

A stylized, light-colored graphic of wheat stalks with detailed grain patterns, positioned in the upper right corner of the dark brown header.

2016

U.S. HARD RED SPRING WHEAT

REGIONAL QUALITY REPORT



U.S. HARD RED SPRING WHEAT

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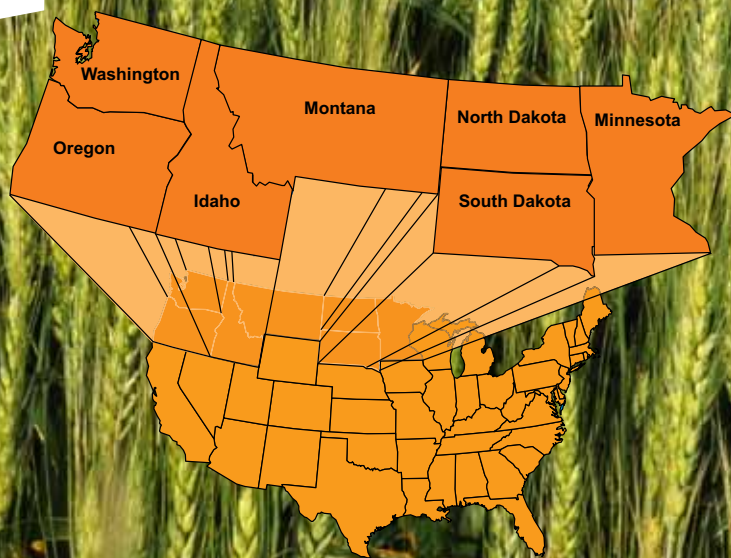
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THE ARISTOCRAT OF WHEAT

HARD RED SPRING—a specialty wheat grown primarily in the Northern Plains of the United States—stands out as the aristocrat of wheat when it comes to baking bread. The high protein content and superior gluten quality of hard red spring wheat make it ideal for use in some of the world's finest baked goods. Yeast breads, hard rolls and specialty products such as

hearth breads, whole grain breads, bagels and pizza crusts look and taste their best when baked with top quality spring wheat flour. Even frozen dough products are better with spring wheat because they can be stored longer than those made with lower protein wheats.

Flour mills in the United States and around the world also use hard

red spring wheat extensively as a blending wheat to increase the gluten strength in a batch of flour. Adding hard red spring to lower protein wheat improves dough handling and mixing characteristics as well as water absorption. The resulting flour can be used to make an assortment of bread products, as well as Chinese-type noodles.

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2016 OVERVIEW

The 2016 U.S. hard red spring wheat crop features a high grade profile, high protein content, sound kernel traits and improved functional performance. An early planting season and excellent growing season pushed the national yield to a record, but production slipped thirteen percent from last year, as planted area declined. Functional performance, from an overall crop perspective, is showing very good values for water absorption, dough strength, loaf volume and bake properties.

The crop averages a No. 1 Dark Northern Spring and is very similar to the 2015 crop for many grade parameters. Specifically, the crop averages a 61.6 lb/bu (81 kg/hl) test weight, near zero damage and 77% vitreous kernels. Ninety-two percent of the samples grade No. 1, and 81 percent are above 60 lb/bu (78.9 kg/hl) test weight. The crop average vitreous kernel level is slightly lower than last year, but higher than the 5-yr average. Vitreous levels are exceptionally high across Montana and the PNW. In the eastern half of the region, portions of the crop are showing slightly lower vitreous counts, due to some sporadic harvest rains. Still, more than two-

thirds of the crop exceeds 75% vitreous kernels, the minimum for the DNS subclass.

Protein levels are high, averaging 14.2% (12% moisture basis), up slightly from 14.1% in 2015 and the 5-yr average. Protein distributions are very similar to last year with nearly 60 percent above 14%, and only 12 percent falling below 13%. Compared to 2015 however, when protein levels were the highest across western areas, in 2016 the highest proteins are in the central part of the region, and much of the west fell below 2015 levels.

Kernel moisture is low, averaging just 12.1%, as most areas had dry harvest conditions. These conditions also produced a sound crop, with an average falling number of 406 seconds, although some northern areas of the region had isolated impacts from rain during harvest.

Disease pressures were non-existent across most of the region with only northern areas facing pressure from Fusarium Head Blight. The crop as a whole is less than 0.05 ppm for DON, down from 0.1 ppm in 2015 and 0.4 ppm for a 5-yr average. In areas where disease pressure was highest, DON levels may be closer to the 5-yr average, but based on

PRODUCTION DATA	2016	2015	2011-15 AVERAGE
MILLION BUSHELS			
Minnesota	74	86	89
Montana	76	76	112
North Dakota	269	319	310
South Dakota	47	61	65
ID/OR/WA	25	23	40
U.S. Total	493	568	615
MILLION METRIC TON			
Minnesota	2.01	2.34	2.43
Montana	2.07	2.06	3.04
North Dakota	7.32	8.68	8.43
South Dakota	1.28	1.65	1.76
ID/OR/WA	0.67	0.62	1.08
U.S. Total	13.4	15.5	16.7

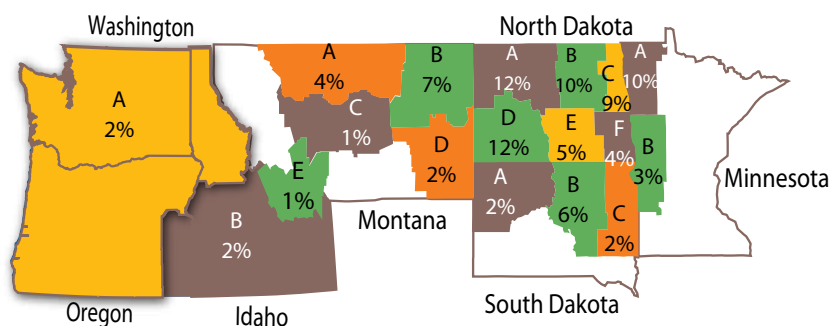
Source: USDA 2016 Small Grains Summary

samples collected in this survey, only one of the eighteen cropping region composites showed detectable DON, averaging 0.3 ppm

Milling yields in 2016, based on a Buhler Lab Mill, are at 66.9%, similar to a year ago, and slightly below the 5-yr average. Likewise, flour ash and wet gluten values are similar to 2015 and the 5-yr, at 0.53% and 34.7%, respectively. Amylograph values are slightly lower than a year ago, but higher than the 5-yr average. The average is 659 B.U., based on the 65 gram test.

The 2016 crop is exhibiting stronger dough properties and greater water absorption on the overall crop compared to 2015. Farinograph tests show a three minute increase in stability, averaging 13.2 minutes, compared to just 10.3 in 2015, and 10.6 for a 5-yr average. Stabilities across western portions of the region are slightly weaker than a year ago, whereas some eastern areas are appreciably stronger. Environment and variety shifts are

Approximate Share of Regional Production by Area



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both contributing factors. Stabilities range from eight to 21 minutes across the region. Absorption values are higher than 2015 in all cropping regions, averaging 62.7%, but still slightly lower than the 5-yr average. Dough strength as measured on the Extensigraph and Alveograph indicates stronger properties overall, with slightly less extensibility.

Baking evaluations show slightly higher loaf volumes compared

to 2015, averaging 976 cubic centimeters, with similar absorption, averaging 67.6%. Loaf volumes range from 897 to 1008. Dough handling properties are similar to a year ago with overall bread scores showing improvements.

The 2016 crop provides buyers with many positive attributes including high grades and protein levels, little to no DON, and good functional performance

overall, especially for dough strength, absorption and bake quality. Differences in growing season environments created some variance in protein levels and functional performance among cropping regions, but key parameters such as dough stability, absorption and loaf volume all tend to improve with protein content in 2016. Buyers can buy with confidence, but diligent contract specifications are still the best way to get the quality demanded.

SEASONAL CONDITIONS



Planting began in late March, with the bulk of the crop planted in April and May. Warm, dry conditions allowed for an early start and steady progress, keeping the pace well ahead of average. A few rain delays occurred but were considered beneficial as some areas fell short on soil moisture, as the planting season progressed.



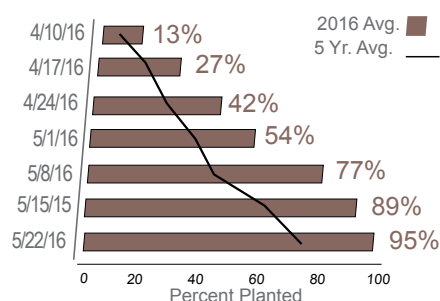
Crop development was two to three weeks ahead of average for most of the growing season. Overall, moisture levels were adequate and timely precipitation was received. Comparatively, the north and west part of the four-state region experienced more frequent and plentiful rain. The good moisture situation, combined with an early planted crop promoted excellent yield potential throughout much of the region and the crop attained record yields. Disease pressure was minimal, except in isolated areas across the north where high humidity at mid-season was an issue.

Growing conditions across the PNW were also excellent and much improved from the 2015 drought.

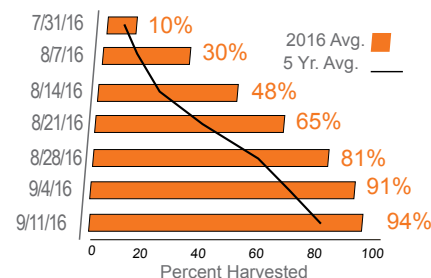


Harvest began the end of July and steady progress was made due to mostly dry conditions. Some delays were experienced in mid to late harvest due to rainfall. The majority of the crop was harvested by mid-September and came off with good quality and few problems. A small portion of the later harvest was delayed due to heavy precipitation in early September.

HRS PLANTING PROGRESS



HRS HARVEST PROGRESS



WHEAT CHARACTERISTICS

OFFICIAL U.S. GRADES AND GRADE REQUIREMENTS (Revised June 1993)

GRADING FACTORS	U.S. Grades				
	1	2	3	4	5
HARD RED SPRING - MINIMUM TEST WEIGHTS					
Pounds per bushel	58.0	57.0	55.0	53.0	50.0
Kilograms per hectoliter	76.4	75.1	72.5	69.9	66.0
MAXIMUM PERCENT LIMITS OF:					
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/broken kernels	3.0	5.0	8.0	12.0	20.0
Total ¹	3.0	5.0	8.0	12.0	20.0
Wheat of other classes ²					
Contrasting classes	1.0	2.0	3.0	10.0	10.0
Total ³	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					
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 material	3	3	3	3	3
Total ⁴	4	4	4	4	4
Insect-damaged kernels	31	31	31	31	31

U.S. sample grade is wheat that:

- Does not meet the requirements for U.S. Nos. 1, 2, 3, 4, or 5; or
- Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
- 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 grades, as defined by the USDA Grain Inspection, Packers and Stockyards Administration (GIPSA), reflect the general quality and condition of a representative sample. U.S. grades are based on test weight and include limits on damaged kernels, foreign material, shrunken and broken kernels, and wheat of contrasting classes.

Subclass is a separate marketing factor based on the number of kernels that are dark, hard and vitreous. For hard red spring wheat the subclasses are:

- | Dark Northern Spring (DNS)—at least 75 percent or more dark, hard, vitreous kernels;
- | Northern Spring (NS)—between 25 and 74 percent dark, hard, vitreous kernels;
- | Red Spring (RS)—less than 25 percent dark, hard, vitreous kernels.

Other basic criteria not included as grading factors but important in the U.S. wheat marketing system.

Protein is probably the most important factor in determining the value of hard red spring wheat since it relates to many processing properties. In the U.S. market HRS prices are usually quoted for 14.0 percent protein (on a 12.0 percent moisture basis). Price premiums or discounts may be specified for halves, fifths and tenths of a percentage point above and below 14.0 percent.

Moisture content is an indicator of grain storability. Wheat with lower moisture content is generally more stable during storage and more profitable to a miller. U.S. HRS ranges from 12 to 13 percent.

Dockage is any material easily removed from a wheat sample during cleaning using standard mechanical means. All U.S. grade and non-grade factors are determined only after dockage is removed.

Falling number indicates the soundness of wheat or its alpha-amylase activity. Falling numbers above 300 seconds are most desired for baking products.

