2019

U.S. HARD RED SPRING WHEAT

Regional Quality Report



U.S. HARD RED SPRING Wheat

MINNESOTA | MONTANA
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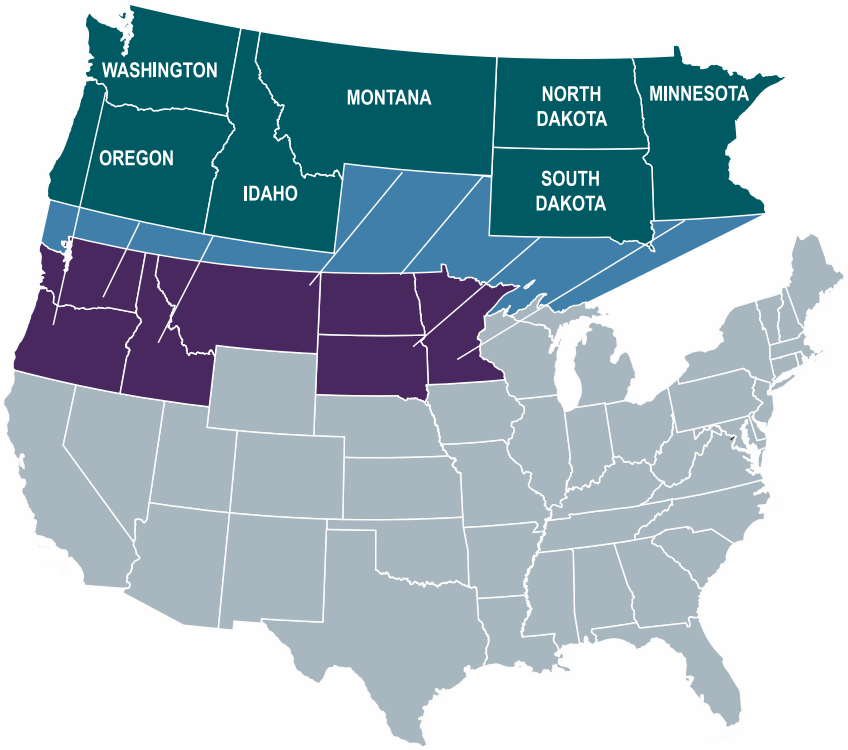
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THE ARISTOCRAT OF WHEAT

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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OVERVIEW

THE 2019 U.S. hard red spring wheat (HRS) crop produced well above average yields and high protein levels, with impacts from excessive rain, prolonging harvest and leading to less than typical quality for some key kernel parameters. Production is estimated at 559 million bushels (15.2 MMT), up eight percent from the 5-yr average, although down five percent from last year, on reduced planted area. Due to historic harvest rains, not all of the crop was able to be surveyed for this report. Final production estimates may also fall as portions of the crop remained unharvested as of mid-October.

THE CROP averages a No. 1 Northern Spring, down from a No. 1 Dark Northern Spring in 2018, as average vitreous kernel levels fell to 55 percent. This is one of the lowest levels in many years, and well below 86 percent last year, and the 5-yr average of 74 percent. Grade distributions, place 86 percent in the No. 1 grade, down from 95 percent a year ago.. The crop average test weight is 60.7 lbs/bu (79.8 kg/hl), lower than last year and the 5-yr. Sixty percent of the crop is above 60 lbs/bu (78.9 kg/hl), compared to 84 percent a year ago. Average damaged kernel levels are 0.7 percent, up from 0.4 percent last year and a 5-yr average of 0.2 percent. Damage levels are notably higher in some parts of the region. All parts of the region experienced lower vitreous kernel levels, with nearly one-third of the crop falling below 50% percent, compared to just 2 percent last year. Forty percent of the 2019 crop is above 75% percent vitreous kernels.

PROTEIN content is high in the 2019 crop, in contrast to expectations considering the excellent growing season moisture and the very high yields produced. The crop average is 14.5% protein (12% moisture basis), equal to last year and above the 5-yr average. Distribution of protein is similar to a year ago with slightly more than one-half of the crop between 13% and 15% protein, and roughly one-third above 15% protein.

THOUSAND KERNEL weights are very high in 2019 with an average of 31.9 grams, slightly higher than the 5-yr average. Disease pressure from Fusarium headlight was higher than recent years, with southern parts of the region more greatly impacted. The crop average DON is 0.6 ppm, up from 0.2 ppm for a 5-yr average. Lower falling number values are evident in much of the region, with the exception of the Pacific Northwest. The average for the crop is 337 seconds, well below 399 seconds in 2018, and a 5-yr average of 381 seconds. Some portions of the crop were impacted more severely than others, as 78 percent of the crop remains above 350 seconds, but 10 percent falls below 300 seconds compared to just 1 percent in 2018.

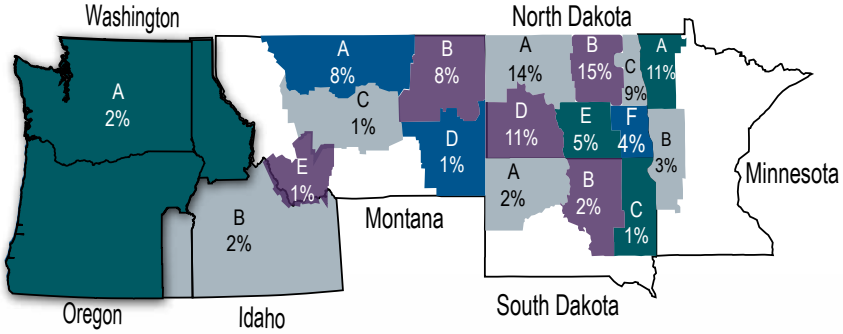
MILLING analysis, based on a Buhler Lab Mill, averaged 68.7 percent extraction, higher than 2018. Average flour ash is 0.53 percent, similar to last year. Starch damage averages 7.4 percent, lower than last year. Wet gluten values for the crop average 34.1 percent, lower than both last year and the 5-yr average. The flour is showing less viscosity with an average 65 gram amylograph value of 441 B.U. compared to 649 in 2018, reflective of the reduced kernel soundness in portions of the crop due to the wet harvest.

PRODUCTION DATA

	2019	2018	2014-18 AVERAGE
MILLION BUSHELS			
Minnesota	80	93	79
Montana	106	96	80
North Dakota	323	318	281
South Dakota	27	41	48
ID/OR/WA	24	38	28
U.S. Total	**560**	**586**	**516**
MILLION METRIC TON			
Minnesota	2.18	2.53	2.14
Montana	2.89	2.61	2.18
North Dakota	8.79	8.66	7.65
South Dakota	0.73	1.12	1.31
ID/OR/WA	0.63	1.03	0.76
U.S. Total	**15.2**	**15.9**	**14.0**

Source: USDA 2019 Small Grains Summary

APPROXIMATE SHARE OF REGIONAL PRODUCTION



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PHYSICAL dough tests indicate lower Farinograph absorption, compared to 2018, but similar to the 5-yr average, at 62.6 percent. The average Farinograph stability time is 10 minutes, below both last year and the 5-yr average. Dough stability is lower across most of the region, likely due to environmental impacts but also some shift in cultivars planted. Alveograph and Extensigraph analysis of the crop parallels the Farinograph data, indicating a more extensible crop with less resistance. The average P/L ratio on the Alveograph is 0.61 as compared to 0.74 a year ago, and a 5-yr average of 0.71. On the 135 minute pull on the Extensograph, overall extensibility and resistance to extension is 16.2 cm and 682 B.U., compared to 14.2 and 847 in 2018.

