1.2/8.5	90.4/-1.4/9.2
O5	89.9/-1.4/8.6	90.3/-1.3/8.3	89.5/-1.3/8.1	90.3/-1.4/8.4
O6	92.0/-1.7/8.4	91.0/-1.2/8.6	91.4/1.3/8.1	91.3/-1.3/8.3
O7	90.6/-1.3/8.5	90.4/-1.2/8.5	90.1/-1.2/8	90.1/-1.3/8.3
Protein (%) 14%/0% moisture basis				
O1	-	11.4/13.2	12.8/14.9	12.7/14.8
O2	-	12.4/14.4	13.3/15.4	12.4/14.4
O3	-	-	14.0/16.3	-
O4	-	12.3/14.3	13.8/16	13.7/15.9
O5	10.6/12.3	11.9/13.8	11.8/13.7	11.3/13.2
O6	10.4/12.1	12.0/14	12.7/14.8	12.1/14.1
O7	10.9/12.6	12.0/14	12.8/14.8	12.0/13.9
Ash (%) 14%/0% moisture basis				
O1	-	0.42/0.49	0.46/0.54	0.41/0.48
O2	-	0.69/0.81	0.58/0.68	0.57/0.67
O3	-	-	0.75/0.87	-
O4	-	0.82/0.95	0.72/0.83	0.76/0.88
O5	0.70/0.81	0.69/0.81	0.73/0.85	0.75/0.87
O6	0.54/0.63	0.55/0.64	0.57/0.66	0.66/0.77
O7	0.58/0.67	0.58/0.67	0.62/0.72	0.59/0.68
Wet gluten (%/index)				
O1	-	32.5/87.9	38.7/88	36.6/92.9
O2	-	32.7/76.3	36.5/80.3	29.8/91.3
O3	-	-	36.4/80.2	-
O4	-	34.7/84.4	40.3/64.7	41.0/58.1
O5	27.7/90.8	30.6/85	31.3/86.7	35.3/78.9
O6	25.6/89.1	33.0/74.1	37.1/75.7	32.6/76.9
O7	27.1/92.2	35.8/78.1	35.7/83.2	36.0/78
Falling number (sec)				
O1	-	363	369	380
O2	-	416	395	399
O3	-	-	414	-
O4	-	377	407	399
O5	392	370	426	407
O6	414	442	412	427
O7	378	412	410	370

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5 % (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 6. *Kansas hard red winter wheat flour quality data for the 2006 crop year¹*