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WHEAT GRADING DATA

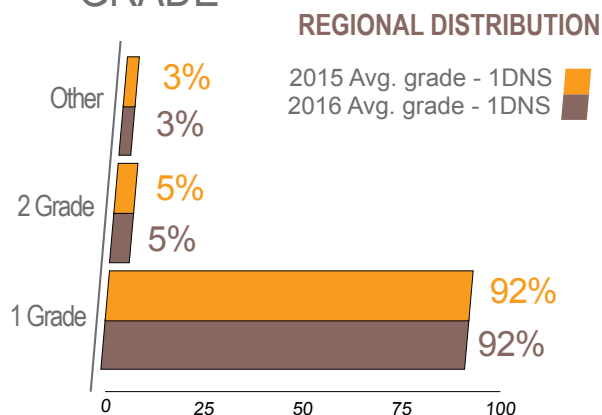
STATE AND CROP REPORTING AREA	TEST WEIGHT LBS/BU KG/HL		DAMAGE %	SHRUNKEN/ BROKEN KERNELS %	TOTAL DEFECTS %	U.S. GRADE SUBCLASS	VITREOUS KERNELS %
MINNESOTA							
Area A	61.3	80.6	0.1	0.6	0.7	1 NS	72
Area B	61.2	80.5	0.0	0.1	0.1	1 NS	70
State Avg. 2016	61.3	80.6	0.1	0.5	0.6	1 NS	72
State Avg. 2015	61.4	80.7	0.3	0.7	1.0	1 DNS	86
MONTANA							
Area A	60.5	79.5	0.0	1.1	1.1	1 DNS	91
Area B	62.0	81.6	0.0	1.1	1.1	1 DNS	95
Area C	61.4	80.8	0.0	1.4	1.4	1 DNS	88
Area D	61.5	80.9	0.0	1.8	1.8	1 DNS	89
Area E	63.4	83.3	0.0	0.5	0.5	1 DNS	98
State Avg. 2016	61.4	80.8	0.0	1.1	1.1	1 DNS	93
State Avg. 2015	61.1	80.4	0.1	1.2	1.3	1 DNS	95
NORTH DAKOTA							
Area A	61.8	81.3	0.2	1.1	1.3	1 DNS	83
Area B	61.4	80.8	0.0	0.8	0.8	1 NS	70
Area C	61.0	80.3	0.0	0.2	0.2	1 NS	67
Area D	61.6	81.0	0.0	0.8	0.8	1 NS	71
Area E	61.5	80.9	0.0	0.5	0.5	1 NS	67
Area F	62.0	81.6	0.0	0.2	0.2	1 NS	70
State Avg. 2016	61.6	81.0	0.1	0.7	0.8	1 NS	73
State Avg. 2015	61.9	81.4	0.5	0.7	1.2	1 DNS	81
SOUTH DAKOTA							
Area A	61.4	80.8	0.0	0.9	0.9	1 NS	70
Area B	61.9	81.4	0.0	0.5	0.5	1 DNS	80
Area C	61.7	81.1	0.0	0.8	0.8	1 NS	73
State Avg. 2016	61.8	81.2	0.0	0.6	0.6	1 DNS	77
State Avg. 2015	61.7	81.1	0.3	0.8	1.1	1 DNS	76
ID/OR/WA							
Area A	63.1	83.0	0.0	1.0	1.0	1 DNS	96
Area B	63.4	83.3	0.0	0.6	0.6	1 DNS	96
State Avg. 2016	63.3	83.2	0.0	0.8	0.8	1 DNS	96
State Avg. 2015	60.7	79.8	0.2	1.1	1.3	1 DNS	93
REGION AVERAGE							
Avg. 2016	61.6	81.0	0.0	0.8	0.8	1 DNS	77
Avg. 2015	61.6	81.0	0.4	0.8	1.2	1 DNS	83
Five-Year Avg	61.4	80.8	0.2	1.0	1.2	1 NS	72

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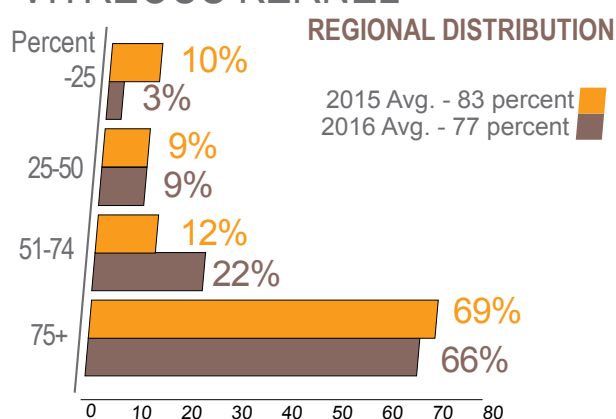
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GRADE

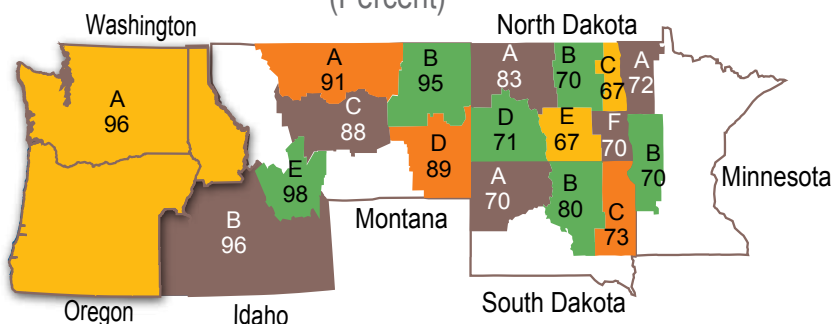


VITREOUS KERNEL

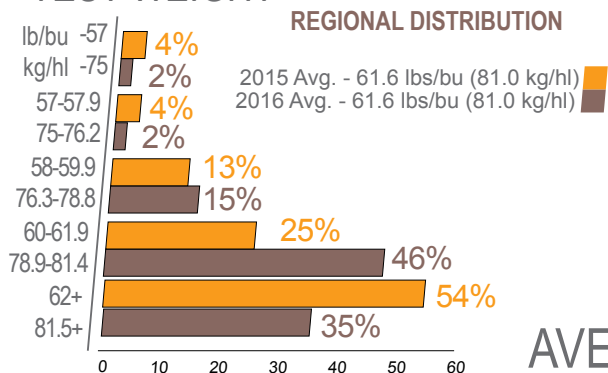


AVERAGE VITREOUS KERNEL BY AREA

(Percent)

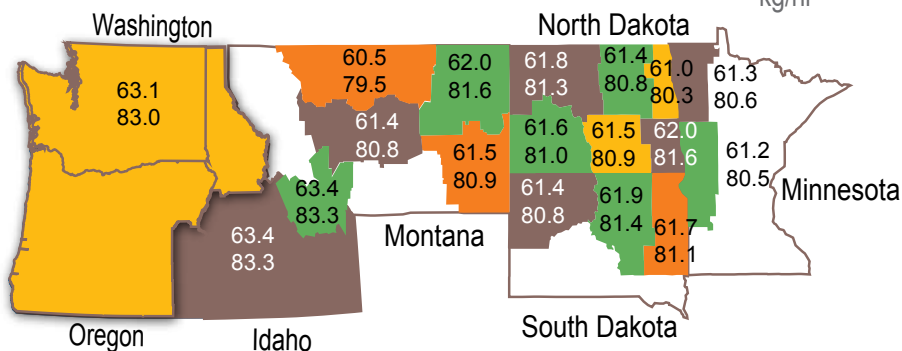


TEST WEIGHT



AVERAGE TEST WEIGHT BY AREA

lbs/bu
kg/hl



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OTHER KERNEL QUALITY DATA

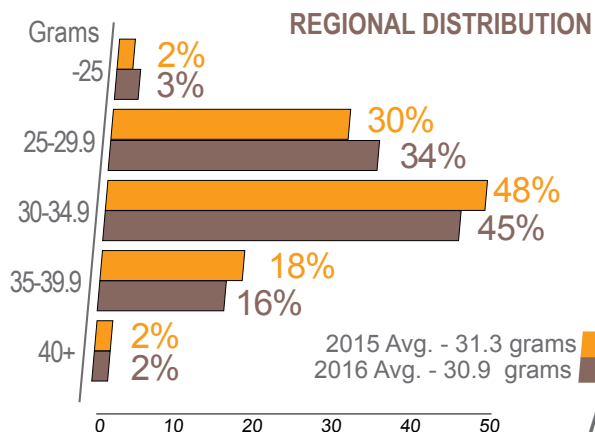
STATE AND CROP REPORTING AREA	Dockage %	Moisture %	1000 Kernel Weight G	Kernel Dist. Medium %	Kernel Dist. Large %	Protein (12% moisture) %	Protein (0% moisture) %	DON PPM	Wheat Ash %	Falling Number SEC	Zeleny Sed CC
MINNESOTA											
Area A	0.5	13.1	33.2	42	56	13.8	15.7	0.0	1.44	428	66
Area B	0.3	13.4	35.7	33	66	13.7	15.5	0.0	1.56	396	64
State Avg. 2016	0.4	13.1	33.7	40	58	13.8	15.6	0.0	1.47	422	65
State Avg. 2015	0.7	12.9	32.2	42	55	13.8	15.7	0.0	1.50	373	61
MONTANA											
Area A	0.6	11.1	31.3	60	36	13.6	15.4	0.0	1.49	365	67
Area B	0.5	11.0	28.4	66	31	13.6	15.5	0.0	1.54	374	64
Area C	0.5	11.7	30.4	62	34	13.9	15.8	0.0	1.51	371	69
Area D	0.6	11.7	28.9	68	28	13.9	15.8	0.0	1.51	389	64
Area E	0.4	11.0	32.9	47	51	14.4	16.4	0.0	1.51	349	70
State Avg. 2016	0.5	11.1	29.7	63	33	13.6	15.5	0.0	1.52	370	65
State Avg. 2015	0.6	10.7	30.5	67	29	14.4	16.3	0.0	1.53	359	65
NORTH DAKOTA											
Area A	0.6	12.3	29.5	58	39	14.3	16.3	0.0	1.46	411	67
Area B	0.5	13.0	31.0	47	51	14.2	16.1	0.0	1.54	379	63
Area C	0.5	13.0	32.2	46	52	14.1	16.0	0.3	1.57	427	64
Area D	0.5	11.8	29.6	63	34	14.8	16.8	0.0	1.57	403	67
Area E	0.4	12.5	30.8	51	46	14.7	16.7	0.0	1.60	427	66
Area F	0.6	13.0	31.5	46	52	14.1	16.0	0.0	1.63	434	62
State Avg. 2016	0.5	12.5	30.4	54	44	14.4	16.4	0.0	1.54	407	66
State Avg. 2015	0.8	12.3	31.3	48	50	14.1	16.1	0.2	1.53	372	61
SOUTH DAKOTA											
Area A	0.4	11.6	28.6	69	27	14.0	15.9	0.0	1.54	429	66
Area B	0.4	12.0	29.5	61	34	14.5	16.5	0.0	1.57	428	63
Area C	0.3	12.9	30.7	57	41	14.7	16.7	0.0	1.58	453	60
State Avg. 2016	0.4	12.1	29.5	62	34	14.5	16.4	0.0	1.57	432	63
State Avg. 2015	0.6	12.4	31.3	50	48	14.0	15.9	0.0	1.57	385	51
ID/OR/WA											
Area A	0.4	9.3	34.2	46	52	14.2	16.1	0.0	1.50	414	67
Area B	0.2	8.8	35.0	44	54	14.0	15.9	0.0	1.55	405	57
State Avg. 2016	0.3	9.0	34.6	45	53	14.1	16.0	0.0	1.53	408	62
State Avg. 2015	0.2	9.4	32.3	47	49	15.0	17.0	0.0	1.62	384	61
REGION AVERAGE											
Avg. 2016	0.5	12.1	30.9	53	44	14.2	16.1	0.0	1.53	406	65
Avg. 2015	0.7	12.1	31.3	49	48	14.1	16.0	0.1	1.53	372	61
Five-Year Avg	0.7	12.1	30.7	52	45	14.1	16.0	0.4	1.56	380	61

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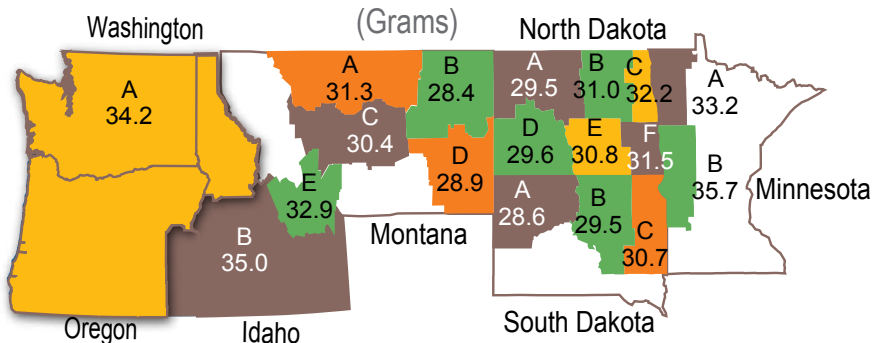
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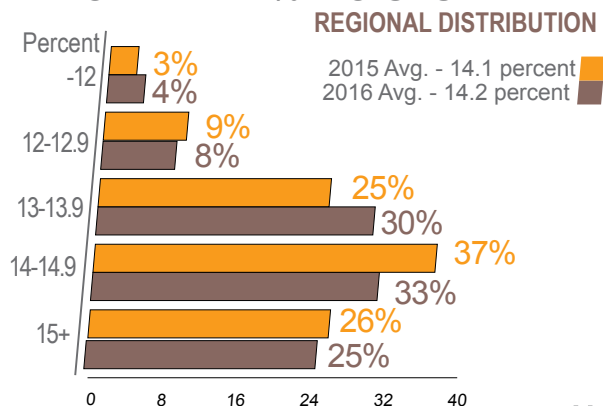
1000 KERNEL WEIGHT