BAKING evaluations produced very high loaf volumes, with a crop average of 1019 cubic centimeters, up from 963 for the 5-yr average. Bake absorptions are lower than a year ago, but similar to the 5-yr average. Dough handling properties were rated at 8.4 compared to 9.0 in 2018, and overall bread scores were rated similar to slightly lower than last year and the 5-yr average.

BUYERS will find the 2019 crop to be of good quality, although some key kernel parameters were greatly impacted by adverse harvest conditions. Significant carryover stocks from the excellent quality 2018 crop will be beneficial in meeting many customer quality demands, but premium contract specifications will command premium market values. Buyers are encouraged to review contract specifications diligently to best balance market availabilities and end product quality demands.

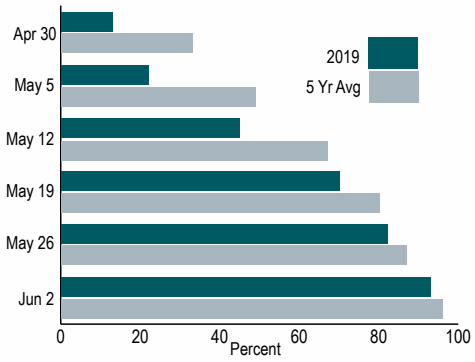
SEASONAL CONDITIONS - 2019

PLANTING started in late April – well behind the five-year average due to cool, wet conditions and late season snow. Planting was very slow during the first few weeks with only half of the crop planted by mid-May. The second half of the month brought improved weather conditions and planting accelerated, allowing most of the planting to be done by the first week in June. Due to the delayed and variable planting season, some intended acres did not get planted in southern areas.

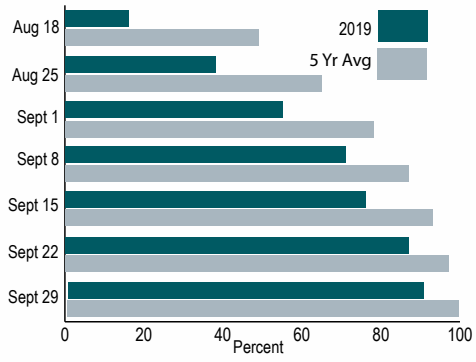
EMERGENCE was slow due to the late planting and cool conditions, and in areas emergence was variable. Crop development was slowed early due to cool temperatures. Southern areas benefitted early from good moisture while some northern areas endured a period of drought stress. More frequent and widespread rains developed across the region in the latter half of the growing season, boosting yield potential region wide, but also elevating disease pressures.

HARVEST began in mid-August and initial progress was slow due to scattered precipitation and high humidity. About half of the crop was harvested by September 1. Weather became more challenging into September with heavy rains. Much of the region received record levels of rain, limiting the number of harvest days and impacting quality. The balance of the harvest remained sluggish. By the first week of October, about 90 percent of the spring wheat had been harvested, with some areas not able to complete harvest due to saturated soils.

PLANTING PROGRESS



HARVEST PROGRESS



WHEAT CHARACTERISTICS

WHEAT GRADES as defined by the Federal Grain Inspection Service (FGIS) of 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. Each determination is made on the basis of the grain when free from dockage and shrunken and broken kernels.

SUBCLASS is as 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.

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 class[2]					
Contrasting classes	1.0	2.0	3.0	10.0	20.0
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:

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

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

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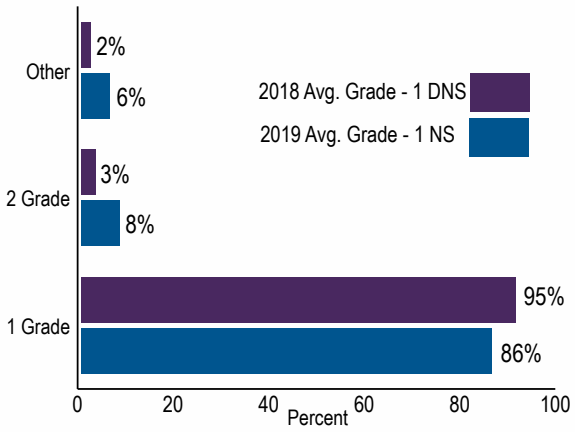
WHEAT GRADING DATA

STATE AND CROP REPORTING AREA	TEST WEIGHT LBS/BU	TEST WEIGHT KG/HL	DAMAGE %	SHRUNKEN/ BROKEN KERNELS %	TOTAL DEFECTS %	U.S GRADE SUBCLASS	VITREOUS KERNELS %
MINNESOTA							
Area A	60.8	80.0	1.2	0.5	1.7	1 NS	47
Area B	59.4	78.2	1.2	0.5	1.7	1 NS	40
State Avg 2019	60.5	79.6	1.2	0.5	1.7	1 NS	46
State Avg 2018	62.0	81.6	0.6	0.7	1.3	1 DNS	78
MONTANA							
Area A	60.1	79.1	0.2	1.3	1.5	1 NS	73
Area B	60.9	80.1	0.2	1.1	1.3	1 NS	62
Area C	59.0	77.6	0.9	1.6	2.5	1 NS	54
Area D	61.6	81.0	0.2	0.8	1.0	1 NS	46
Area E	61.6	81.0	0.7	0.8	1.5	1 NS	60
State Avg 2019	60.5	79.6	0.2	1.2	1.4	1 NS	66
State Avg 2018	61.0	80.2	0.2	1.3	1.5	1 DNS	90
NORTH DAKOTA							
Area A	61.7	81.1	0.3	0.7	1.0	1 NS	59
Area B	60.6	79.7	0.7	0.6	1.3	1 NS	39
Area C	61.0	80.2	0.7	0.4	1.1	1 NS	57
Area D	60.3	79.4	1.2	0.9	2.1	1 NS	55
Area E	59.8	78.6	0.8	0.7	1.5	1 NS	60
Area F	59.2	77.9	1.7	0.6	2.3	1 NS	52
State Avg 2019	60.7	79.9	0.8	0.7	1.5	1 NS	52
State Avg 2018	62.6	82.3	0.3	0.7	1.0	1 DNS	87
SOUTH DAKOTA							
Area A	60.1	79.1	0.7	1.4	2.1	1 NS	37
Area B	59.3	78.1	0.7	0.6	1.3	1 NS	44
Area C	59.1	77.7	1.5	0.9	2.4	1 NS	41
State Avg 2019	59.5	78.2	0.8	0.8	1.6	1 NS	42
State Avg 2018	61.1	80.4	0.8	1.6	2.4	1 DNS	75
IDAHO - OREGON - WASHINGTON							
Area A	63.0	82.9	0.2	0.5	0.7	1 DNS	84
Area B	62.7	82.5	0.2	0.5	0.7	1 DNS	81
State Avg 2019	62.9	82.6	0.2	0.5	0.7	1 DNS	82
State Avg 2018	63.0	82.8	0.3	0.7	1.0	1 DNS	96
REGION AVERAGE							
Avg 2019	60.7	79.8	0.7	0.7	1.4	1 NS	55
Avg 2018	62.2	81.8	0.4	0.9	1.3	1 DNS	86
Five-Year Avg	61.7	81.1	0.2	0.8	1.0	1 NS	74