Area Composite ³	Protein Level Composite ²			Overall
	Medium	High	Strong	
Extraction rate (%)				
K1	-	-	-	68.5
K2	-	-	68.9	-
K3	71.4	69.7	69.9	70.8
K4	-	69.6	69.9	70.5
K5	69.9	70.9	72.4	68.6
K6	-	67.3	69.5	68
K7	-	69.1	68.5	69.8
K8	70.1	70.4	71.0	71.9
K9	70.8	71.2	72.5	73.3
K10	72.6	72.2	-	74.2
Color L/a/b				
K1	-	-	-	90.5/-1.4/8.1
K2	-	-	89.9/-1.3/8.6	-
K3	91.5/-1.6/9.2	90.3/-1.5/8.7	91.2/-1.4/8.8	90.1/-1.3/8.9
K4	-	90.7/-1.4/8.3	90.3/-1.3/8.1	89.1/-1.2/8.4
K5	90.2/-1.5/8.1	90.2/-1.4/7.8	90.5/-1.4/8.2	90.4/-1.5/8.1
K6	-	87.2/-1.3/8.2	87.6/-1.3/8.1	86.6/-1.3/8.1
K7	-	87.2/-1.1/7.1	86.8/-1.2/7.3	90.2/-1.2/7.8
K8	86.9/-1.1/7.3	87.6/-1.2/7.4	86.8/-1.1/7.8	86.2/-1.1/7.4
K9	87.4/-1.1/7	86.6/-1.1/7.3	87.3/-1.3/7.7	88.1/-1.4/7.5
K10	88.1/-1.6/7.9	87.8/-1.4/8.1	-	87.4/-1.5/7.9
Protein (%) 14%/0% moisture basis				
K1	-	-	-	13.3/15.4
K2	-	-	14.8/17.2	-
K3	11.3/13.2	12.4/14.4	13.9/16.2	13.1/15.2
K4	-	11.9/13.8	13.0/15.1	12.3/14.3
K5	10.9/12.7	11.6/13.5	12.4/14.4	11.5/13.3
K6	-	12.9/15	14.8/17.2	13.9/16.2
K7	-	12.4/14.4	13.4/15.6	13.4/15.6
K8	10.8/12.5	11.7/13.6	13.1/15.3	11.8/13.7
K9	11.2/13	11.7/13.6	12.9/15	11.7/13.6
K10	10.1/11.8	11.4/13.2	-	11.0/12.8
Ash (%) 14%/0% moisture basis				
K1	-	-	-	0.64/0.74
K2	-	-	0.78/0.9	-
K3	0.70/0.81	0.66/0.77	0.70/0.82	0.75/0.87
K4	-	0.65/0.75	0.61/0.71	0.65/0.76
K5	0.64/0.75	0.70/0.82	0.65/0.75	0.75/0.87
K6	-	0.62/0.72	0.63/0.73	0.58/0.67
K7	-	0.55/0.63	0.61/0.71	0.61/0.71
K8	0.58/0.67	0.58/0.68	0.58/0.67	0.55/0.64
K9	0.55/0.64	0.56/0.65	0.55/0.64	0.51/0.59
K10	0.53/0.62	0.56/0.65	-	0.54/0.62
Wet gluten (%/index)				
K1	-	-	-	36.5/74.6
K2	-	-	42.3/80.1	-
K3	30.4/80.1	34.2/84.5	42.2/77.2	36.2/81.9
K4	-	30.4/80.1	38.2/73.9	31.3/75.7
K5	23.9/91.3	30.8/87.7	40.6/71.6	33.1/84.5
K6	-	38.2/81.8	46.1/77	42.6/72.8
K7	-	35.1/89	42.5/82.6	39.3/80.6
K8	28.6/91.7	30.2/91.7	35.6/86.6	32.4/85.7
K9	28.2/97.5	29.6/96.8	33.2/92.6	31.7/92.8
K10	27.2/94.5	30.5/93.1	-	28.0/90.7
Falling number (sec)				
K1	-	-	-	376
K2	-	-	399	-
K3	416	417	416	431
K4	-	380	379	396
K5	423	363	370	423
K6	-	435	437	435
K7	-	394	418	404
K8	404	323	394	392
K9	405	446	439	430
K10	419	430	-	443

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5% (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 7. Colorado hard red winter wheat flour quality data for the 2006 crop year¹

Area Composite ³	Protein Level Composite ²			Overall
	Medium	High	Strong	
Extraction rate (%)				
C1	70.5	71.7	70.9	70.7
C2	-	71.3	70.4	70.5
C3	71.5	70.7	70.1	70.5
Color L/a/b				
C1	87.6/-1.4/7.7	87.5/-1.6/8.7	90.9/-1.6/8.9	86.7/-1.5/8.3
C2	-	87.5/-1.6/8.7	87.4/-1.5/8.6	87.0/-1.6/8.8
C3	88.4/-1.7/8.4	88.2/-1.7/8.4	87.2/-1.6/8.8	87.7/-1.6/8.7
Protein (%) 14%/0% moisture basis				
C1	10.4/12.1	11.8/13.7	13.4/15.6	12.2/14.2
C2	-	12.6/14.7	13.4/15.6	12.8/14.9
C3	10.9/12.7	11.7/13.6	13.1/15.3	12.7/14.7
Ash (%) 14%/0% moisture basis				
C1	0.53/0.61	0.55/0.64	0.52/0.6	0.53/0.61
C2	-	0.56/0.65	0.55/0.64	0.56/0.65
C3	0.55/0.64	0.49/0.57	0.55/0.64	0.55/0.64
Wet gluten (%/index)				
C1	28.2/93.6	33.5/76.2	38.2/66.9	35.1/72.5
C2	-	34.6/79.5	38.6/69.9	37.5/70.7
C3	28.4/98.4	33.7/88.8	36.7/76.7	35.7/80.7
Falling number (sec)				
C1	409	450	472	447
C2	-	458	457	450
C3	417	354	467	408