AVERAGE 1000 KERNEL WEIGHT BY AREA

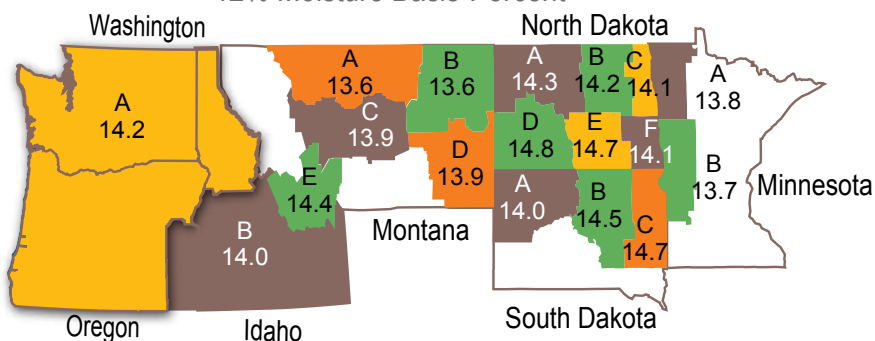


PROTEIN - 12% MOISTURE



AVERAGE WHEAT PROTEIN BY AREA

12% Moisture Basis-Percent

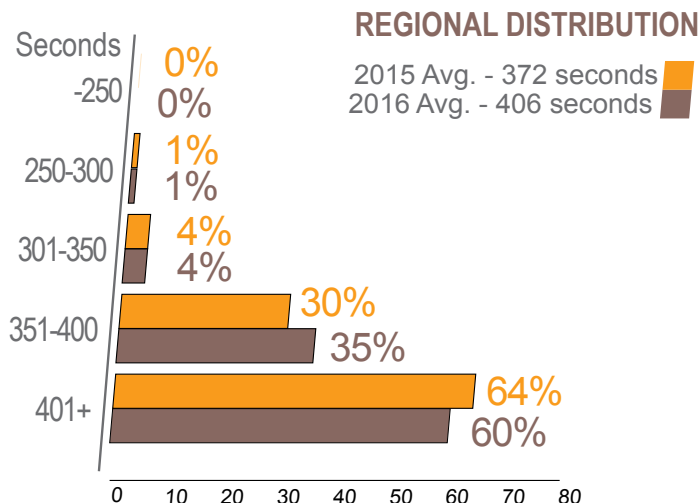


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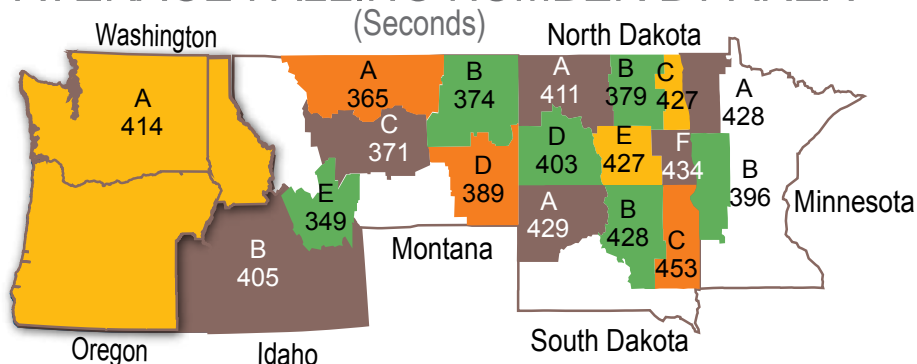
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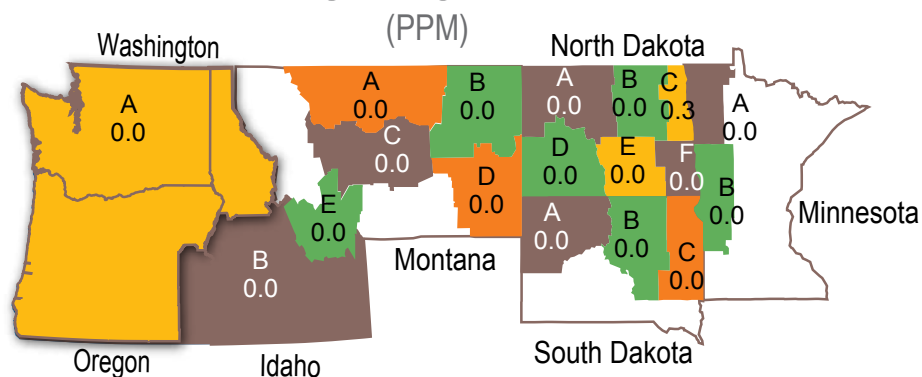
FALLING NUMBER



AVERAGE FALLING NUMBER BY AREA



AVERAGE DON BY AREA



MILLING CHARACTERISTICS



Flour is evaluated for several factors to determine overall milling efficiency, grade, soundness and functional properties.

Extraction, or the proportion of the wheat kernel that can be milled into flour, is important to mill profitability. For purposes of this survey, test milling was conducted with a Buhler laboratory mill. Results are suitable for comparison between crop years, however yields are lower than those obtained in commercial mills.

Another measure of milling efficiency and of flour grade is the ash content, or mineral residue, remaining after incineration of a sample.

Starch damage measures physical damage to a proportion of the starch granules of flour. The level directly affects water absorption and dough mixing properties.

Wet gluten provides a quantitative measure of the gluten forming proteins in flour that are primarily responsible for its dough mixing and baking properties.

Falling number measures enzyme activity in flour. A fast time indicates high activity, revealing too much sugar and too little starch. Since starch provides bread's supporting structure, too much activity results in sticky dough and poor texture in finished products.

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FLOUR QUALITY DATA

STATE AND CROP REPORTING AREA	FLOUR EXTRACTION %	FLOUR ASH %	FLOUR PROTEIN (14% MOISTURE) %	STARCH DAMAGE %	SRC: GPI	WATER/ 50% SUCROSE	5% LACTIC ACID/5% NA ₂ CO ₃	WET GLUTEN %	GLUTEN INDEX	FALLING NUMBER
MINNESOTA										
Area A	66.2	0.56	12.7	6.9	0.66	69/118	143/98	31.3	96	439
Area B	69.0	0.57	12.7	6.8	0.65	69/122	143/100	32.5	98	412
State Avg. 2016	66.8	0.56	12.7	6.8	0.66	69/119	143/98	31.5	97	433
State Avg. 2015	68.2	0.53	12.9	7.2	0.63	71/119	135/96	34.4	93	383
MONTANA										
Area A	66.3	0.56	12.7	6.7	0.66	67/120	145/99	33.2	92	381
Area B	66.4	0.55	12.7	6.4	0.64	69/119	140/99	35.6	88	379
Area C	67.5	0.54	13.1	7.2	0.61	74/128	145/107	34.0	96	422
Area D	67.5	0.54	12.9	6.7	0.64	64/120	138/97	35.7	87	399
Area E	64.5	0.54	13.3	7.2	0.66	74/131	157/108	40.2	82	404
State Avg. 2016	66.4	0.55	12.7	6.6	0.65	68/120	143/99	34.7	90	382
State Avg. 2015	65.3	0.52	13.3	6.6	0.65	69/122	143/98	36.1	84	395
NORTH DAKOTA										
Area A	67.9	0.54	13.1	7.0	0.69	69/116	144/94	35.4	90	431
Area B	67.3	0.52	13.0	7.0	0.65	69/117	137/96	36.2	88	369
Area C	65.8	0.48	12.8	6.9	0.65	68/120	139/95	33.8	96	425
Area D	66.4	0.50	13.6	6.3	0.66	68/119	142/98	36.5	92	412
Area E	67.1	0.48	13.3	6.9	0.68	69/119	146/96	35.1	92	420
Area F	66.4	0.50	12.8	6.6	0.68	72/115	144/96	33.9	96	408
State Avg. 2016	67.0	0.51	13.2	6.8	0.66	69/118	142/96	35.5	91	409
State Avg. 2015	67.4	0.52	13.0	7.0	0.63	71/118	134/96	35.0	85	381
SOUTH DAKOTA										
Area A	68.0	0.55	13.0	6.4	0.67	71/119	147/99	33.5	96	439
Area B	68.2	0.55	13.2	6.9	0.67	69/113	138/92	34.5	94	441
Area C	67.4	0.56	13.5	5.8	0.67	67/113	136/89	35.0	92	465
State Avg. 2016	68.0	0.55	13.2	6.6	0.67	69/115	139/93	34.4	94	444
State Avg. 2015	67.0	0.52	12.6	7.0	0.65	70/112	130/88	32.3	91	395
ID/OR/WA										
Area A	65.5	0.55	13.1	6.8	0.66	73/124	147/99	34.1	93	474
Area B	66.0	0.57	13.1	7.7	0.61	74/125	139/104	36.1	80	451
State Avg. 2016	65.8	0.56	13.1	7.3	0.63	73/124	143/102	35.2	86	461
State Avg. 2015	67.0	0.55	13.9	6.7	0.59	73/125	131/96	38.9	73	432
REGION AVERAGE										
Avg. 2016	66.9	0.53	13.0	6.8	0.66	69/118	142/96	34.7	92	415
Avg. 2015	67.1	0.52	13.0	6.9	0.63	71/118	135/95	34.9	86	386
Five-Year Avg.	67.9	0.51	13.0	7.3	0.64	74/130	*146/99	34.8	91	397

*Four-Year Avg.

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AMLYLOGRAPH PEAK VISCOSITY

65 G FL 100 G FL
B.U. B.U.

679	2519
705	2745
684	2562
684	3041

652	2367
798	2716
834	3067
800	2862
783	2650
741	2593
685	2898

632	2366
672	2695
573	2181
559	2196
637	2373
685	2543
620	2390
662	2847

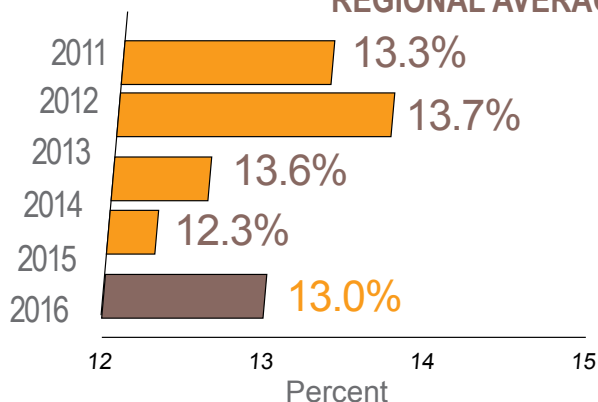
539	2194
708	2679
674	2595
667	2564
718	3110

670	2437
773	2672
728	2569
727	3043

659	2473
676	2917
620	2370

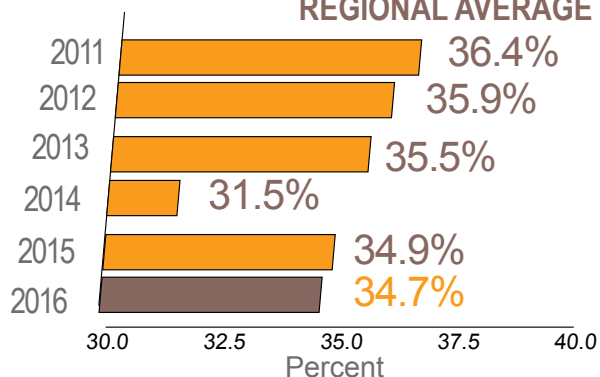
FLOUR PROTEIN

REGIONAL AVERAGE



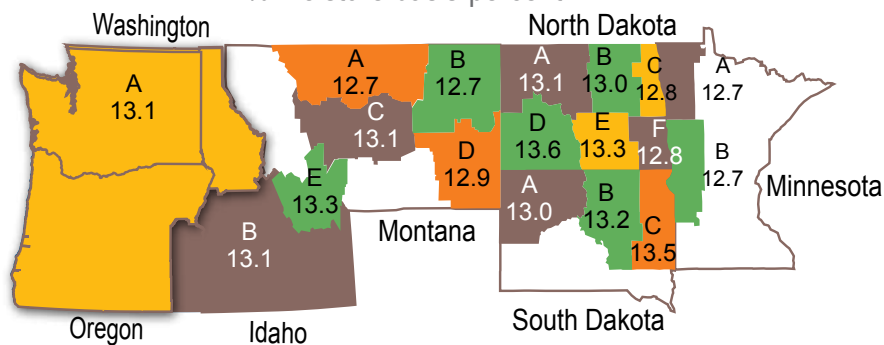
WET GLUTEN

REGIONAL AVERAGE



AVERAGE FLOUR PROTEIN BY AREA

14% moisture basis-percent



DOUGH CHARACTERISTICS

Physical characteristics of dough are evaluated to reveal useful information about variations in flour types, processing requirements and expected end-product quality.

A farinograph traces a curve during the dough mixing process to record variations in gluten development and the breakdown of gluten proteins over time. Water absorption indicates the amount of water that can be added to the flour until the dough reaches a definite consistency. Peak time

indicates the number of minutes

dough consistency and stability of the dough. Both related to dough strength.

dough strength by on a hook until it breaks.

curve that measures to extension and the energy value.

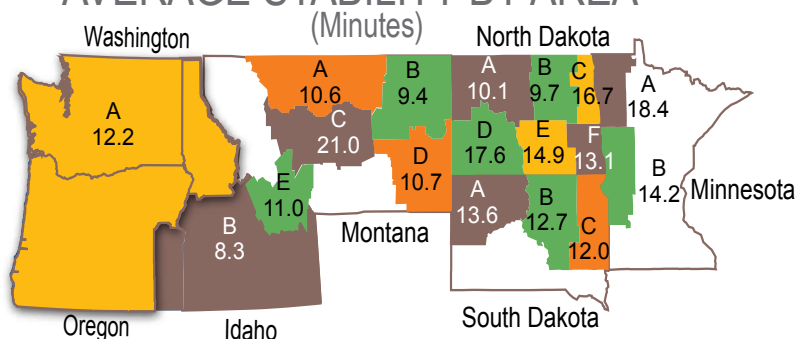


a definite consistency. Peak time required to achieve this level of mixing tolerance indicates the peak time and stability are The extensigraph measures stretching a piece of dough The apparatus traces a extensibility, resistance area beneath the curve, or

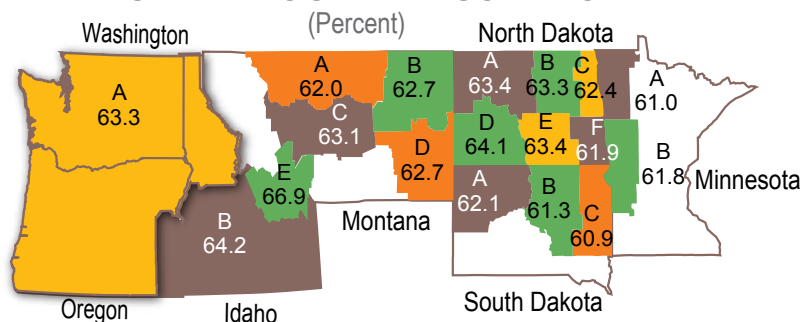
An alveograph traces a pressure necessary to inflate of rupture. The overpressure pressure needed to deform the piece and is an indication of resistance, or dough dough extensibility. The deformation energy (W) measurement is the amount of energy needed to inflate the dough to the point of rupture and is indicative of dough strength.

curve that measures the air a piece of dough to the point (P) value reflects the maximum of dough during the inflation process stability. The length (L) measurement reflects