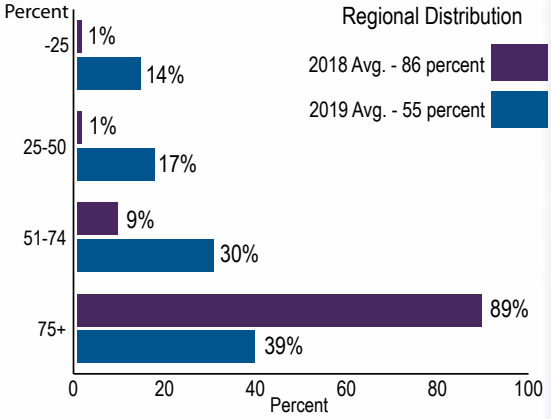
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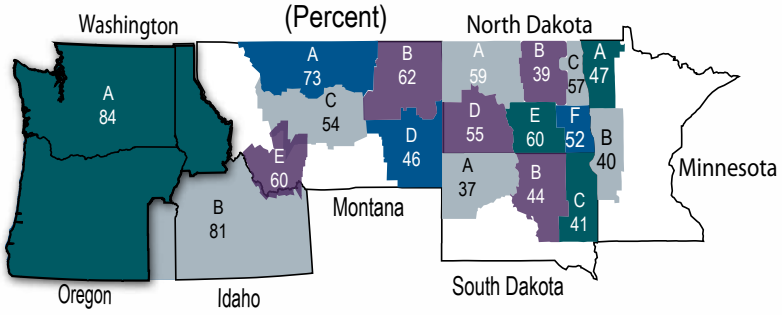
GRADE – Regional Distribution



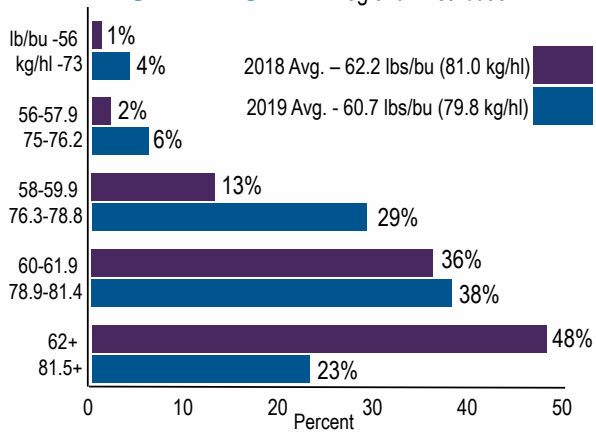
VITREOUS KERNEL



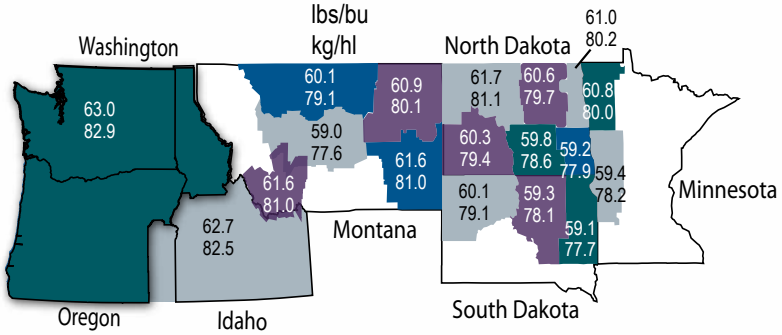
AVERAGE VITREOUS KERNEL BY AREA



TEST WEIGHT – Regional Distribution



AVERAGE TEST WEIGHT BY AREA



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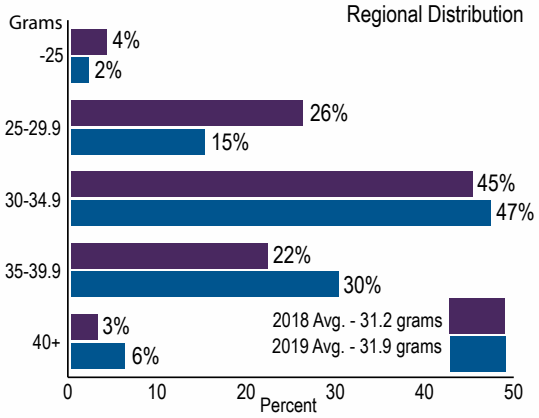
OTHER KERNEL QUALITY DATA

STATE AND CROP REPORTING AREA	DOCKAGE %	MOISTURE %	1000 KERNEL WEIGHT G	KERNEL DIST. MED/LGE %	PROTEIN 12%/0% MOISTURE BASIS %	DON (PPM)	WHEAT ASH %	FALLING NUMBER (SEC)	ZELENY SED (CC)
MINNESOTA									
Area A	0.5	13.2	34.9	36/63	14.2/16.1	0.5	1.55	257	69
Area B	0.6	13.2	29.7	54/44	14.2/16.1	1.6	1.68	337	66
State Avg 2019	0.5	13.2	34.0	39/60	14.2/16.1	0.7	1.57	271	68
State Avg 2018	0.5	12.5	31.5	45/53	14.2/16.1	0.7	1.60	409	66
MONTANA									
Area A	0.6	11.5	29.9	61/34	13.8/15.6	0.0	1.46	361	67
Area B	0.6	12.5	29.8	55/41	14.4/16.4	0.1	1.52	386	67
Area C	1.4	11.5	31.0	49/46	13.7/15.6	0.0	1.51	344	65
Area D	0.4	10.9	31.3	48/50	14.1/16.0	0.0	1.47	386	66
Area E	0.5	10.7	31.6	47/52	14.4/16.4	0.1	1.46	359	70
State Avg 2019	0.6	11.9	29.9	57/39	14.1/16.0	0.0	1.49	372	67
State Avg 2018	0.6	10.8	27.8	69/26	14.3/16.2	0.0	1.47	395	64
NORTH DAKOTA									
Area A	0.4	13.3	32.4	45/52	14.8/16.8	0.3	1.48	339	70
Area B	0.6	13.2	32.5	42/57	14.2/16.1	0.8	1.53	323	68
Area C	0.6	13.1	33.8	37/60	14.2/16.2	0.3	1.49	354	67
Area D	0.7	13.0	30.9	55/43	15.1/17.1	0.8	1.57	363	68
Area E	0.8	13.0	30.0	47/51	15.2/17.2	1.3	1.67	300	66
Area F	0.9	13.3	30.0	45/53	14.6/16.6	2.5	1.71	335	64
State Avg 2019	0.6	13.2	32.0	45/53	14.6/16.6	0.7	1.54	337	68
State Avg 2018	0.5	12.3	31.9	45/52	14.6/16.6	0.5	1.57	398	67
SOUTH DAKOTA									
Area A	1.3	12.7	30.1	49/49	15.0/17.1	0.6	1.69	349	67
Area B	0.6	13.1	29.8	54/44	15.3/17.4	1.4	1.74	327	62
Area C	0.7	13.2	29.3	51/47	14.4/16.3	1.3	1.69	334	52
State Avg 2019	0.8	13.0	29.8	52/46	15.1/17.1	1.2	1.72	333	61
State Avg 2018	0.5	11.9	29.4	65/31	15.2/17.3	0.3	1.73	383	62
IDAHO - OREGON - WASHINGTON									
Area A	0.3	9.7	36.6	38/61	14.2/16.1	0.1	1.47	383	67
Area B	0.2	11.1	33.9	45/53	14.3/16.3	0.0	1.51	423	65
State Avg 2019	0.2	10.5	35.1	42/56	14.3/16.2	0.1	1.49	406	66
State Avg 2018	0.3	9.3	34.9	44/54	14.2/16.1	0.0	1.56	406	66
REGION AVERAGE									
State Avg 2019	0.6	12.8	31.9	47/51	14.5/16.4	0.6	1.54	337	67
State Avg 2018	0.5	11.9	31.2	50/47	14.5/16.5	0.4	1.57	399	66
Five-State Avg	0.6	12.2	31.5	49/48	14.1/16.0	0.2	1.52	381	63