¹ Based on samples composited by area and protein level² Protein levels: <11.5% (**Low**); 11.5-12.5 % (**Medium**), 12.5-13.5% (**High**), and >13.5% (**Strong**).³ Refer to area map of the Great Plains region

Table 8. Nebraska hard red winter wheat flour quality data for the 2006 crop year¹

Area Composite ³	Protein Level Composite ²				
	Low	Medium	High	Strong	Overall
Extraction rate (%)					
N1	-	70.0	69.9	70.4	69.0
N2	-	73.4	72.8	72.3	72.2
N3	-	72.1	71.7	68.7	72.2
N4	-	72.1	72.6	71.8	72.8
N5	68.1	71.3	71.8	72.2	71.8
Color L/a/b					
N1	-	88.1/-1.6/7.7	87.7/-1.6/7.8	87.7/-1.7/8.8	87.8/-1.6/8
N2	-	92.1/-1.8/7.6	90.3/-1.5/7.8	92.7/-1.5/7.7	92.7/-1.6/7.6
N3	-	88.4/-1.5/7.8	88.3/-1.5/7.7	87.7/-1.5/7.5	87.0/-1.4/7.6
N4	-	88.2/-1.5/7.3	87.9/-1.4/7.5	87.7/-1.3/7.2	87.6/-1.4/7.4
N5	92.0/-1.4/7.6	92.4/-1.6/7.9	92.5/-1.6/7.7	92.6/-1.5/7.8	92.1/-1.6/8.5
Protein (%) 14%/0% moisture basis					
N1	-	10.2/11.8	11.4/13.2	13.1/15.2	12.1/14.1
N2	-	11.1/12.9	12.1/14	13.3/15.5	12.6/14.7
N3	-	10.7/12.4	11.9/13.8	12.5/14.5	12.4/14.4
N4	-	10.5/12.2	11.5/13.4	13.1/15.3	11.2/13.1
N5	8.7/10.1	11.1/12.9	11.4/13.3	13.0/15.1	11.7/13.7
Ash (%) 14%/0% moisture basis					
N1	-	0.50/0.58	0.49/0.57	0.52/0.6	0.52/0.6
N2	-	0.55/0.64	0.49/0.57	0.55/0.64	0.61/0.71
N3	-	0.49/0.57	0.53/0.61	0.50/0.58	0.55/0.64
N4	-	0.47/0.54	0.51/0.59	0.50/0.58	0.55/0.64
N5	0.43/0.5	0.52/0.6	0.50/0.58	0.50/0.58	0.50/0.58
Wet gluten (%/index)					
N1	-	26.7/95.9	32.8/92.7	36.5/87	33.4/94.3
N2	-	30.0/94.5	31.8/91.8	37.9/85.5	34.9/91.3
N3	-	27.1/95.2	32.8/84	31.9/96.5	31.3/93.2
N4	-	26.4/98.1	30.4/98.4	35.2/94.5	30.4/94.6
N5	16.9/98.5	28.1/97.4	31.5/88.7	36.5/85.1	31.3/95.2
Falling number (sec)					
N1	-	380	404	430	397
N2	-	362	376	399	398
N3	-	414	413	443	398
N4	-	401	397	393	390
N5	374	357	363	404	377

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5 % (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 9. South Dakota hard red winter wheat flour quality data for the 2006 crop year¹