AVERAGE STABILITY BY AREA



AVERAGE FARINOGRAM ABSORPTION BY AREA



PHYSICAL DOUGH QUALITY

FARINOGRAPH

STATE AND CROP REPORTING AREA	ABSORPTION %	PEAK TIME MIN	STABILITY MIN	MTI B.U.	QUALITY NUMBER MM
MINNESOTA					
Area A	61.0	7.0	18.4	17	187
Area B	61.8	8.0	14.2	16	164
State Avg. 2016	61.1	7.1	17.6	16	182
State Avg. 2015	60.9	6.4	11.0	29	113
MONTANA					
Area A	62.0	7.6	10.6	26	136
Area B	62.7	7.3	9.4	22	150
Area C	63.1	8.4	21.0	15	202
Area D	62.7	8.0	10.7	23	149
Area E	66.9	8.3	11.0	17	164
State Avg. 2016	62.5	7.5	10.3	23	146
State Avg. 2015	62.1	7.7	14.8	24	145
NORTH DAKOTA					
Area A	63.4	8.8	10.1	25	150
Area B	63.3	7.5	9.7	27	131
Area C	62.4	7.4	16.7	13	192
Area D	64.1	9.9	17.6	9	256
Area E	63.4	9.0	14.9	17	182
Area F	61.9	8.2	13.1	17	165
State Avg. 2016	63.3	8.5	13.2	19	179
State Avg. 2015	62.3	6.5	9.1	32	112
SOUTH DAKOTA					
Area A	62.1	7.3	13.6	13	160
Area B	61.3	8.1	12.7	19	160
Area C	60.9	8.7	12.0	24	152
State Avg. 2016	61.4	8.0	12.8	18	159
State Avg. 2015	60.9	6.9	9.5	37	106
ID/OR/WA					
Area A	63.3	8.3	12.2	22	159
Area B	64.2	6.2	8.3	23	124
State Avg. 2016	63.8	7.1	10.0	22	139
State Avg. 2015	62.6	7.3	12.0	23	143
REGION AVERAGE					
Avg. 2016	62.7	8.0	13.2	19	170
Avg. 2015	61.9	6.7	10.3	31	117
Five-Year Avg.	63.1	6.8	10.6	34	122

FARINOGRAPH RESULTS REGIONAL AVERAGE

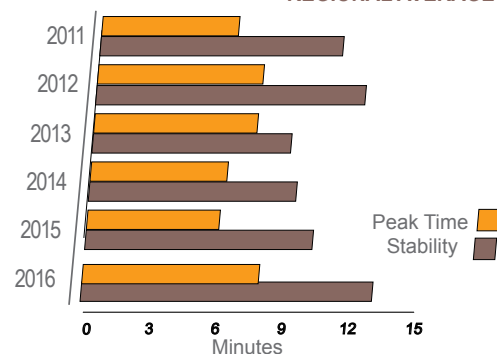
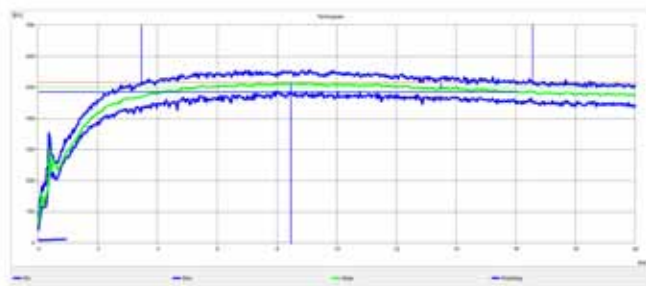
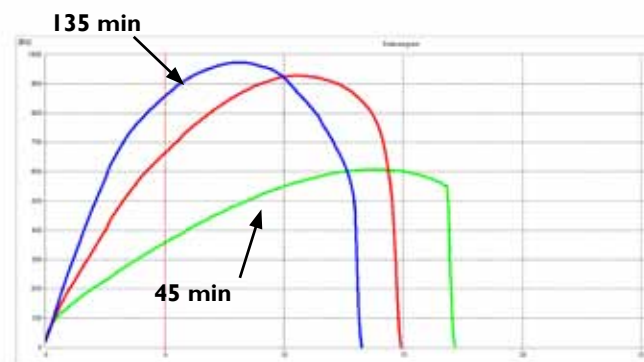


Photo: Kaitlyn Peterson, Bismarck, ND

2016 AVERAGE FARINOGRAM



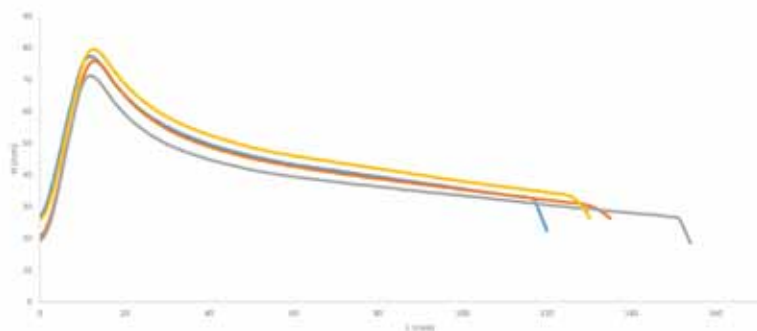
2016 AVERAGE EXTENSIGRAM



Indicates extensibility and resistance to extension. Area beneath curve indicates the energy or work required.



2016 AVERAGE ALVEOGRAM



P-curve height shows maximum pressure needed to deform dough, indicating stability.

L-length of curve reflects extensibility.

W- measurement of total energy or work needed to inflate dough.



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PHYSICAL DOUGH QUALITY

STATE AND CROP REPORTING AREA	EXTENSIGRAPH						ALVEOGRAPH			
	EXTENSIBILITY 45 MIN CM	RESISTANCE 45 MIN B.U.	AREA SQ CM	EXTENSIBILITY 135 MIN CM	RESISTANCE 135 MIN B.U.	AREA SQ CM	P MM	L MM	P/L RATIO	W JOULES X 10 ⁴
MINNESOTA										
Area A	17.4	704	157	12.8	1072	180	88	137	0.64	442
Area B	17.0	625	139	13.3	973	172	90	129	0.70	416
State Avg. 2016	17.3	689	154	12.9	1053	178	88	135	0.65	437
State Avg. 2015	16.3	515	109	13.5	831	148	80	127	0.63	356
MONTANA										
Area A	17.4	450	106	11.9	854	135	75	141	0.53	335
Area B	14.6	453	87	11.8	1064	161	82	137	0.60	362
Area C	16.1	713	141	11.7	1122	173	107	96	1.11	408
Area D	17.5	469	109	11.4	934	139	79	140	0.56	356
Area E	17.5	418	98	13.3	834	148	95	131	0.73	388
State Avg. 2016	15.9	459	97	11.9	975	150	80	137	0.58	353
State Avg. 2015	15.8	463	95	12.8	902	147	87	123	0.71	364
NORTH DAKOTA										
Area A	17.4	449	102	13.4	898	157	72	142	0.51	335
Area B	16.1	450	92	11.3	867	133	79	123	0.64	327
Area C	17.0	574	127	13.5	878	160	90	113	0.80	361
Area D	15.9	565	114	10.9	1141	160	97	120	0.81	424
Area E	16.0	625	128	11.9	1129	171	91	124	0.73	403
Area F	15.3	585	113	13.2	962	165	84	135	0.62	391
State Avg. 2016	16.5	516	109	12.2	969	154	84	127	0.66	366
State Avg. 2015	16.9	418	92	14.3	779	147	80	119	0.67	314
SOUTH DAKOTA										
Area A	16.8	618	127	12.6	1002	170	92	131	0.70	417
Area B	17.8	585	135	13.5	1052	188	80	137	0.58	378
Area C	17.2	547	124	14.6	976	185	74	131	0.56	344
State Avg. 2016	17.5	586	132	13.5	1029	184	82	135	0.61	381
State Avg. 2015	15.5	456	92	14.1	833	154	77	113	0.69	288
ID/OR/WA										
Area A	18.0	533	124	12.1	767	127	86	129	0.67	383
Area B	15.1	356	72	13.9	598	109	86	122	0.70	326
State Avg. 2016	16.4	434	95	13.1	672	117	86	125	0.69	351
State Avg. 2015	17.4	413	95	15.5	680	139	80	123	0.66	320
REGION AVERAGE										
Avg. 2016	16.6	536	115	12.4	973	158	84	130	0.64	376
Avg. 2015	16.5	442	95	14.0	805	147	80	120	0.67	324
Five-Year Avg.	17.0	441	98	15.0	682	131	89	116	0.79	343

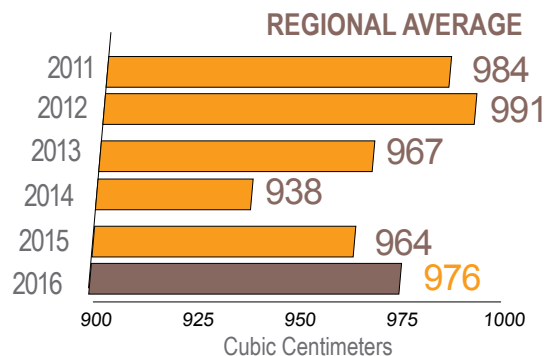
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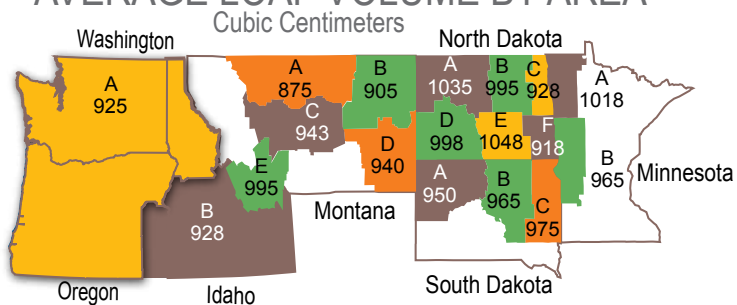
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LOAF VOLUME



AVERAGE LOAF VOLUME BY AREA



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BAKING DATA

STATE AND CROP REPORTING AREA	BAKING ABSORPTION %	DOUGH HANDLING PROPERTIES	LOAF VOLUME CC	GRAIN AND TEXTURE	CRUMB COLOR	CRUST COLOR	SYMMETRY
MINNESOTA							
Area A	65.3	10.0	1018	7.5	7.5	10.0	9.0
Area B	67.3	9.5	965	7.8	8.0	9.5	8.5
State Avg. 2016	65.7	9.9	1008	7.5	7.6	9.9	8.9
State Avg. 2015	67.5	9.4	978	7.7	7.9	9.0	9.1
MONTANA							
Area A	66.7	9.5	875	8.0	7.8	10.0	9.0
Area B	68.7	9.5	905	7.8	7.3	9.5	8.5
Area C	69.5	8.5	943	7.3	7.8	10.0	8.5
Area D	66.8	9.5	940	7.8	7.5	10.0	9.0
Area E	70.9	9.5	995	7.3	8.3	10.0	9.5
State Avg. 2016	67.9	9.5	897	7.8	7.5	9.7	8.7
State Avg. 2015	67.2	10.0	948	7.5	7.7	9.7	9.4
NORTH DAKOTA							
Area A	67.5	8.5	1035	7.3	7.8	10.0	9.5
Area B	68.7	10.0	995	7.5	7.8	10.0	9.5
Area C	66.3	9.5	928	8.0	8.0	9.0	9.0
Area D	68.9	9.0	998	7.5	7.5	10.0	9.5
Area E	68.2	9.5	1048	7.5	7.3	10.0	9.0
Area F	66.2	9.5	918	7.5	7.5	9.5	8.0
State Avg. 2016	67.9	9.2	997	7.5	7.7	9.8	9.3
State Avg. 2015	67.9	9.4	968	7.3	7.3	9.4	9.2
SOUTH DAKOTA							
Area A	67.6	9.0	950	7.5	8.0	10.0	8.5
Area B	67.8	9.0	965	8.3	8.3	9.5	9.0
Area C	65.4	9.0	975	7.8	8.3	10.0	9.5
State Avg. 2016	67.4	9.0	963	8.0	8.2	9.7	9.0
State Avg. 2015	65.4	9.8	938	7.8	7.7	9.3	7.6
ID/OR/WA							
Area A	67.8	9.5	925	8.3	8.3	10.0	9.0
Area B	68.9	8.5	928	8.0	8.3	10.0	9.5
State Avg. 2016	68.4	8.9	926	8.1	8.3	10.0	9.3
State Avg. 2015	69.3	9.0	1014	7.5	8.0	9.7	9.5
REGION AVERAGE							
Avg. 2016	67.6	9.3	976	7.6	7.7	9.8	9.1
Avg. 2015	67.5	9.5	964	7.4	7.5	9.4	9.0
Five-Year Avg.	65.3	9.3	969	8.0	7.9	9.8	8.7

HISTORICAL AVERAGE OF QUALITY FACTORS

SUMMARY INFORMATION							
CROP YEAR	2016	2015	2014	2013	2012	2011	Five-year Average
WHEAT GRADING DATA							
Test Weight (lb/bu)	61.6	61.6	61.4	62.5	60.8	60.7	61.4
Test Weight (kg/hl)	81.0	81.0	80.7	82.2	80.0	79.6	80.8
Vitreous Kernels (%)	77	83	53	68	75	82	72
1000 Kernel Weight (gm)	30.9	31.3	32.4	32.9	29.2	27.9	30.7
Protein: 12% moisture (%)	14.2	14.1	13.6	13.5	14.6	14.6	14.1
Protein: dry (%)	16.1	16.0	15.4	15.4	16.6	16.6	16.0
Ash: 14% moisture (%)	1.53	1.53	1.46	1.54	1.56	1.73	1.56
Falling Number (sec)	406	372	339	403	421	365	380
FLOUR DATA							
Extraction (%)	66.9	67.1	66.0	69.1	69.0	68.1	67.9
Ash: 14% moisture (%)	0.53	0.52	0.45	0.53	0.49	0.54	0.51
Protein: 14% moisture (%)	13.0	13.0	12.3	12.6	13.7	13.3	13.0
Wet Gluten (%)	34.7	34.9	31.5	35.5	35.9	36.4	34.8
Falling Number (sec)	415	386	370	417	424	388	397
AMYLOGRAPH PEAK VISCOSITY							
65g FL (B.U.)	659	676	518	590	733	581	620
100g FL (B.U.)	2473	2917	1816	2221	2831	2069	2370
PHYSICAL DOUGH PROPERTIES							
*FARINOGRAPH:							
Absorption (%)	62.7	61.9	61.9	63.0	63.3	64.5	63.1
Peak Time (min)	8.0	6.7	6.0	6.2	7.4	7.5	6.8
Stability (min)	13.2	10.3	9.4	9.0	12.2	11.0	10.6
EXTENSIGRAPH:							
Extensibility-45 min (cm)	16.6	16.5	16.2	17.2	16.3	18.5	17.0
Resistance-45 min (B.U.)	536	442	475	413	481	394	441
Area-45 min (sq cm))	115	95	100	94	103	97	98
ALVEOGRAPH:							
P (mm)	84	80	103	89	94	80	89
L (mm)	130	120	101	116	115	126	116
W (joules X 10 ⁴)	376	324	364	335	376	318	343
BAKING DATA							
Absorption (%)	67.6	67.5	67.2	66.1	62.9	63.0	65.3
Dough Handling Properties	9.3	9.5	8.6	9.1	9.5	10.0	9.3
Loaf Volume (CC)	976	964	938	967	991	984	969
Grain and Texture	7.6	7.4	7.9	8.0	8.0	8.6	8.0
Crumb Color	7.7	7.5	7.8	7.9	8.0	8.2	7.9
Crust Color	9.8	9.4	9.7	9.8	10.0	10.0	9.8
Symmetry	9.1	9.0	9.3	8.0	8.2	8.8	8.7

HANDLING AND TRANSPORTATION

The hard red spring wheat growing region utilizes truck, rail and water to get wheat from farms to export facilities. The Northern Plains has a vast network of country elevators to facilitate efficient and precise movement to domestic and export markets. On average, nearly 80 percent of the region's wheat moves to markets by rail. The dominant railroads are the Burlington Northern Santa Fe, the Union Pacific and the Canadian Pacific.