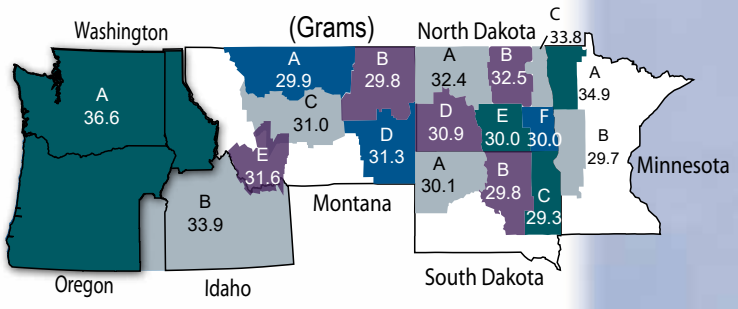
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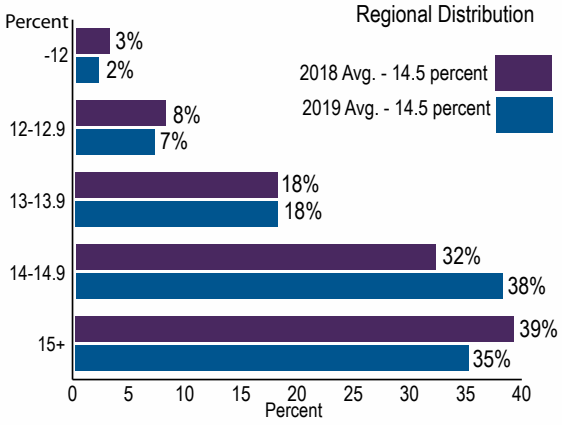
1000 KERNEL WEIGHT



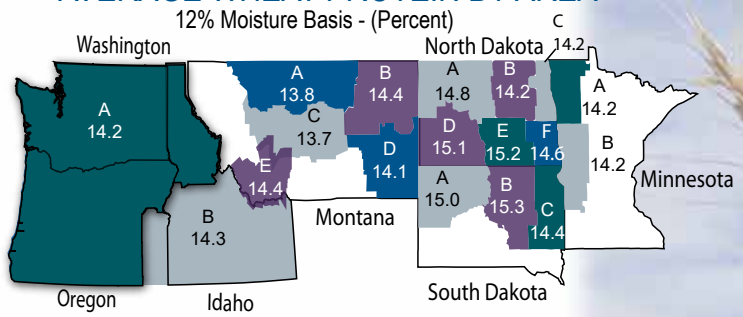
AVERAGE 1000 KERNEL BY AREA



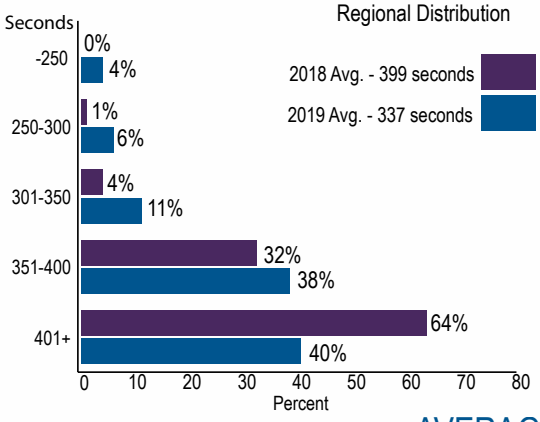
PROTEIN - 12% MOISTURE



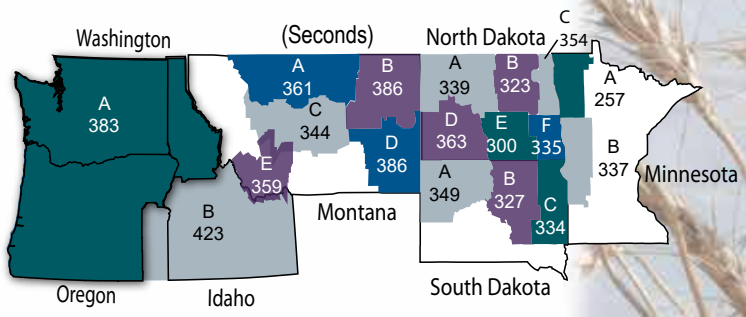
AVERAGE WHEAT PROTEIN BY AREA



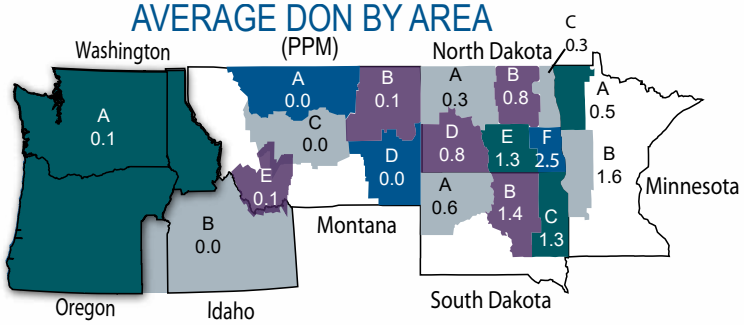
FALLING NUMBER



AVERAGE FALLING NUMBER BY AREA



AVERAGE DON BY AREA



U.S. HARD RED SPRING WHEAT

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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_2CO_3	WET GLUTEN %	GLUTEN INDEX	FALLING NUMBER	AMYLOGRAPH VISCOSITY 65 G FL B.U.
MINNESOTA											
Area A	68.9	0.53	13.1	7.2	0.65	74/120	148/109	33.2	97	287	204
Area B	69.6	0.54	13.4	7.6	0.66	72/118	146/104	34.0	95	363	569
State Avg 2019	69.0	0.53	13.2	7.2	0.65	74/120	148/108	33.3	97	301	270
State Avg 2018	69.1	0.52	13.3	8.3	0.67	75/125	155/107	35.0	96	419	656
MONTANA											
Area A	68.0	0.52	12.9	7.7	0.62	76/124	147/111	32.0	91	389	454
Area B	68.5	0.51	13.6	6.9	0.64	72/122	146/106	35.6	88	399	681
Area C	68.3	0.51	12.8	8.3	0.64	74/121	146/109	34.0	91	357	530
Area D	68.2	0.54	13.3	7.2	0.66	73/119	146/102	35.0	88	420	701
Area E	67.0	0.51	13.5	7.9	0.65	78/130	162/119	36.1	85	383	606
State Avg 2019	68.2	0.52	13.2	7.4	0.63	74/123	147/109	34.0	89	393	572
State Avg 2018	67.3	0.52	13.5	8.0	0.65	78/129	159/114	36.7	83	419	714
NORTH DAKOTA											
Area A	68.6	0.51	13.9	7.2	0.67	73/124	153/105	36.0	90	351	553
Area B	69.1	0.54	13.4	7.7	0.66	73/122	151/108	29.8	96	339	433
Area C	69.4	0.53	13.2	7.4	0.65	74/120	148/106	34.2	93	356	457
Area D	69.8	0.54	14.0	7.1	0.66	74/125	151/105	36.4	82	338	308
Area E	67.7	0.56	14.0	7.4	0.67	74/121	150/105	36.9	90	342	323
Area F	69.2	0.57	13.6	8.1	0.64	74/117	141/103	34.2	89	345	343
State Avg 2019	69.0	0.53	13.7	7.4	0.66	73/122	150/106	34.1	91	345	432
State Avg 2018	68.2	0.52	13.7	8.4	0.66	77/124	154/108	36.7	89	418	633
SOUTH DAKOTA											
Area A	67.6	0.55	13.7	7.1	0.68	73/118	150/103	36.7	86	369	482
Area B	67.0	0.55	13.8	6.6	0.65	69/114	136/94	35.6	84	343	306
Area C	68.3	0.56	13.0	7.6	0.64	67/112	130/92	33.4	86	350	389
State Avg 2019	67.4	0.55	13.6	6.9	0.66	70/115	138/96	35.5	85	350	359
State Avg 2018	67.6	0.53	13.9	7.9	0.61	71/126	136/98	36.6	90	408	555
IDAHO - OREGON - WASHINGTON											
Area A	67.1	0.51	13.4	7.5	0.62	81/134	154/117	35.7	84	429	564
Area B	67.7	0.52	13.6	7.6	0.61	78/131	153/120	35.3	90	463	760
State Avg 2019	67.4	0.52	13.5	7.6	0.61	79/133	153/118	35.5	87	448	676
State Avg 2018	67.2	0.52	13.4	8.6	0.59	81/133	149/118	36.1	84	459	690
REGION AVERAGE											
Avg. 2019	68.7	0.53	13.5	7.4	0.65	74/122	149/107	34.1	91	352	441
Avg. 2018	68.1	0.52	13.6	8.3	0.65	77/126	153/109	36.4	89	421	649
Five-Year Avg.	67.9	0.52	13.1	7.3	0.65	71/122	143/99	34.6	91	400	614