Area Composite ³	Protein Level Composite ²				Overall
	Low	Medium	High	Strong	
Extraction rate (%)					
S1	73.3	72.7	73.9	73.0	72.9
S2	73.9	73.5	74.4	73.5	73.8
Color L/a/b					
S1	88.6/-1.6/7.5	88.1/-1.6/8.1	87.5/-1.5/7.9	87.8/-1.5/8.1	88.2/-1.5/8
S2	88.8/-1.5/8.8	88.9/-1.5/7.8	88.6/-1.5/8.2	88.8/-1.3/7.8	89.5/-1.5/8.1
Protein (%) 14%/0% moisture basis					
S1	9.7/11.3	11.1/12.9	11.6/13.5	13.0/15.1	12.0/14
S2	9.9/11.5	11.0/12.8	11.4/13.3	13.0/15.1	11.6/13.5
Ash (%) 14%/0% moisture basis					
S1	0.49/0.57	0.51/0.6	0.48/0.55	0.47/0.55	0.49/0.57
S2	0.52/0.6	0.47/0.55	0.47/0.54	0.48/0.56	0.47/0.54
Wet gluten (%/index)					
S1	25.3/98.2	29.6/93.6	31.5/94	35.8/95.2	32.6/91.3
S2	24.2/94.5	31.0/96.5	31.1/95.6	35.5/98	31.7/96.7
Falling number (sec)					
S1	401	387	403	393	395
S2	393	391	388	407	397

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5 % (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 10. Texas hard red winter wheat dough quality data for the 2006 crop year¹

Protein Level Composite ²	Farinograph			Mixograph		Alveograph			
	Peak (min)	Stability (min)	Absorption (%)	Peak (min)	Absorption (%)	P (mm)	L (mm)	P/L	W (10 ⁻⁴ joules)
Area T1³									
Medium	5.0	9.0	71.3	3.2	63.4	82	78	1.05	194
High	5.5	7.0	73.2	2.8	65.0	93	111	0.84	295
Strong	6.0	12.0	72.2	2.8	65.2	84	168	0.50	369
Overall	5.5	8.5	71.0	3.0	65.2	131	90	1.45	357
Area T2									
Medium	6.0	7.5	57.6	4.0	59.4	75	106	0.71	269
High	7.2	7.5	63.0	4.0	63.1	102	96	1.06	347
Strong	6.5	6.5	60.6	2.8	63.2	92	121	0.76	373
Overall	7.1	6.5	62.6	4.2	59.9	92	86	1.07	291
Area T3									
Medium	3.4	5.7	57.4	3.2	60.0	54	117	0.46	174
High	-	-	-	-	-	-	-	-	-
Strong	5	7.5	62.1	2.5	60.7	53	162	0.33	230
Overall	3.5	5.0	58.8	2.8	61.3	51	133	0.38	180
Area T4									
Medium	8.5	15.0	75.0	3.3	61.9	96	87	1.10	246
High	7.0	10.0	74.0	3.1	62.2	98	87	1.13	254
Strong	-	-	-	-	-	-	-	-	-
Overall	-	-	-	-	-	-	-	-	-
Area T5									
Medium	-	-	-	-	-	-	-	-	-
High	-	-	-	-	-	-	-	-	-
Strong	-	-	-	-	-	-	-	-	-
Overall	-	-	-	-	-	-	-	-	-
Area T6									
Medium	-	-	-	-	-	-	-	-	-
High	-	-	-	-	-	-	-	-	-
Strong	5.5	12.0	70.2	2.5	67.3	83	92	0.90	204
Overall	-	-	-	-	-	-	-	-	-

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5-12.5 % (**Medium**), 12.5-13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 11. Oklahoma hard red winter wheat dough quality data for the 2006 crop year¹