In the Pacific Northwest, a large

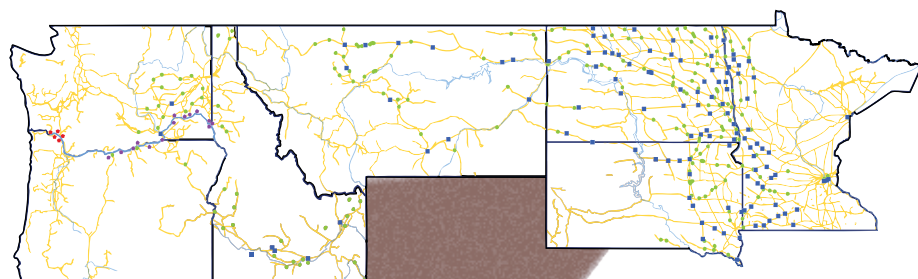
river system is used along with rail to move wheat to export points.

An increasing number of the elevators in the region are investing in facilities and rail capacity to ship 100-110 car units in "shuttle" trains. Each rail car holds approximately 3,500 bushels (95 metric tons) of wheat. Shuttle-equipped facilities receive the lowest rates, sharing volume and transaction efficiencies with the railroad.

The diverse rail and water shipping capacities and a widespread

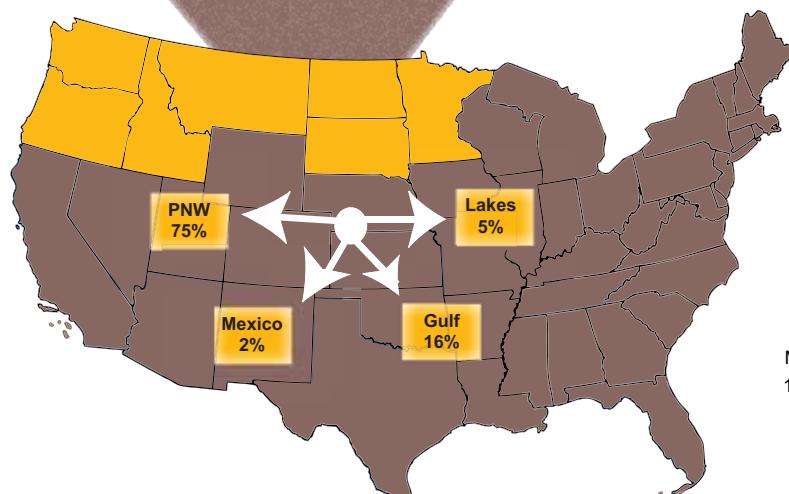
network of elevators are strengths that buyers can capitalize on, especially as their demand heightens for more precise quality specifications and consistency between shipments. Buyers are encouraged to explore origin-specific shipments to optimize the quality and value of wheat they purchase.

The elevator network in the U.S. hard red spring wheat region is well suited for meeting the increasing quality demands of both domestic and international customers.



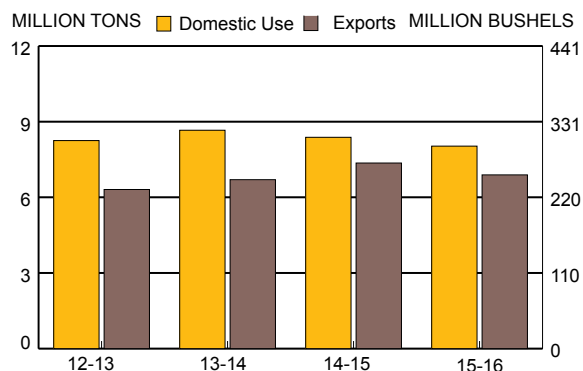
Grain Handling and Transportation Facilities in the U.S. HRS Region

- 100+ rail car track
- 50 - 99 rail car track
- ◆ Export terminals
- River terminals
- River system
- Rail network



AVERAGE SHARE OF U.S. HRS EXPORTS BY PORT (2012-2015)

2012-2015 U.S. HRS DOMESTIC USE AND EXPORTS

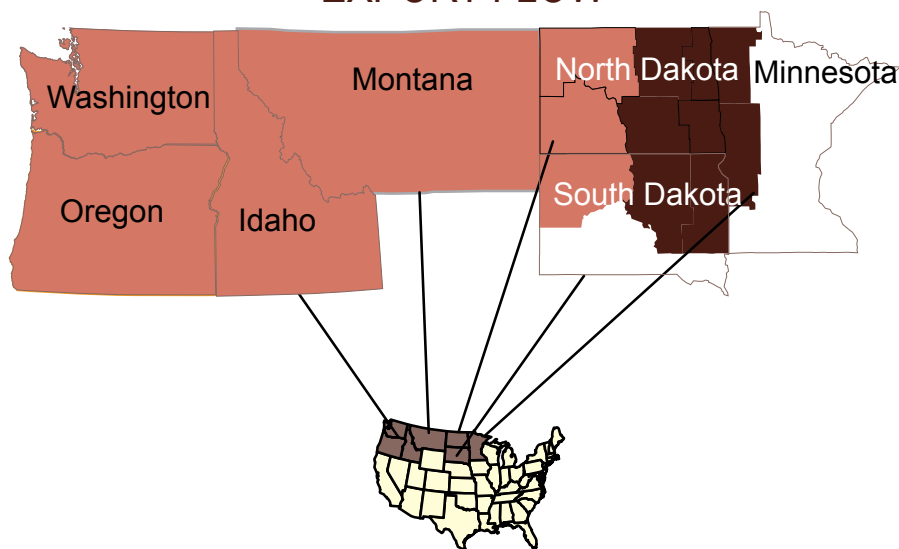


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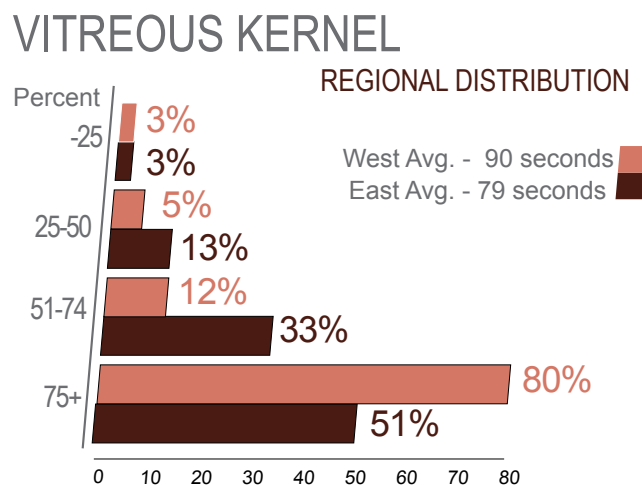
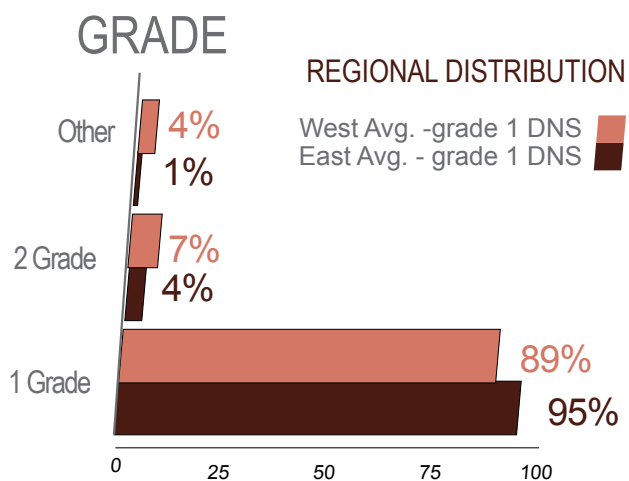
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TYPICAL GEOGRAPHICAL SPLIT FOR EXPORT FLOW



WEST-PNW EXPORT TRIBUTARY
EAST - GULF/GREAT LAKES EXPORT TRIBUTARY

DISTRIBUTIONS BY EAST/WEST PRODUCTION REGIONS

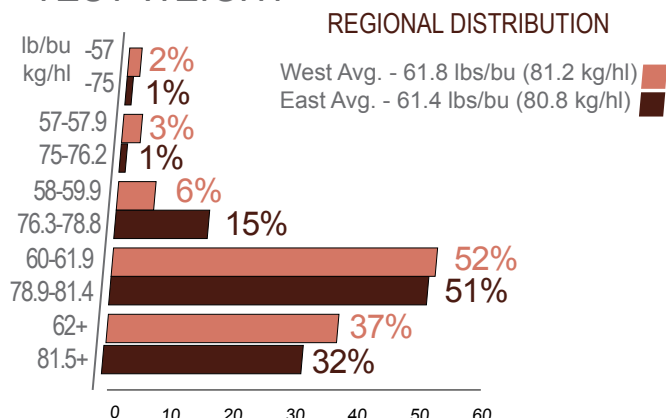


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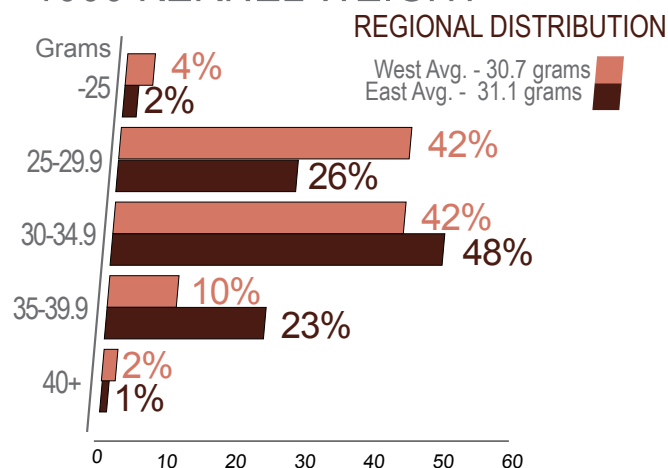
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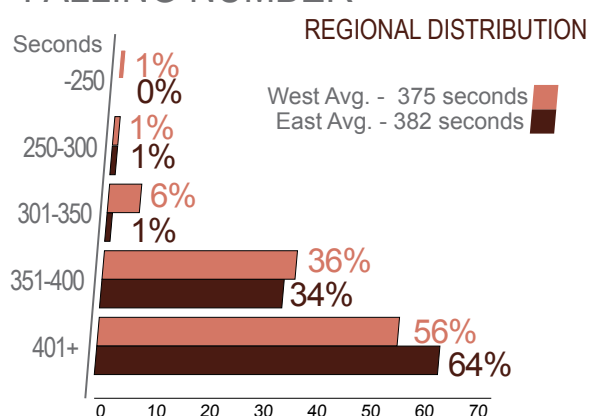
TEST WEIGHT



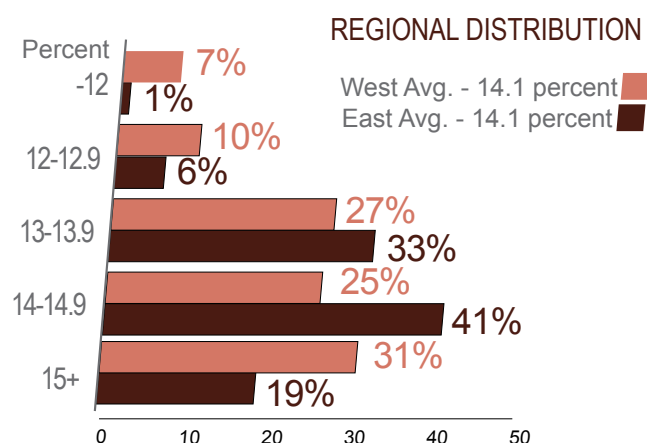
1000 KERNEL WEIGHT



FALLING NUMBER



PROTEIN - 12% MOISTURE



Data contained on pages 24-26 represent the composites of samples by West and East production region and a low, medium and high protein range.

The same base collection samples as shown in the area specific data displayed on previous pages were used for the West/East and protein splits.