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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.

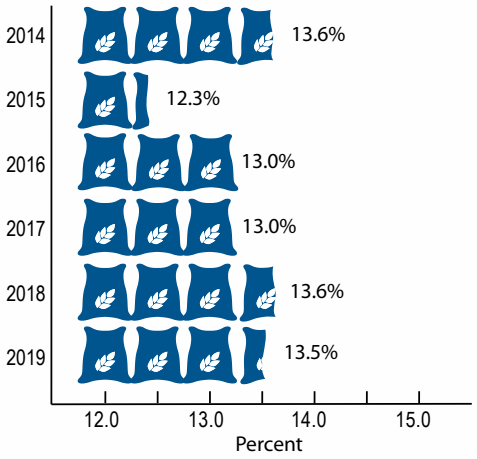
Another measure of milling efficiency and of flour grade is the ash content, or mineral residue, remaining after incineration of a sample.

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

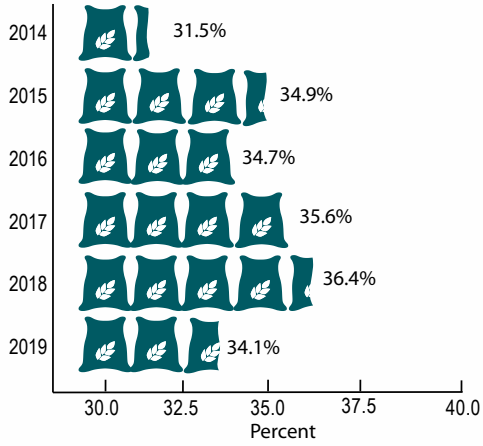
WET GLUTEN provides a quantitative measure of the gluten forming proteins in flour that are primarily responsible for its dough mixing and baking properties.

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.

FLOUR PROTEIN – Regional Average

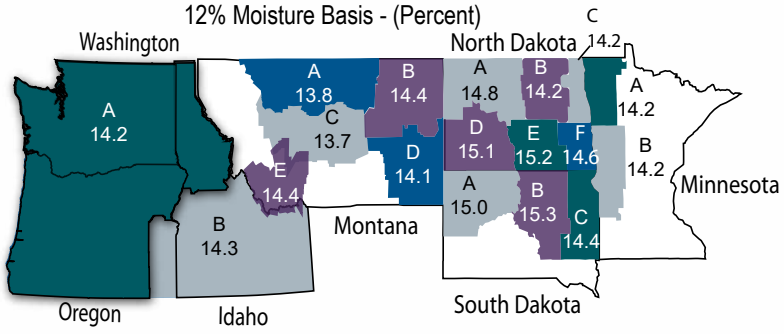


WET GLUTEN – Regional Average



AVERAGE WHEAT PROTEIN BY AREA

12% Moisture Basis - (Percent)



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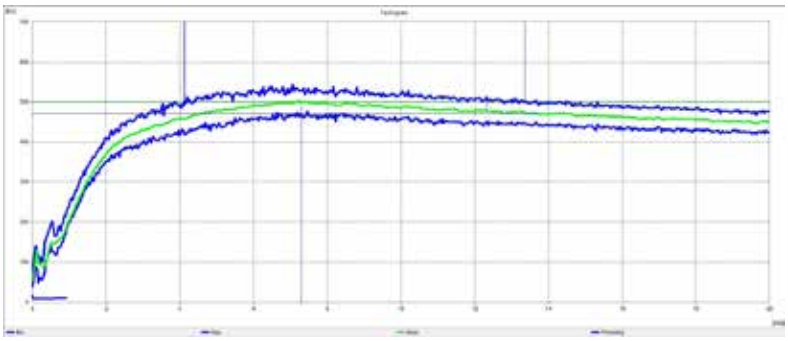
PHYSICAL DOUGH QUALITY

STATE AND CROP REPORTING AREA	ABSORPTION %	PEAK TIME MIN	STABILITY MIN	MTI B.U.	QUALITY NUMBER MM
FARINOGRAPH					
MINNESOTA					
Area A	61.4	6.7	10.7	24	129
Area B	60.6	5.7	12.1	15	150
State Avg 2019	61.3	6.5	11.0	22	133
State Avg 2018	62.1	6.9	14.0	14	167
MONTANA					
Area A	61.4	6.8	9.0	31	118
Area B	62.9	6.9	9.8	23	131
Area C	63.0	7.3	8.8	33	116
Area D	63.0	6.9	8.5	30	120
Area E	66.3	7.8	9.1	25	132
State Avg 2019	62.4	6.9	9.4	27	125
State Avg 2018	64.1	8.2	9.9	27	137
NORTH DAKOTA					
Area A	63.5	7.7	10.6	18	139
Area B	63.0	7.0	9.6	25	130
Area C	61.8	7.7	12.1	19	153
Area D	63.8	8.0	9.9	22	141
Area E	62.9	7.7	9.1	33	119
Area F	61.4	7.4	8.5	40	109
State Avg 2019	63.0	7.5	10.2	23	135
State Avg 2018	64.8	7.8	11.4	21	154
SOUTH DAKOTA					
Area A	63.7	6.7	7.8	36	111
Area B	61.1	7.5	8.4	38	115
Area C	60.2	6.7	8.3	35	104
State Avg 2019	61.5	7.2	8.3	37	112
State Avg 2018	62.6	8.2	10.7	24	143
IDAHO - OREGON - WASHINGTON					
Area A	64.6	7.3	9.2	24	137
Area B	65.7	8.5	11.4	18	158
State Avg 2019	65.2	8.0	10.5	21	149
State Avg 2018	66.0	7.9	9.9	23	147
REGION AVERAGE					
Avg. 2019	62.6	7.3	10.0	25	132
Avg. 2018	64.2	7.7	11.4	21	152
Five-Year Avg.	62.7	7.3	11.2	24	141

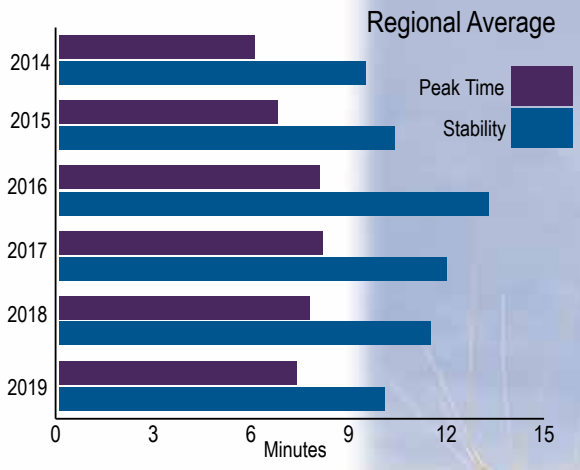
Physical characteristics of dough are evaluated to reveal useful information about variations in flour types, processing requirements and expected end-product quality.