Protein Level Composite ²	Farinograph			Mixograph		Alveograph			
	Peak (min)	Stability (min)	Absorption (%)	Peak (min)	Absorption (%)	P (mm)	L (mm)	P/L	W (10 ⁻⁴ joules)
Area O1³									
Medium	-	-	-	-	-	-	-	-	-
High	5.6	6.5	64.4	3.0	64.0	95	117	0.81	339
Strong	5.7	7.5	67.4	4.5	66.8	105	105	1.00	372
Overall	7.0	7.5	67.0	3.5	64.9	103	106	0.97	369
Area O2									
Medium	-	-	-	-	-	-	-	-	-
High	6.5	8.5	76.8	3.6	67.4	98	129	0.76	351
Strong	6.0	10.0	78.2	3.5	68.3	124	99	1.25	369
Overall	7.7	10.5	77.3	3.2	68.3	110	117	0.94	370
Area O3									
Medium	-	-	-	-	-	-	-	-	-
High	-	-	-	-	-	-	-	-	-
Strong	8.5	15.0	70.8	3.0	65.0	118	74	1.59	289
Overall	-	-	-	-	-	-	-	-	-
Area O4									
Medium	-	-	-	-	-	-	-	-	-
High	9.0	14.0	75.3	4.0	63.3	103	96	1.07	297
Strong	7.5	13.0	75.9	2.7	65.7	151	63	2.40	347
Overall	8.5	11.5	74.5	2.5	64.5	133	72	1.85	327
Area O5									
Medium	7.0	14.0	75.4	3.4	63.8	96	72	1.33	210
High	8.5	14.0	74.2	3.3	62.4	112	102	1.10	338
Strong	8.5	14.5	76.2	3.2	65.6	100	129	0.77	360
Overall	9.0	10.5	76.3	3.6	64.5	108	87	1.24	283
Area O6									
Medium	7.5	7.0	71.7	3.3	62.3	94	75	1.25	104
High	8.0	7.5	73.1	3.0	63.4	96	72	1.33	210
Strong	7.5	7.5	75.1	3.2	66.5	94	123	0.76	317
Overall	7.2	10.1	75.8	3.5	66.8	95	102	0.93	276
Area O7									
Medium	5.7	9.0	60.1	3.5	65.1	95	93	1.02	259
High	6.0	9.5	62.9	3.7	67.6	55	135	0.41	217
Strong	7.0	8.5	62.1	3.3	67.6	74	131	0.56	300
Overall	7.0	11.0	63.4	3.5	66.6	47	155	0.30	285

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5-12.5 % (**Medium**), 12.5-13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 12. *Kansas hard red winter wheat dough quality data for the 2006 crop year¹*