U.S. HARD RED SPRING WHEAT

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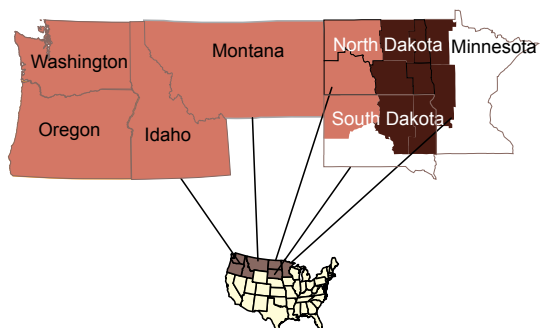
24

2016 QUALITY FACTORS BY PROTEIN RANGE

WEST

Samples in this region were collected from Montana, North Dakota areas A and D, South Dakota area A, and Idaho, Oregon and Washington.

WEST-PNW EXPORT TRIBUTARY
EAST - GULF/GREAT LAKES EXPORT TRIBUTARY



WHEAT GRADING DATA	Protein Ranges		
	Low	Medium	High
Test Weight (lb/bu)/kg/hl	62.3/81.9	61.9/81.4	61.3/80.6
Damage (%)	0.0	0.2	0.0
Shrunken/Broken (%)	1.1	1.0	1.2
Total Defects (%)	1.1	1.2	1.2
Vitreous Kernels (%)	87	88	94
Grade	1 DNS	1 DNS	1 DNS
WHEAT DATA			
Dockage (%)	0.7	0.6	0.7
Moisture (%)	11.2	11.3	11.2
Protein: 12%/0% moisture (%)	12.4/14.0	14.1/16.0	15.5/17.6
Ash: 14%/0% moisture (%)	1.48/1.72	1.53/1.78	1.51/1.76
1000 Kernel Weight	30.9	31.8	29.6
Falling Number (sec)	368	383	373
Sedimentation (cc)	61	66	68
FLOUR DATA			
Extraction (%)	68.2	67.4	66.1
Color: L	91.2	90.9	90.8
a/b	-1.23/9.5	-1.16/9.7	-1.15/9.9
Protein: 14%/0% moisture (%)	11.7/13.6	13.0/15.1	14.3/16.6
Ash: 14%/0% moisture (%)	0.45/0.52	0.50/0.58	0.53/0.62
Wet Gluten (%)	29.0	33.2	38.3
Gluten Index (%)	94	94	90
Falling Number (sec)	393	401	395
Amylograph Viscosity: 65g FL (BU)	671	712	598
DOUGH PROPERTIES			
Farinograph: Absorption (%)	62.1	63.3	64.6
Peak Time (min)	7.5	8.1	8.7
Stability (min)	8.3	10.1	12.1
Alveograph: P (mm)	82	80	83
L (mm)	131	144	144
P/L Ratio	0.63	0.56	0.58
W (10 ⁻⁴ joules)	350	373	401
Extensograph (45/135 min): Resistance	449/917	478/1024	507/1117
Extensibility (cm)	15.2/10.8	16.7/10.8	16.2/11.4
Area (sq cm)	89/134	104/141	104/165
BAKING DATA			
Absorption (%)	68.7	70.2	71.3
Crumb Grain and Texture	7.5	8.0	8.3
Loaf Volume (cc)	898	1035	1075
PRODUCTION %	30	32	38

U.S. HARD RED SPRING WHEAT

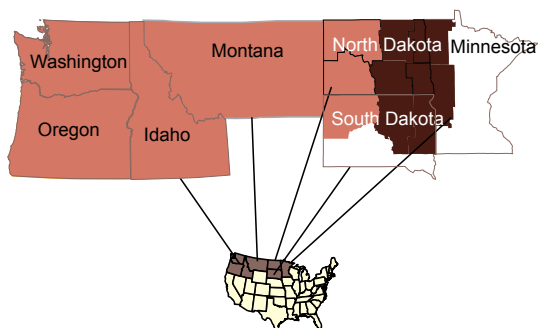
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Samples in this region were collected from North Dakota areas B, C, E and F, South Dakota areas B and C, and Minnesota.

EAST

WEST-PNW EXPORT TRIBUTARY
EAST - GULF/GREAT LAKES EXPORT TRIBUTARY



WHEAT GRADING DATA	Protein Ranges		
	Low	Medium	High
Test Weight (lb/bu)/kg/hl)	61.9/81.4	61.3/80.6	61.3/80.6
Damage (%)	0.1	0.2	0.3
Shrunken/Broken (%)	0.6	0.5	0.6
Total Defects (%)	0.7	0.7	0.9
Vitreous Kernels (%)	64	79	90
Grade	1 NS	1 DNS	1 DNS
WHEAT DATA			
Dockage (%)	0.3	0.3	0.5
Moisture (%)	13.0	13.0	12.7
Protein: 12%/0% moisture (%)	13.1/14.8	14.0/15.9	15.1/17.1
Ash: 14%/0% moisture (%)	1.49/1.73	1.51/1.76	1.50/1.74
1000 Kernel Weight	31.8	31.5	30.0
Falling Number (sec)	373	378	394
Sedimentation (cc)	58	64	66
FLOUR DATA			
Extraction (%)	67.6	66.5	65.7
Color: L	91.0	90.9	90.7
a/b	-1.01/9.0	-1.04/9.4	-1.11/9.9
Protein: 14%/0% moisture (%)	11.8/13.7	12.8/14.9	13.9/16.2
Ash: 14%/0% moisture (%)	0.53/0.62	0.48/0.56	0.48/0.56
Wet Gluten (%)	29.4	32.6	36.8
Gluten Index (%)	98	97	94
Falling Number (sec)	377	384	400
Amylograph Viscosity: 65g FL (BU)	724	679	646
DOUGH PROPERTIES			
Farinograph: Absorption (%)	61.1	62.4	63.4
Peak Time (min)	7.5	8.1	8.7
Stability (min)	13.6	14.1	14.9
Alveograph: P (mm)	83	86	86
L (mm)	131	142	145
P/L Ratio	0.64	0.61	0.59
W (10 ⁻⁴ joules)	377	417	430
Extensigraph (45/135 min): Resistance	584/925	574/947	557/1048
Extensibility (cm)	16.3/12.5	17.3/13.3	17.0/12.7
Area (sq cm)	122/151	130/166	121/171
BAKING DATA			
Absorption (%)	66.1	68.9	68.9
Crumb Grain and Texture	8.0	7.5	8.0
Loaf Volume (cc)	878	975	995
PRODUCTION %			
	23	44	33

U.S. HARD RED SPRING WHEAT

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OVERALL

WHEAT GRADING DATA	Protein Ranges		
	Low	Medium	High
Test Weight (lb/bu)/kg/hl	62.1/81.7	61.6/81.0	61.3/80.6
Damage (%)	0.0	0.2	0.1
Shrunken/Broken (%)	0.9	0.7	0.9
Total Defects (%)	0.9	0.9	1.1
Vitreous Kernels (%)	77	83	92
Grade	1 DNS	1 DNS	1 DNS
WHEAT DATA			
Dockage (%)	0.5	0.4	0.6
Moisture (%)	12.0	12.2	11.9
Protein: 12%/0% moisture (%)	12.7/14.4	14.0/15.9	15.3/17.4
Ash: 14%/0% moisture (%)	1.48/1.73	1.52/1.77	1.51/1.75
1000 Kernel Weight	31.3	31.6	29.8
Falling Number (sec)	370	380	382
Sedimentation (cc)	60	65	67
FLOUR DATA			
Extraction (%)	67.9	66.9	65.9
Color: L	91.1	90.9	90.8
a/b	-1.1/9.3	-1.1/9.5	-1.1/9.9
Protein: 14%/0% moisture (%)	11.7/13.7	12.9/15.0	14.1/16.4
Ash: 14%/0% moisture (%)	0.48/0.56	0.49/0.57	0.51/0.59
Wet Gluten (%)	29.1	32.8	37.7
Gluten Index (%)	96	96	92
Falling Number (sec)	386	391	397
Amylograph Viscosity: 65g FL (BU)	693	694	619
DOUGH PROPERTIES			
Farinograph: Absorption (%)	61.7	62.8	64.1
Peak Time (min)	7.5	8.1	8.7
Stability (min)	10.5	12.3	13.3
Alveograph: P (mm)	82	83	84
L (mm)	131	143	144
P/L Ratio	0.63	0.58	0.58
W (10 ⁻⁴ joules)	361	397	414
Extensigraph (45/135 min): Resistance	506/920	531/981	529/1087
Extensibility (cm)	15.7/11.5	17.0/12.2	16.6/12.0
Area (sq cm)	103/141	118/155	111/168
BAKING DATA			
Absorption (%)	67.6	69.5	70.2
Crumb Grain and Texture	7.7	7.7	8.2
Loaf Volume (cc)	890	1002	1040
PRODUCTION %	26	38	36

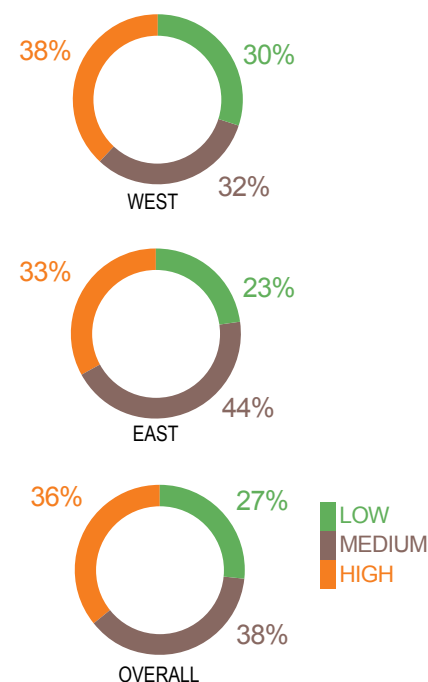
Performance characteristics often improve as buyers increase their protein specifications. To illustrate the correlation between higher protein and other quality parameters, samples of the regional crop were segregated by protein levels (all based on 12 percent moisture content):

LOW (less than 13.5 percent),

MEDIUM (13.5 to 14.5 percent), and

HIGH (more than 14.5 percent).

PRODUCTION DISTRIBUTION BY PROTEIN



In 2016, absorption, dough stability, w-value and loaf volume all improved with protein content.

2016 SURVEY BACKGROUND



Kristin Whitney, Chris Cosette and Karen Dickey with the Hard Red Spring Wheat Quality Laboratory in the Department of Plant Science at North Dakota State University, Fargo, USA.

Collection - The North Dakota, South Dakota, Montana and Minnesota state offices of the National Agricultural Statistics Service obtained wheat samples during harvest directly from growers either in the fields or farm bins and local elevators. These samples reflect the condition of the grain at the point of origin. Collection began in early August when approximately 10 percent of the hard red spring wheat had been harvested and

continued until mid September when about 90 percent of the region's crop was harvested.

Sample collection was weighted by county production histories

with a total of 799 samples being collected during harvest from Minnesota (124), Montana (152), North Dakota (384), South Dakota (85) and PNW (54).

Analysis - Approximately 60 percent of the total wheat samples collected were analyzed for grade and other physical kernel characteristics. Distributions as a percentage of the harvested crop were calculated for key factors including test weight, thousand kernel weight, protein, falling number, and overall grade. Distribution results may differ from data presented in the various tables, because the latter are derived from production adjusted averages, rather than simple averages.

Quality tests, including milling, flour evaluation, physical dough and bread properties, were conducted on composite samples representing each crop reporting area. Again, all state and regional averages have been adjusted to reflect production as opposed to simple averaging.

All quality data contained in this report are the result of testing and analysis conducted under the supervision of Dr. Senay Simsek, Wheat Quality Specialist, and by her team members Kaitlin Beck, DeLane Olsen, Kelly McMonagle,

METHODS, TERMS, SYMBOLS

WHEAT

SAMPLE COLLECTION • Each sample contained approximately 2 to 3 pounds of wheat, stored in sealed, moisture proof plastic bags.

MOISTURE • Official USDA procedure using Dickey-John Moisture Meter.

GRADE • Official United States Standards for Grain, as determined

by a licensed grain inspector. North Dakota Grain Inspection Service, Fargo, ND, provided grades for composite wheat samples representing each crop reporting area.

VITREOUS KERNELS • Approximate percentage of kernels having vitreous endosperm.

DOCKAGE • Official USDA procedure. All matter other than

wheat which can be removed readily from a test portion of the original sample by use of an approved device (Carter Dockage Tester). Dockage may also include underdeveloped, shriveled and small pieces of wheat kernels removed in properly separating the material other than wheat and which cannot be recovered by properly rescreening or recleaning.

TEST WEIGHT • American Association of Cereal Chemists Method 55-10. Measured as pounds per bushel (lb/bu), kilograms per hectoliter (kg/hl) = (lbs/bu X 1.292) + 1.419. *Approved Methods of the American Association of Cereal Chemists International Approved Methods (11th Edition), St. Paul, MN.

THOUSAND KERNEL WEIGHT

• Based on 10 gram sample of cleaned wheat (free of foreign material and broken kernels) counted by electronic seed counter.

KERNEL SIZE DISTRIBUTION

Percentages of the size of kernels (large, medium, small) were determined using a wheat sizer equipped with the following sieve openings:

- top sieve—Tyler #7 with 2.92 mm opening;
- middle sieve—Tyler #9 with 2.24 mm opening; and
- bottom sieve—Tyler #12 with 1.65 mm opening.

PROTEIN • American Association of Cereal Chemists (NIR) Method: 39.10.01 expressed on dry basis and 12 percent moisture basis.

ASH • American Association of Cereal Chemists Method 08.01, expressed on a 14 percent moisture basis.

DON • Analysis was done on ground wheat using a gas chromatograph with an electron capture detector as described in J. Assoc. Official Anal. Chem 79,472 (1996)

FALLING NUMBER • American Association of Cereal Chemists

Method 56.81.03; units of seconds (14 percent moisture basis).

SEDIMENTATION • American Association of Cereal Chemists Method 56.61.01, expressed in centimeters.

FLOUR

EXTRACTION • Thoroughly cleaned wheat is tempered to 16 percent moisture for 16 hours and add an additional 0.5 percent water 15 minutes prior to milling. The milling laboratory is controlled at 68 percent relative humidity and 72°F to 74°F. Milling is performed on a Buhler laboratory mill (Type MLU-202). Straight grade flour (of all six flour streams) is blended and reported as “flour extraction.” The blended flour is rebolted through an 84 SS sieve to remove any foreign material. This product is used for the other flour quality determinations.