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 required to achieve this level of dough consistency and mixing tolerance indicates the stability of the dough. Both peak time and stability are related to dough strength.

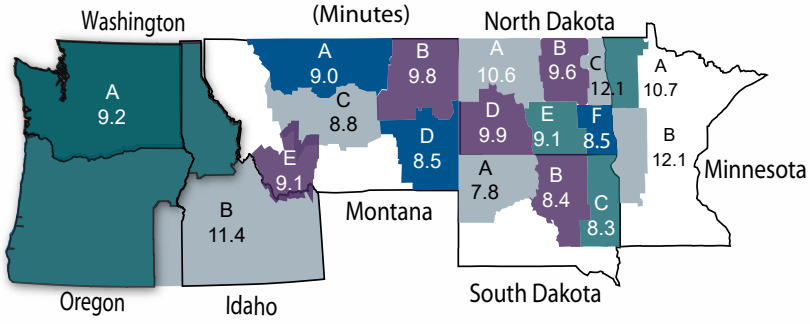
2019 AVERAGE FARINOGRAM



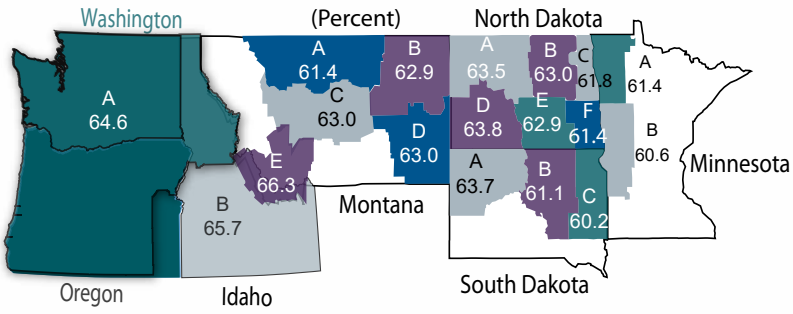
FARINOGRAPH RESULTS



AVERAGE STABILITY BY AREA



AVERAGE FARINOGRAM ABSORPTION BY AREA



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PHYSICAL DOUGH QUALITY

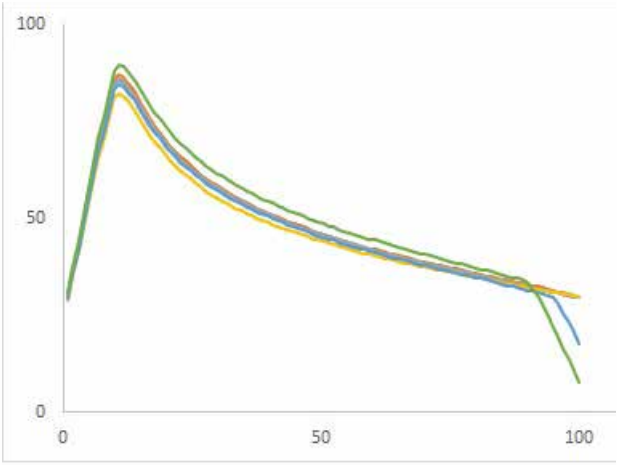
STATE AND CROP REPORTING AREA	EXTENSOGRAPH EXTENSIBILITY 45 MIN CM	EXTENSOGRAPH RESISTANCE 45 MIN B.U.	EXTENSOGRAPH AREA SQ CM	EXTENSOGRAPH EXTENSIBILITY 135 MIN CM	EXTENSOGRAPH RESISTANCE 135 MIN B.U.	EXTENSOGRAPH AREA SQ CM	ALVEOGRAPH P MM	ALVEOGRAPH L MM	ALVEOGRAPH W P/L RATIO	ALVEOGRAPH JOULES X 10^4
MINNESOTA										
Area A	19.1	570	138	17.7	750	174	86	134	0.64	401
Area B	18.0	573	137	17.1	654	151	72	141	0.51	337
State Avg 2019	18.9	571	138	17.6	733	170	83	135	0.62	389
State Avg 2018	15.7	709	145	13.3	1055	180	91	130	0.70	385
MONTANA										
Area A	15.2	495	98	13.4	805	143	85	126	0.67	348
Area B	18.5	453	112	16.8	699	149	86	122	0.70	349
Area C	17.8	477	118	17.1	523	124	85	129	0.66	337
Area D	18.5	429	102	15.4	580	123	84	124	0.68	340
Area E	15.8	394	84	13.9	876	161	100	122	0.82	367
State Avg 2019	16.9	470	105	15.1	746	146	86	124	0.69	349
State Avg 2018	15.8	535	111	14.0	812	149	96	111	0.86	358
NORTH DAKOTA										
Area A	19.2	478	128	16.1	794	173	90	130	0.69	401
Area B	18.5	538	127	16.3	592	122	76	147	0.52	343
Area C	17.7	581	131	17.5	675	156	87	126	0.69	380
Area D	15.9	475	95	13.9	696	127	76	153	0.50	350
Area E	18.5	438	104	17.3	536	119	75	146	0.51	342
Area F	18.0	385	92	17.2	542	120	72	133	0.54	290
State Avg 2019	18.1	498	118	16.1	668	141	81	139	0.58	361
State Avg 2018	16.4	553	120	14.9	808	156	86	120	0.72	337
SOUTH DAKOTA										
Area A	17.6	418	100	17.5	519	117	76	144	0.53	321
Area B	17.9	376	92	17.3	420	100	69	135	0.51	277
Area C	17.1	369	88	16.9	449	102	64	133	0.48	251
State Avg 2019	17.7	384	93	17.3	447	104	70	137	0.51	282
State Avg 2018	15.4	550	112	12.4	859	144	71	121	0.59	275
IDAHO - OREGON - WASHINGTON										
Area A	17.6	519	122	16.1	658	144	99	121	0.82	391
Area B	17.5	439	102	15.5	706	143	106	116	0.91	402
State Avg 2019	17.5	473	111	15.8	685	143	103	118	0.87	397
State Avg 2018	15.8	476	99	13.5	749	136	99	105	0.95	347
REGION AVERAGE										
Avg. 2019	17.9	497	117	16.2	682	144	83	135	0.61	360
Avg. 2018	16.1	570	120	14.2	847	157	88	119	0.74	345
Five-Year Avg.	16.4	507	109	13.6	848	151	87	122	0.71	356

2019 AVERAGE EXTENSOGRAM



The extensigraph measures dough strength by stretching a piece of dough on a hook until it breaks. The apparatus traces a curve that measures extensibility, resistance to extension and the area beneath the curve, or energy value.