Protein Level Composite ²	Farinograph			Mixograph		Alveograph			
	Peak (min)	Stability (min)	Absorption (%)	Peak (min)	Absorption (%)	P (mm)	L (mm)	P/L	W (10 ⁻⁴ joules)
Area K1³									
Medium	-	-	-	-	-	-	-	-	-
High	-	-	-	-	-	-	-	-	-
Strong	-	-	-	-	-	-	-	-	-
Overall	8.0	10.0	74.5	2.8	66.3	93	156	0.59	387
Area K2									
Medium	-	-	-	-	-	-	-	-	-
High	-	-	-	-	-	-	-	-	-
Strong	8.5	13.0	76.6	3.5	66.8	94	122	0.77	458
Overall	-	-	-	-	-	-	-	-	-
Area K3									
Medium	7.0	16.5	70.3	3.2	60.9	83	76	1.09	267
High	9.5	19.0	75.2	3.3	63.1	105	111	0.95	341
Strong	9.0	19.0	74.6	2.9	65.1	81	63	1.29	389
Overall	9.5	14.5	75.0	3.3	64.4	86	129	0.66	370
Area K4									
Medium	-	-	-	-	-	-	-	-	-
High	8.0	13.5	75.2	3.5	67.3	101	138	0.73	389
Strong	11.0	17.0	79.2	3.5	67.5	112	117	0.96	376
Overall	10.0	16.0	77.9	3.8	63.6	114	111	1.02	367
Area K5									
Medium	6.0	12.5	70.4	3.2	60.8	139	120	1.16	229
High	6.5	12.0	75.1	3.3	61.8	91	120	0.76	304
Strong	8.0	12.5	74.1	3.3	63.1	85	123	0.69	290
Overall	6.0	12.0	71.9	3.0	61.7	81	111	0.73	256
Area K6									
Medium	-	-	-	-	-	-	-	-	-
High	8.5	17.0	74.6	2.7	63.7	101	44	2.29	378
Strong	7.7	19.5	75.3	3.2	66.5	109	49	2.22	453
Overall	6.5	15.0	76.4	3.1	66.4	115	51	2.25	491
Area K7									
Medium	-	-	-	-	-	-	-	-	-
High	8.0	17.0	76.8	3.9	63.5	114	93	1.23	318
Strong	7.5	18.5	74.4	3.7	65.4	112	92	1.22	442
Overall	7.6	18.0	75.0	3.8	65.2	85	94	0.90	340
Area K8									
Medium	6.0	17.0	73.8	3.8	64.6	107	64	1.67	308
High	7.0	18.0	73.8	3.8	63.3	104	70	1.49	325
Strong	7.5	18.5	76.4	3.7	64.9	107	42	2.55	392
Overall	5.7	18.0	72.3	4.2	63.9	84	57	1.47	395
Area K9									
Medium	8.5	16.5	70.4	3.5	63.0	94	70	1.34	292
High	7.0	16.0	76.3	4.0	65.5	91	74	1.23	299
Strong	7.7	29.0	75.0	4.0	63.5	130	57	2.28	312
Overall	7.0	19.0	68.5	4.7	60.2	138	64	2.16	361
Area K10									
Medium	7.5	13.4	66.3	4.7	60.5	132	68	1.94	335
High	5.0	11.5	69.1	4.0	59.6	152	56	2.71	344
Strong	-	-	-	-	-	-	-	-	-
Overall	5.5	13.5	65.1	4.2	59.4	126	65	1.94	313

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5% (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 13. Colorado hard red winter wheat dough quality data for the 2006 crop year¹

Protein Level Composite ²	Farinograph			Mixograph		Alveograph			
	Peak (min)	Stability (min)	Absorption (%)	Peak (min)	Absorption (%)	P (mm)	L (mm)	P/L	W (10 ⁻⁴ joules)
Area C1³									
Medium	6.1	14.0	64.1	3.4	58.6	109	69	1.58	274
High	6.3	14.0	70.8	2.7	60.4	127	69	1.84	301
Strong	5.7	15.5	74.0	2.8	62.7	160	64	2.50	367
Overall	7.3	16.5	70.3	2.8	60.9	146	65	2.25	341
Area C2									
Medium	–	–	–	–	–	–	–	–	–
High	7.2	18.5	70.5	3.0	63.0	111	82	1.35	321
Strong	7.0	17.0	73.1	3.3	62.4	147	59	2.49	338
Overall	7.4	17.0	72.3	2.7	63.4	139	65	2.14	341
Area C3									
Medium	6.5	18.0	63.7	3.4	63.2	102	96	1.06	335
High	6.6	16.0	65.6	3.0	62.9	104	93	1.12	318
Strong	7.5	14.5	69.6	3.4	62.1	112	97	1.15	353
Overall	6.5	16.5	67.9	2.6	62.8	118	86	1.37	345

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5% (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 14. Nebraska hard red winter wheat dough quality data for the 2006 crop year¹