ASH • American Association of Cereal Chemists Method 08.01, expressed on a 14 percent moisture basis.

PROTEIN • American Association of Cereal Chemists Method 39.10.01 (NIR Method), expressed on a 14 percent moisture basis.

WET GLUTEN • American Association of Cereal Chemists Method 38.12.02, expressed on a 14 percent moisture basis determined with the glutomatic instrument.

GLUTEN INDEX • American Association of Cereal Chemists Method 38.12.02, determined with the glutomatic instrument as an indication of gluten strength.

FLOUR FALLING NUMBER

• American Association of Cereal Chemists Method 56.81.03, units of seconds. Determination is performed on 7.0 g of Buhler milled flour (14 percent moisture basis).

AMYLOGRAM • (100 g) American Association of Cereal Chemists Method 22.10.01. Peak viscosity reported in Brabender units (B.U.), on a 14 percent moisture basis.

(65 g) American Association of Cereal Chemists Method 22.10.01, modified as follows: 65 g of flour (14 percent moisture basis) are slurried in 450 ml distilled water, paddle stirrers are used with the Brabender Amylograph. Peak viscosity reported in Brabender units (B.U.), on a 14 percent moisture basis.

STARCH DAMAGE • American Association of Cereal Chemists Method 76.31.02. Proportion of starch granules that have incurred physical damage from milling.

SOLVENT RETENTION CAPACITY (SRC) • AACC 56-11.02, expressed on a 14 percent moisture basis. SRC is used to predict commercial baking performance. Flour is shaken with excess of four types of solvent, to determine the amount of solvent held by the flour. The four solvents used relate to the functionality to flour components as follows:

Water – Water absorption

Sucrose – Non-starch polysaccharides

Lactic Acid – Glutenins

Sodium Carbonate – Damaged Starch

Gluten Performance Index (GPI) – is a ratio of the solvents and used as an overall performance of flour glutenins especially in relation to bread wheat flour.

PHYSICAL DOUGH PROPERTIES

FARINOGRAM • American Association of Cereal Chemists Method 54-21.02; constant flour weight method, small (50 g) mixing bowl. (Flour weight 14 percent moisture basis). Farinograph-E.

ABSORPTION • Amount of water required to center curve peak on the 500 Brabender unit line, expressed on 14 percent moisture basis.

PEAK TIME • The interval, to the nearest 0.5 min, from the first addition of water to the maximum consistency immediately prior to the first indication of weakening. Also known as dough development time.

STABILITY • The time interval, to the nearest 0.5 min, between the point where the top of the curve that first intersects the 500-BU line and the point where the top of the curve departs the 500-BU line.

MIXING TOLERANCE INDEX • The difference, in Brabender units, from the top of the curve at the peak to the top of the curve measured five minutes after the peak.

QUALITY NUMBER • International Cereal Chemists Method 115. The length, expressed in mm, along the time axis, between the point of water addition and the point where the height in the center of the curve decreased by 30 BU compared to the height of the center of the curve at development time. Stronger flours have a higher quality number.

EXTENSIGRAM • American Association of Cereal Chemists Method 54-10.01; modified as follows: (a) 100 grams of flour (14 percent moisture basis), 2.0 percent sodium chloride (U.S.P.) and water (equal to farinograph absorption minus 2 percent) are mixed to optimum development in a National pin dough mixer; (b) doughs are scaled to 150 grams, rounded, moulded, placed in extensigram holders, and rested for 45 minutes and 135 minutes, respectively, at 30°C and 78 percent relative humidity. The dough is then stretched as described in the procedure referenced above. For conversion purposes, 500 grams equals 400 B.U.

EXTENSIBILITY • Total length of the curve at the base line in centimeters.

RESISTANCE • Maximum curve height, reported in Brabender units (B.U.).

AREA • The area under the curve is measured and reported in square centimeters.

ALVEOGRAPH • AACC Method 54.30.02. Measurement of dough extensibility and resistance to extension.

“P” • Maximal overpressure; related to dough’s resistance to deformation.

“L” • Dough extensibility.

“W” • The “work” associated with dough deformation.

BAKING

PROCEDURE • American Association of Cereal Chemists Method 10-09.01, modified as follows: (a) fungal amylase (SKB

15) replacing malt dry powder, (b) Instant dry yeast (1 percent) in lieu of compressed yeast, (c) 5 to 10 ppm ammonium phosphate, where added oxidants are required, (d) 2 percent shortening added. Doughs are mechanically punched using 6-inch rolls, and mechanically moulded using a National Laboratory Test moulder. Baking is accomplished in “Shogren-type” pans.

BAKING ABSORPTION • Water required for optimum dough baking performance, expressed as a percent of flour weight on a 14 percent moisture basis.

DOUGH CHARACTER • Handling conversion assessed at panning on a scale of 1 to 10 with higher scores preferred.

LOAF VOLUME • Rapeseed displacement measurement made 30 minutes after bread is removed from the oven.

CRUMB GRAIN AND TEXTURE • Visual comparison to standard using a constant illumination source. Scale of 1 to 10, the higher scores preferred.

CRUMB COLOR • Visual comparison with a standard using a constant illumination source on a scale of 1 to 10, the higher scores preferred.

CRUST COLOR • Visual comparison with a standard using a constant illumination source on a scale of 1 to 10, the higher scores preferred.

SYMMETRY • Visual comparison with a standard using a constant illumination source on a scale of 1 to 10, the higher scores preferred.

VARIETAL INFORMATION

MAJOR VARIETIES PRODUCED ACROSS ND, SD AND MN • AGRONOMIC FACTORS

	Agent or Origin ¹	Year Released	Agronomic Description			Reaction to Disease ²			Average Yield		
			Straw Strength	Maturity	Leaf Rust	Foliar Disease	Head (Scab)	Eastern, North Dakota ³ BU/Acre	North Dakota ³ MT/Hect	Western, North Dakota ⁴ BU/Acre	North Dakota ⁴ MT/Hect
Barlow	ND	2009	med.	m. early	MS	MR	M	72.6	4.88	57.7	3.88
Bolles	MN	2015	med.	m. late	MR	MR	M	77.2	5.19	60.7	4.08
Elgin-ND	ND	2012	med.	med.	MS	M	M	75.1	5.05	61.7	4.15
Faller	ND	2007	med.	med.	S	MR	M	80.2	5.39	63.8	4.29
Forefront	SD	2012	med.	m. early	MR	MR	MR	76.1	5.12	57.1	3.84
Glenn	ND	2005	strg.	m. early	MS	M	MR	71.8	4.83	55.8	3.75
Linkert	MN	2013	strg.	m. early	MR/MS	M	M	73.4	4.93	57.7	3.88
Prevail	SD	2014	med.	med.	MR	MS	M	79.8	5.36	60.9	4.09
Prosper	ND	2011	med.	med.	MS	M	M	77.6	5.22	62.6	4.21
SY Ingmar	AgriPro/ Syngenta	2014	m. strg.	med.	MR	M	M	74.1	4.98	63.0	4.23
SY Soren	AgriPro/ Syngeta	2011	m. strg.	m. early	MR	M	M	70.1	4.71	60.2	4.05
WB Mayville	Westbred	2011	m. strg.	m. early	R	MS	S	69.5	4.67	57.8	3.89

MAJOR VARIETIES PRODUCED ACROSS MT AND WESTERN ND • AGRONOMIC FACTORS

			Agronomic Description		Reaction to Disease ²			Average Yield	
Variety	Agent or Origin ¹	Year Released	Straw Strength	Maturity	Leaf Rust	Foliar Disease	Head (Scab)	Williston, North Dakota ⁴ BU/Acre	MT/Hect
Barlow	ND	2009	med.	m. early	MS	MR	M	31.7	2.13
Brennan	AgriPro/ Syngenta	2009	m. strg.	m. early	MR	M	MS	36.0	2.42
Elgin-ND	ND	2012	med.	med.	MS	M	M	36.0	2.42
Glenn	ND	2005	strg.	m. early	MS	M	MS	33.7	2.27
Mott	ND	2009	strg.	m. late	S	MS	MS	35.6	2.39
Reeder	ND	1999	strg.	m. early	S	S	S	n/a	n/a
SY Soren	AgriPro/ Syngenta	2011	med.	m. early	MR	M	M	33.2	2.23
Vida	MT	2005	m. strg.	m. late	MR	MS	S	39.0	2.62

1. ND=North Dakota State University (Public), SD=South Dakota State University (Public), MN=University of Minnesota (Public), MT=Montana State University (Public), Westbred (Private) and AgriPro/Syngenta (Private).
2. Reaction to Disease: resistant (R), moderately resistant (MR), intermediate (M), moderately susceptible (MS), susceptible (S), very susceptible (VS).
3. 2013-15 ND average yield data from four locations in ND.
4. 2013-15 ND average yield data from Williston, ND.

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MAJOR VARIETIES PRODUCED ACROSS ND, SD AND MN • QUALITY & END-USE FACTORS

Variety	Quality Factors ⁵							Mill & Bake Quality Rating ⁷
	Test Weight LB/BU	Test Weight KG/HL	Wheat Protein %	Wheat Falling # Seconds	Farinogram Stability (Min)	Absorption %	Loaf Volume CC	
Barlow	62.0	81.5	14.6	382	9.8	65.7	980	★★★
Bolles	61.9	81.4	15.0	413	14.9	62.8	963	★★★★
Elgin-ND	61.1	80.4	14.2	405	8.8	63.8	953	★★★
Faller	60.8	80.0	13.4	409	10.1	62.5	945	★★★
Forefront	62.3	81.8	14.1	417	9.6	61.3	979	★★
Glenn	63.7	83.7	14.9	386	12.3	64.9	983	★★★★★
Linkert	61.8	81.3	15.0	428	16.7	63.0	983	★★★★
Prevail	61.4	80.8	13.4	380	8.0	60.2	921	★★
Prosper	61.0	80.2	13.4	395	9.7	62.4	940	★★★
SY Ingmar	62.2	81.8	14.0	408	9.0	60.8	1006	★★★
SY Soren	62.0	81.5	14.4	423	10.9	62.4	969	★★★
WB Mayville	61.0	80.2	14.4	415	10.1	63.4	947	★★

MAJOR VARIETIES PRODUCED ACROSS MT AND WESTERN ND • QUALITY & END-USE FACTORS

Variety	Quality Factors ⁶							Mill & Bake Quality Rating ⁷
	Test Weight LB/BU	Test Weight KG/HL	Wheat Protein %	Wheat Falling # Seconds	Farinogram Stability (Min)	Absorption %	Loaf Volume CC	
Barlow	61.0	80.2	13.8	385	10.6	62.8	911	★★★
Brennan	60.9	80.1	14.7	419	8.8	63.1	917	★★★
Elgin-ND	59.8	78.7	14.0	426	11.5	62.5	894	★★★
Glenn	63.1	82.9	14.0	386	14.4	61.9	938	★★★★★
Mott	60.4	79.5	14.8	364	12.2	60.3	934	★★★
Reeder	60.8	80.0	14.5	426	8.5	61.9	895	★★
SY Soren	60.8	80.0	14.7	497	14.9	61.7	973	★★★
Vida	60.5	79.6	14.8	421	7.8	63.7	925	★★★

5 Source: NDSU Plant Science Department, Hard Red Spring Wheat Quality Laboratory, 2011-2015 drill strip trials across ND locations.

6 Drill strip trials in Williston, ND only for 2011 and 2013-15. No 2012 data available.

7 Mill and bake quality rating based on protein content, milling performance, flour attributes, dough characteristics and baking performance. Five stars = superior, four stars = excellent, three stars = good, two stars = average, one star = poor.

QUALITY COMPARISON OF POPULAR VARIETIES

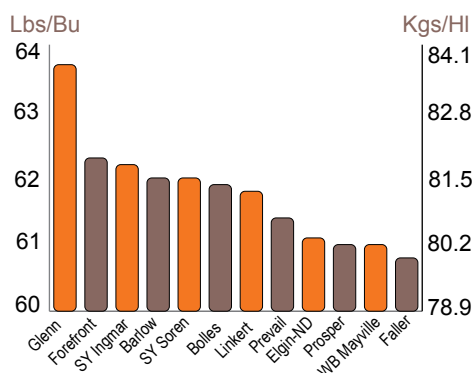
The annual quality characteristics of the U.S. Hard Red Spring (HRS) wheat crop are influenced by the growing season environment and variety or genetics. Within the HRS class, different varieties are available for producers – to fit the broad climatic conditions and to meet varying disease and pest challenges across the region.

To enhance uniform functional quality among the varieties designed to meet multiple growing regions, kernel and end-use quality targets have been developed. These targets are industry agreed upon values that provide guidance to wheat breeders.

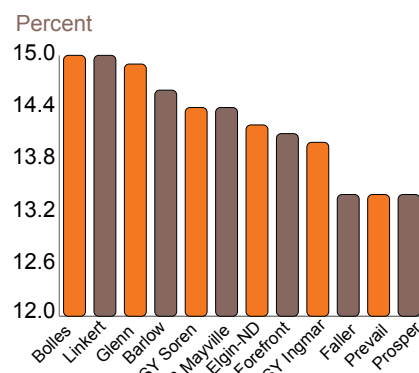
Variety development is carried out through public and private breeding programs. Major public programs are North Dakota State University, the University of Minnesota, South Dakota State University, University of Idaho, and Washington State University. Major private breeding programs include Westbred, Limagrain, AgriPro/ Syngenta, Bayer and others.

Prior to the release of a variety for commercial production, breeding programs evaluate varieties for desired milling and baking characteristics, as well as yield, protein content, disease and pest resistance, straw strength and other traits. This testing typically takes place across multiple years and growing locations to account for environmental influences. These charts illustrate key quality traits of popular varieties for the 2011-2015 growing seasons.