2019 AVERAGE ALVEOGRAM



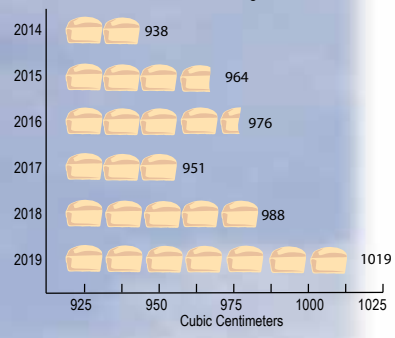
An alveograph traces a curve that measures the air pressure necessary to inflate a piece of dough to the point of rupture. The overpressure (P) value reflects the maximum pressure needed to deform the piece of dough during the inflation process and is an indication of resistance, or dough stability. The length (L) measurement reflects 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.

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BAKING DATA

LOAF VOLUME – Regional Distribution



STATE AND CROP REPORTING AREA	BAKING ABSORPTION %	DOUGH HANDLING PROPERTIES	LOAF VOLUME CC	GRAIN AND TEXTURE	CRUMB COLOR	CRUST COLOR	SYMMETRY
MINNESOTA							
Area A	64.7	9.0	1040	7.0	8.0	10.0	9.0
Area B	64.5	8.0	990	8.0	7.5	9.0	8.0
State Avg 2019	64.7	8.8	1031	7.2	7.9	9.8	8.8
State Avg 2018	67.9	9.0	952	7.6	8.0	10.0	9.1
MONTANA							
Area A	66.5	9.0	965	7.5	7.5	10.0	9.0
Area B	67.1	9.0	980	8.0	7.5	10.0	9.0
Area C	69.1	8.0	955	7.5	7.5	10.0	8.0
Area D	67.9	9.0	990	7.5	8.0	10.0	9.0
Area E	71.0	8.0	1040	8.0	8.5	10.0	10.0
State Avg 2019	67.0	8.9	975	7.8	7.6	10.0	9.0
State Avg 2018	69.9	8.8	932	7.4	7.5	10.0	9.2
NORTH DAKOTA							
Area A	68.3	9.0	1010	8.0	7.5	10.0	9.0
Area B	68.1	8.0	1045	8.0	7.5	10.0	10.0
Area C	67.0	9.0	1025	7.5	8.0	10.0	9.0
Area D	68.5	7.0	1070	7.5	7.0	9.0	9.0
Area E	67.6	8.0	1030	7.0	7.5	9.0	9.0
Area F	66.2	7.0	970	8.0	7.5	9.0	8.0
State Avg 2019	67.9	8.2	1031	7.8	7.5	9.7	9.2
State Avg 2018	69.8	9.1	1016	7.7	7.7	10.0	9.4
SOUTH DAKOTA							
Area A	67.8	8.0	1070	6.5	7.5	10.0	10.0
Area B	65.2	8.0	1005	8.0	8.0	10.0	9.0
Area C	63.7	8.0	945	7.5	8.0	10.0	9.0
State Avg 2019	65.5	8.0	1009	7.6	7.9	10.0	9.2
State Avg 2018	67.2	8.8	976	7.3	7.8	10.0	8.7
IDAHO - OREGON - WASHINGTON							
Area A	69.5	9.0	1005	7.5	8.0	10.0	10.0
Area B	71.7	9.0	1040	8.0	8.0	10.0	10.0
State Avg 2019	70.8	9.0	1025	7.8	8.0	10.0	10.0
State Avg 2018	71.7	8.3	987	7.8	7.9	10.0	9.8
REGION AVERAGE							
Avg 2019	67.2	8.4	1019	7.7	7.6	9.8	9.1
Avg 2018	69.5	9.0	988	7.6	7.7	10.0	9.3
Five-Year Avg	67.6	9.1	963	7.7	7.7	9.7	9.2

RECENT QUALITY TRENDS

SUMMARY INFORMATION							
CROP YEAR	2019	2018	2017	2016	2015	2014	FIVE-YEAR AVERAGE
WHEAT GRADING							
Test Weight (lbs/bu)	60.7	62.2	61.7	61.6	61.6	61.4	61.7
Test Weight (kg/hl)	79.8	81.8	81.1	81.0	81.0	80.7	81.1
Vitreous Kernels (%)	55	86	71	77	83	53	74
1000 Kernel Weight (gm)	31.9	31.2	31.5	30.9	31.3	32.4	31.5
Protein: 12%/0% moisture	14.5/16.4	14.5/16.5	14.5/16.5	14.2/16.1	14.1/16.0	13.6/15.4	14.1/16.0
Ash: 14% moisture (%)	1.54	1.57	1.50	1.53	1.53	1.46	1.52
Falling Number (sec)	337	399	389	406	372	339	381
FLOUR DATA							
Extractions (%)	68.7	68.1	71.2	66.9	67.1	66.0	67.9
Ash: 14% moisture (%)	0.53	0.52	0.57	0.53	0.52	0.45	0.52
Protein: 14% moisture (%)	13.5	13.6	13.8	13.0	13.0	12.3	13.1
Wet Gluten (%)	34.1	36.4	35.6	34.7	34.9	31.5	34.6
Falling Number (sec)	352	421	407	415	386	370	400
Amylograph Peak Viscosity							
65g FL (B.U.)	441	649	570	659	676	518	614
PHYSICAL DOUGH PROPERTIES							
***FARINOGRAPH:**							
Absorption (%)	62.6	64.2	62.6	62.7	61.9	61.9	62.7
Peak Time (min)	7.3	7.7	8.1	8.0	6.7	6.0	7.3
Stability (min)	10.0	11.4	11.9	13.2	10.3	9.4	11.2
EXTENSOGRAPH:							
Extensibility-45 min (cm)	17.9	16.1	16.8	16.6	16.5	16.2	16.4
Resistance-45 min (B.U.)	497	570	513	536	442	475	507
Area-45 min (sq cm)	117	120	113	115	95	100	109
ALEOGRAPH:							
P (mm)	83	88	80	84	80	103	87
L (mm)	135	119	141	130	120	101	122
W (joules x10^4)	360	345	372	376	324	364	356
BAKING DATA							
Absorption (%)	67.2	69.5	66.2	67.6	67.5	67.2	67.6
Dough Handling Properties	8.4	9.0	9.0	9.3	9.5	8.6	9.1
Loaf Volume (CC)	1019	988	951	976	964	938	963
Grain and Texture	7.7	7.6	7.8	7.6	7.4	7.9	7.7
Crumb Color	7.6	7.7	7.8	7.7	7.5	7.9	7.7
Crust Color	9.8	10.0	9.8	9.8	9.4	9.7	9.7
Symmetry	9.1	9.3	9.1	9.1	9.0	9.3	9.2



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2019 QUALITY FACTORS BY PROTEIN RANGE/AREA

WEST

Samples in this region were collected from Montana, North Dakota areas A and D, South Dakota area A, and Idaho, Oregon and Washington. Please reference page 3.