Protein Level Composite ²	Farinograph			Mixograph		Alveograph			
	Peak (min)	Stability (min)	Absorption (%)	Peak (min)	Absorption (%)	P (mm)	L (mm)	P/L	W (10 ⁻⁴ joules)
Area N1³									
Medium	4.0	13.0	64.3	4.0	62.6	110	70	1.57	290
High	4.3	14.5	65.1	3.4	62.5	93	116	0.80	362
Strong	8.5	17.0	69.5	3.0	63.0	95	112	0.85	354
Overall	8.5	15.5	65.8	3.5	62.6	103	96	1.07	348
Area N2									
Medium	7.0	13.0	67.8	4.5	62.6	120	48	2.50	246
High	7.4	17.5	66.8	3.4	62.7	129	54	2.39	289
Strong	5.5	18.0	69.6	3.5	64.3	121	96	1.26	410
Overall	5.5	17.7	67.4	3.6	64.2	128	76	1.68	369
Area N3									
Medium	3.0	8.0	64.7	3.3	60.2	132	61	2.16	318
High	7.0	17.2	65.4	3.5	61.5	135	76	1.78	385
Strong	6.0	18.6	67.8	3.8	62.4	134	73	1.84	382
Overall	5.5	18.8	66.7	3.5	62.7	101	91	1.11	340
Area N4									
Medium	6.5	16.5	67.0	4.0	57.4	122	55	2.22	269
High	6.0	19.5	66.2	4.3	61.3	125	62	2.02	316
Strong	7.0	17.5	67.2	4.8	63.4	124	86	1.44	428
Overall	7.0	16.5	68.1	4.4	59.0	135	72	1.88	378
Area N5									
Low	3.0	5.9	62.6	4.3	62.4	88	48	1.83	169
Medium	7.5	17.5	65.3	3.4	62.5	111	68	1.63	279
High	8.0	17.0	65.5	3.7	62.7	96	104	0.92	328
Strong	8.6	16.6	65.7	3.5	62.7	107	86	1.24	335
Overall	7.5	17.4	66.6	4.0	62.5	102	78	1.31	286

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5% (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 15. South Dakota hard red winter wheat dough quality data for the 2006 crop year¹

Protein Level Composite ²	Farinograph			Mixograph		Alveograph			
	Peak (min)	Stability (min)	Absorption (%)	Peak (min)	Absorption (%)	P (mm)	L (mm)	P/L	W (10 ⁻⁴ joules)
Area S1³									
Low	6.5	14.5	65.3	4.7	60.6	101	72	1.40	267
Medium	8.4	17.5	67.2	4.0	63.3	115	75	1.53	321
High	8.5	17.5	67.0	4.4	63.2	120	73	1.64	328
Strong	9.0	17.9	67.2	4.7	63.5	116	97	1.20	413
Overall	9.0	16.6	67.1	4.3	60.5	128	78	1.64	369
Area S2									
Low	5.0	10.5	61.9	4.1	60.5	87	88	0.99	243
Medium	6.8	16.0	63.9	4.3	61.5	86	90	0.96	287
High	7.0	17.9	65.2	4.0	60.1	104	95	1.09	341
Strong	7.0	17.5	66.0	3.4	62.0	106	100	1.06	393
Overall	6.5	17.9	63.9	4.1	61.4	92	109	0.84	342

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5 % (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 16. Texas hard red winter wheat bake quality data for the 2006 crop year¹

Area Composite	Protein Level Composite			Overall
	Medium	High	Strong	
Loaf volume (cc)				
T1	575	700	790	785
T2	795	820	795	795
T3	945	–	860	825
T4	550	600	–	–
T5	–	–	–	–
T6	–	–	850	–
Crumb grain score (1-8)				
T1	6	4	4	5
T2	4.6	5	5	5.2
T3	4.6	–	5.2	4.6
T4	3	4	–	–
T5	–	–	–	–
T6	–	–	7	–
Crumb texture score (1-8)				
T1	6	5	5	6
T2	5.2	6	6	6
T3	6	–	6	6
T4	4	5	–	–
T5	–	–	–	–
T6	–	–	6	–

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5 % (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 17. Oklahoma hard red winter wheat bake quality data for the 2006 crop year¹