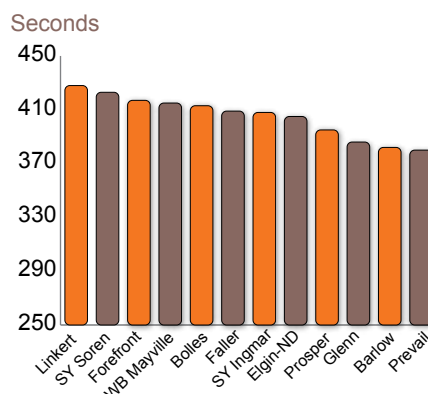
TEST WEIGHT



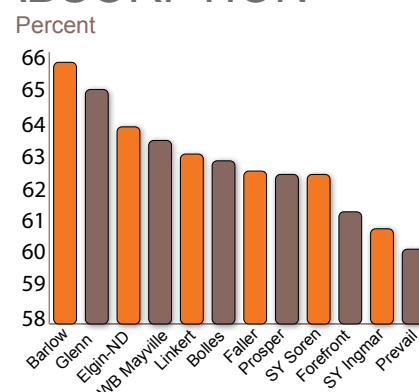
PROTEIN (12% moisture basis)



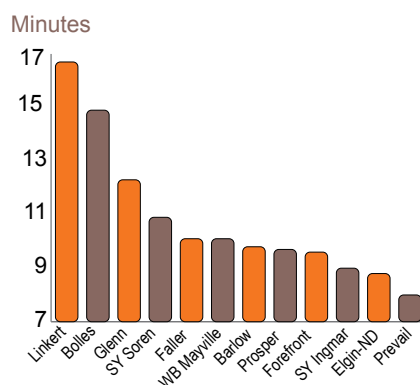
FALLING NUMBER



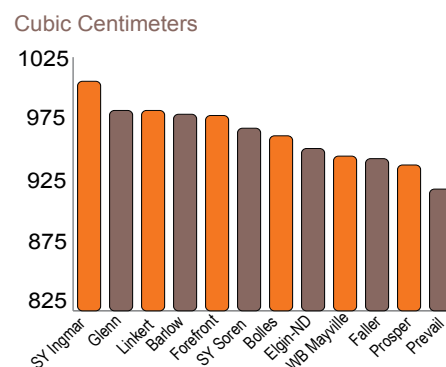
FARINOGRAPH ABSORPTION



FARINOGRAPH STABILITY



LOAF VOLUME



NORTH DAKOTA

SY SOREN overtook the top variety position in North Dakota up from second in 2015, marking five straight years of acreage gains and reaching 15.4 percent in 2016. It ranks seventh in both Montana and Minnesota with 5.7 and 4.6 percent, respectively. A 2011 release from AgriPro/Syngenta, it has broad acceptance across the region, being most popular in central and southern North Dakota. SY Soren provides producers with a balance of yield potential, moderately high protein levels, disease resistance and straw strength. It is rated as good for milling and baking quality.

SY INGMAR surged into second place in North Dakota, garnering 11.5 percent of the acres, up from 3 percent in 2015. It made the most gains of any variety this year with broad acceptance. SY Ingmar is a 2014 release from AgriPro/Syngenta with high yield potential, improved straw strength, a high level of disease resistance and moderate protein levels. It is rated as good for milling and baking quality.

ELGIN-ND remained in third place in North Dakota in 2016, but slipped in acreage share to 8.7 percent. Elgin-ND is a 2012 release from NDSU with higher protein potential than other high yielding varieties. Elgin-ND is rated as good for milling and baking quality.

BARLOW fell to fourth place in North Dakota in 2016 with 8 percent of the acres, after being the top variety for four straight years. The 2009 NDSU release

provides producers with enhanced yield potential and a good balance of test weight, protein and leaf disease resistance. Barlow is rated as good for overall baking quality with uniquely high farinograph absorption.

NORTH DAKOTA VARIETIES SHARE OF PLANTED ACRES³

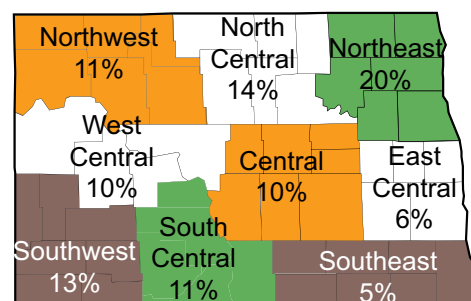
Variety	2016% ¹	2015% ¹
SY Soren	15.4	12.1
SY Ingmar	11.5	3.1
Elgin-ND	8.7	10.8
Barlow	8.0	12.6
Glenn	7.9	6.5
Faller	7.3	8.3
Prosper	6.6	10.5
Linkert	4.0	1.0
WB Mayville	3.1	4.6
Rollag	3.0	1.5
Other ²	24.5	29.0

1. Percentages may not add to 100 due to rounding.
2. Includes varieties with less than 1% of acreage and unknown varieties.
3. (1 acre = 0.405 hectare)
2016 - 6,000,000 planted acres
2015 - 6,700,000 planted acres

TOP 3 ND VARIETIES BY CROP DISTRICT

	First	Second	Third
percentage (%)			
Northwest	Barlow (18.1)	SY Ingmar (16.3)	SY Soren (15.2)
North Central	SY Soren (18.9)	SY Ingmar (12.5)	Prosper (10.4)
Northeast	Faller (20.9)	Linkert (12.3)	SY Ingmar (12.2)
West Central	Glenn (14.3)	SY Soren (14.1)	Elgin-ND (13.7)
Central	SY Soren (18.8)	SY Ingmar (17.5)	Elgin-ND (13.5)
East Central	SY Soren (19.0)	Linkert (18.2)	WB Mayville (11.7)
Southwest	SY Soren (20.1)	Barlow (15.6)	Elgin-ND (15.4)
South Central	SY Soren (20.7)	Glenn (14.5)	SY Ingmar (14.2)
Southeast	SY Soren (17.3)	Prosper (16.7)	SY Ingmar (12.4)

NORTH DAKOTA 2016 SHARE OF PLANTED ACRES BY NASS DISTRICT



Estimated planted acres in 2016 are 6,000,000

SOUTH DAKOTA

PREVAIL and **FOREFRONT** are the top two varieties planted in South Dakota in 2016. Both are releases from South Dakota State University, Prevail in 2014 and Forefront in 2012. Prevail has elite yield potential. Forefront is below Prevail in yield potential but produces more moderate protein levels. Both have a high level of resistance to Fusarium headblight disease and are rated as average for milling and baking quality.

SOUTH DAKOTA VARIETIES SHARE OF SURVEYED ACRES

Variety	State%	Year Released
Prevail	24.9	2014
Forefront	14.4	2012
Advance	14.3	2012
Select	8.2	2010
Focus	5.7	2015
Brick	5.5	2008

*2016 survey completed "in-house" based on voluntary producer responses representing 10 percent of 2016 acres.

MONTANA

VIDA is the most popular variety in Montana in 2016 for a sixth straight year, moving up to 18.8 percent. It is a high yielding variety with moderate resistance to leaf and stripe rust. A 2005 release from the Montana Agricultural Experiment Station, Vida is rated good for milling and baking quality.

REEDER held onto second place in Montana with 9.9 percent of the acres, down from 15.7 in 2015. A 1999 NDSU release, it remains most popular in the eastern third of the state. Reeder has high protein content and is rated as average for milling and baking quality.

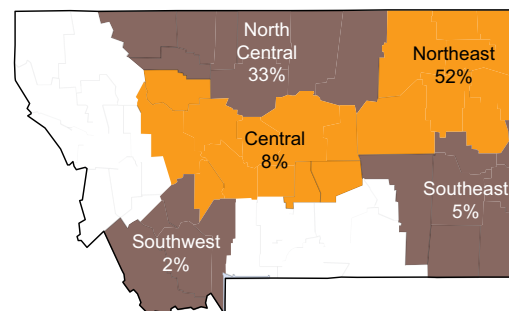
CORBIN AND MOTT are the third and fourth most popular varieties in Montana in 2016 with 7.5 and 7 percent of the acres, respectively. Both showed marginal gains from 2015. Corbin is a 2006 release from WestBred, and Mott is a 2009 NDSU release. Both varieties have a high level of tolerance to the wheat stem sawfly, and are most popular in the north central and central districts. They are rated as good for milling and baking quality.

MONTANA VARIETIES SHARE OF PLANTED ACRES³

Variety	2016% ¹	2015% ¹
Vida	18.8	16.8
Reeder	9.9	15.7
Corbin	7.5	5.8
Mott	7.0	5.9
Brennan	6.7	6.1
Duclair	6.4	4.0
SY Soren	5.7	6.2
ONeal	4.3	2.7
Choteau	4.3	5.1
WB-Gunnison	3.4	2.5
Other ²	70.8	29.2

1. Percentages may not add to 100 due to rounding.
2. Includes varieties with less than 1% of acreage and unknown varieties.
3. (1 acre = 0.405 hectares)
2016 - 2,150,000 planted acres
2015 - 2,650,000 planted acres

MONTANA SHARE OF PLANTED ACRES BY NASS DISTRICT



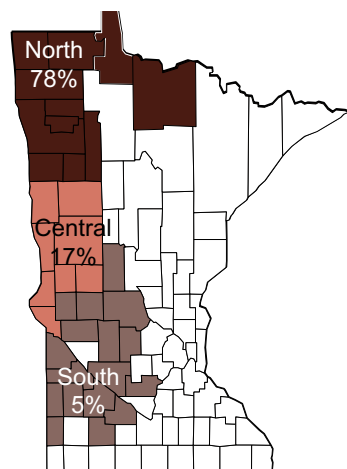
Estimated planted acres in 2016 are 2,150,000

TOP 3 MONTANA VARIETIES BY CROP DISTRICT

	First	Second	Third
percentage (%)			
North Central	Vida (25.9)	Corbin (19.1)	Duclair (12.7)
Northeast	Reeder (20.2)	Brennan (14.2)	Vida (13.3)
Central	Vida (18.3)	Choteau (13.7)	ONeal (11.9)
Southeast	Reeder (15.6)	Barlow (10.3)	

MINNESOTA

MINNESOTA 2016 SHARE OF PLANTED ACRES



Estimated planted acres in 2016 are 1,310,000.

LINKERT made significant gains in 2016 and is now the dominant variety in Minnesota with 27.8 percent of the acres, up from 13.5 percent in 2015. It made marginal gains in North Dakota, advancing from 1 to 4 percent in 2016. Linkert is a 2013 release from the University of Minnesota which

has very strong straw, high protein levels and good disease resistance. It has slightly lower yield potential but is rated excellent for milling baking quality, with strong dough properties.

MINNESOTA VARIETIES SHARE OF SURVEYED ACRES³

Variety	2016% ¹	2015% ¹
Linkert	27.8	13.5
WB-Mayville	13.1	13.6
Prosper	10.2	16.6
Bolles	8.8	0.4
Faller	6.0	12.2
Samson	4.7	2.8
SY Soren	4.6	7.0
SY Ingmar	3.1	2.4
SY Valda	3.0	0.3
Forefront	2.4	7.1
Other ²	16.4	24.14

1. Percentages may not add to 100 due to rounding.
2. Includes varieties with less than 1% of acreage and unknown varieties.
3. (1 acre = 0.405 hectares)
2016 - 1,310,000 planted acres
2015 - 1,480,000 planted acres

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PNW VARIETAL INFORMATION

POPULAR VARIETIES GROWN IN WA/OR AND ID • QUALITY AND END-USE FACTORS									
Variety	Agent or Origin ¹	Year Released	End Use ³				Quality Factors ²		
			Test Weight LB/BU	Test Weight KG/HL	Wheat Protein %	Farinogram Stability (Min)	Absorption %	Loaf Volume CC	Mill/Bake Quality Rating
Buck Pronto	Buck Semillas S.A.	2001	61.5	80.9	15.3	21.7	67.9	935	D
Bullseye	AgriPro	2009	63.2	83.0	13.7	22.4	67.1	980	D
Cabernet	Resource Seeds	2008	62.3	82.0	13.3	9.0	65.9	1064	D
Espresso	Westbred	2007	62.6	82.2	14.7	5.1	68.5	1032	A
Glee	WSU	2012	62.2	81.8	14.3	16.5	66.5	1106	MD
Jefferson	ID	1997	62.3	82.0	13.7	20.1	68.3	976	D
Kelse	WSU	2008	61.6	81.0	15.1	19.8	68.7	1115	D
Solano	Westbred	2006	63.1	83.0	14.8	6.5	67.9	1095	A
SY605CL	Syngenta	2010	62.45	82.0	15.8	n/a	68.6	1049	MD
WB Fuzion	Westbred	2011	61.7	81.1	14.2	n/a	68.2	1122	MD

1. ID=University of Idaho (Public), WSU=Washington State University (Public), AgriPro (Private), Buck Semillas S.A. (Private), Resource Seeds (Private), Syngenta (Private) and Westbred (Private).
2. Western Wheat Quality Lab, Pullman, WA.
3. Mill and bake quality rating based on protein content, milling performance, flour attributes, dough characteristics and baking. Western Wheat Quality Lab. Most Desirable (MD), Desirable (D), Acceptable (A).

Minnesota con't from p. 34

WB MAYVILLE remains the second most popular variety in Minnesota with a 13.1 percent share of acres. It is predominantly grown in northwest Minnesota and northeast North Dakota where straw strength is a priority. A 2011 release from WestBred it provides producers with higher protein potential compared to other high yielding varieties. WB Mayville is rated as average for milling and baking quality.

PROSPER fell to third place in Minnesota and seventh place in North Dakota with 10.2 and 6.6 percent of the acres, respectively. It remains popular due to its elite yield potential but is being challenged by newer releases that have improved straw strength. Prosper is rated as good for milling and baking quality.

TOP 3 MINNESOTA VARIETIES BY CROP DISTRICT

	First	Second	Third
percentage (%)			
North	Linkert (30.1)	WB Mayville (15.9)	Prosper (14.3)
Central	Linkert (16.5)	Bolles (15.6)	Prosper (13.7)
South	Linkert (31.4)	Prosper (12.8)	Rollag (12.2)



2016

U.S. HARD RED SPRING WHEAT

REGIONAL QUALITY REPORT

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