Area Composite ³	Protein Level Composite ²			Overall
	Medium	High	Strong	
Loaf volume (cc)				
O1	-	795	800	795
O2	-	550	750	740
O3	-	-	875	-
O4	-	835	850	825
O5	550	600	675	550
O6	625	720	785	675
O7	700	590	835	755
Crumb grain score (1-8)				
O1	-	6.6	6	5.2
O2	-	5	5	4
O3	-	-	6	-
O4	-	5	5	6
O5	4	5	6	3
O6	6	6	5	4
O7	5	4	6	5
Crumb texture score (1-8)				
O1	-	6	5.2	4.6
O2	-	6	5	6
O3	-	-	6	-
O4	-	6	5	6
O5	4	5	5	5
O6	6	6	6	6
O7	6	4.5	6	3

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5-12.5 % (**Medium**), 12.5-13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 18. *Kansas hard red winter wheat bake quality data for the 2006 crop year¹*

Area Composite ³	Protein Level Composite ²			Overall
	Medium	High	Strong	
Loaf volume (cc)				
K1	-	-	-	875
K2	-	-	850	-
K3	650	710	800	825
K4	-	675	650	600
K5	675	650	750	675
K6	-	710	780	775
K7	-	635	710	785
K8	635	685	735	715
K9	635	750	785	820
K10	680	725	-	745
Crumb grain score (1-8)				
K1	-	-	-	5
K2	-	-	4	-
K3	5	5	5	6
K4	-	5	5	4
K5	5	5	5	5
K6	-	4	6	5
K7	-	6	5	6
K8	4	5	4	4
K9	4	5	4	6
K10	6	4	-	6
Crumb texture score (1-8)				
K1	-	-	-	5
K2	-	-	6	-
K3	5	6	6	5
K4	-	4	5	6
K5	4	5	5	5
K6	-	5	5	5
K7	-	6	5	6
K8	4	4	5	3
K9	5	5	5	6
K10	6	5	-	6

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5-12.5 % (**Medium**), 12.5-13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 19. *Colorado hard red winter wheat bake quality data for the 2006 crop year¹*

Area Composite ³	Protein Level Composite ²			Overall
	Medium	High	Strong	
Loaf volume (cc)				
C1	720	745	820	755
C2	-	800	770	765
C3	735	810	805	785
Crumb grain score (1-8)				
C1	6	4	5	6
C2	-	3	5	4
C3	5	5	7	5
Crumb texture score (1-8)				
C1	7	5	5	6
C2	-	4	6	5
C3	5	5	6	6

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5-12.5 % (**Medium**), 12.5-13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 20. Nebraska hard red winter wheat bake quality data for the 2006 crop year¹

Area Composite ³	Protein Level Composite ²				Overall
	Low	Medium	High	Strong	
Loaf volume (cc)					
N1	-	740	830	845	845
N2	-	770	825	860	850
N3	-	735	835	855	885
N4	-	790	910	910	795
N5	600	820	800	875	845
Crumb grain score (1-8)					
N1	-	6	5	6	6
N2	-	5	5	5	6
N3	-	4	5	5	5
N4	-	4	5	5	4
N5	4	5	7	6	4
Crumb texture score (1-8)					
N1	-	7	6	6	7
N2	-	6	6	6	6
N3	-	5	4	5	5
N4	-	5	5	5	5
N5	5	6	6	7	6

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5 % (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Table 21. South Dakota hard red winter wheat bake quality data for the 2006 crop year¹

Area Composite ³	Protein Level Composite ²				Overall
	Low	Medium	High	Strong	
Loaf volume (cc)					
S1	685	725	775	900	775
S2	650	750	775	825	825
Crumb grain score (1-8)					
S1	5	5	6	5	5
S2	4	6	5	5	4
Crumb texture score (1-8)					
S1	6	4	6	7	5
S2	5	7	6	6	5

¹ Based on samples composited by area and protein level

² Protein levels: <11.5% (**Low**); 11.5–12.5 % (**Medium**), 12.5–13.5% (**High**), and >13.5% (**Strong**).

³ Refer to area map of the Great Plains region

Leland McKinney
Extension State Leader
Grain Science and Industry

Jane Lingenfelter
Assistant Agronomist
Agronomy

Mark Fowler
Director of Technical Services
International Grains Program

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