To illustrate the correlation between higher protein and other quality parameters, samples of the regional crop were segregated by protein levels:

LOW
<13.5%

MEDIUM
13.5 to 14.5 %

HIGH
> 14.5%
* (12% moisture basis)

PROTEIN RANGES			
WHEAT GRADING DATA	LOW	MEDIUM	HIGH
WHEAT GRADING DATA			
Test Weight (lbs/bu/kg/hl)	61.5/80.8	61.6/81.1	60.4/79.5
Damage (%)	0.2	0.4	0.8
Shrunken/Broken (%)	0.9	0.8	1.0
Total Defects (%)	1.1	1.2	1.8
Vitreous Kernels (%)	62	59	62
Grade	1 NS	1 NS	1 NS
WHEAT DATA			
Dockage (%)	0.6	0.5	0.6
Moisture (%)	11.7	12.4	12.4
Protein:12%/0% moisture (%)	12.7/14.5	14.0/16.0	15.3/17.4
Ash: 14%/0% moisture (%)	1.43/1.66	1.43/1.66	1.55/1.80
1000 Kernel Weight	31.0	31.0	30.2
Falling Number (sec)	386	355	379
Sedimentation (cc)	63.9	65.0	67.9
FLOUR DATA			
Extraction (%)	68.2	69.0	68.0
Color: L	90.1	90.1	89.8
a/b	-2.1/9.3	-2.1/9.4	-2.1/9.6
Protein: 14%/0% moisture (%)	11.8/13.7	13.1/15.2	14.4/16.7
Ash: 14%/0% moisture (%)	0.52/0.60	0.53/0.61	0.53/0.62
Wet Gluten (%)	28.1	34.1	36.9
Gluten Index (%)	97	85	85
Falling Number (sec)	398	392	382
Amylograph Viscosity: 65g FL (BU)	554	506	495
BAKING DATA			
Farinograph: Absorption (%)	62.0	63.3	64.3
Peak Time (min)	7.0	8.2	9.3
Stability (min)	8.8	9.7	10.5
Alveograph: P (mm)	94	87	80
L (mm)	102	125	143
P/L Ratio	0.92	0.70	0.56
W (10^{-4} joules)	325	349	362
Extensograph (45/135 min): Resistance	470/710	436/695	446/638
Extensibility (sm)	17.8/15.8	16.1/15.0	18.6/16.1
Area (sq cm)	112/150	94/138	111/134
BAKING DATA			
Absorption (%)	66.8	68.3	69.4
Crumb Grain and Texture	7.0	8.0	8.5
Loaf Volume (cc)	865	935	1090
PRODUCTION %	**22**	**24**	**54**

Data contained on pages 18-20 represent the composites of samples by West and East production regions and a low, medium and high protein range.

EAST

PROTEIN RANGES			
WHEAT GRADING DATA	**LOW**	**MEDIUM**	**HIGH**
WHEAT GRADING DATA			
Test Weight (lbs/bu/kg/hl)	60.9/80.0	60.7/79.8	60.0/80.0
Damage (%)	0.7	1.8	1.1
Shrunken/Broken (%)	0.5	0.5	0.7
Total Defects (%)	1.2	2.3	1.8
Vitreous Kernels (%)	35	33	56
Grade	1 NS	1 NS	1 NS
WHEAT DATA			
Dockage (%)	0.5	0.6	0.5
Moisture (%)	13.2	13.2	13.0
Protein:12%/0% moisture (%)	12.8/14.6	14.0/15.9	15.1/17.1
Ash: 14%/0% moisture (%)	1.54/1.79	1.57/1.83	1.65/1.91
1000 Kernel Weight	32.7	32.0	30.7
Falling Number (sec)	346	279	316
Sedimentation (cc)	64.1	66.9	67.0
FLOUR DATA			
Extraction (%)	69.6	69.4	67.6
Color: L	90.1	89.8	89.7
a/b	-2.0/8.8	-1.9/8.8	-1.9/8.9
Protein: 14%/0% moisture (%)	12.0/13.9	13.1/15.2	14.1/16.4
Ash: 14%/0% moisture (%)	0.52/0.60	0.54/0.63	0.56/0.65
Wet Gluten (%)	29.4	31.4	37.0
Gluten Index (%)	97	96	89
Falling Number (sec)	350	320	344
Amylograph Viscosity: 65g FL (BU)	321	255	350
BAKING DATA			
Farinograph: Absorption (%)	60.1	61.9	62.9
Peak Time (min)	6.0	6.8	8.5
Stability (min)	11.2	9.8	10.4
Alveograph: P (mm)	82	74	77
L (mm)	119	127	145
P/L Ratio	0.69	0.58	0.53
W (10^{-4} joules)	328	312	352
Extensograph (45/135 min): Resistance	440/657	500/530	450/668
Extensibility (sm)	18.6/16.5	17.8/16.1	17.9/14.6
Area (sq cm)	101/145	117/111	103/131
BAKING DATA			
Absorption (%)	64.8	66.7	67.5
Crumb Grain and Texture	7.0	7.5	7.5
Loaf Volume (cc)	985	1035	1075
PRODUCTION %	**16**	**38**	**46**

Samples in this region were collected from North Dakota areas B, C, E and F, South Dakota areas B and C, and Minnesota. Please reference pg 3.

To illustrate the correlation between higher protein and other quality parameters, samples of the regional crop were segregated by protein levels:

LOW
<13.5%

MEDIUM
13.5 to 14.5 %

HIGH
> 14.5%
* (12% moisture basis)



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OVERALL REGION

To illustrate the correlation between higher protein and other quality parameters, samples of the regional crop were segregated by protein levels:

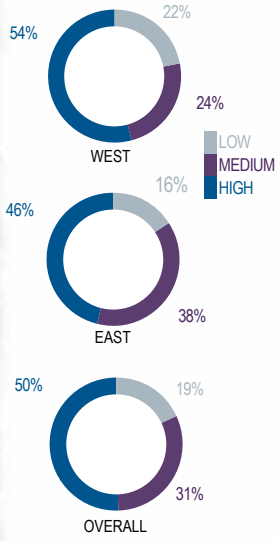
LOW
<13.5%

MEDIUM
13.5 to 14.5 %

HIGH
> 14.5%
* (12% moisture basis)

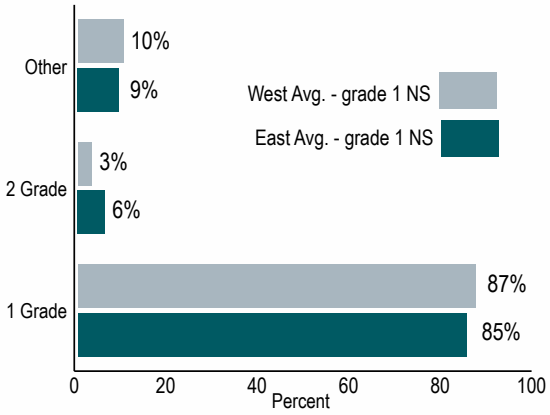
PROTEIN RANGES			
WHEAT GRADING DATA	**LOW**	**MEDIUM**	**HIGH**
WHEAT GRADING DATA			
Test Weight (lbs/bu/kg/hl)	61.2/80.5	61.0/80.3	60.2/79.2
Damage (%)	0.4	1.3	0.9
Shrunken/Broken (%)	0.7	0.6	0.9
Total Defects (%)	1.1	1.9	1.8
Vitreous Kernels (%)	50	43	59
Grade	1 NS	1 NS	1 NS
WHEAT DATA			
Dockage (%)	0.5	0.5	0.6
Moisture (%)	12.4	12.9	12.7
Protein:12%/0% moisture (%)	12.8/14.5	14.0/15.9	15.2/17.3
Ash: 14%/0% moisture (%)	1.48/1.72	1.52/1.77	1.60/1.86
1000 Kernel Weight	31.7	31.6	30.4
Falling Number (sec)	368	307	349
Sedimentation (cc)	64.0	66.2	67.5
FLOUR DATA			
Extraction (%)	68.8	69.3	67.8
Color: L	90.1	89.9	89.7
a/b	-2.1/9.1	-1.9/9.0	-2.0/9.3
Protein: 14%/0% moisture (%)	11.9/13.8	13.1/15.2	14.3/16.6
Ash: 14%/0% moisture (%)	0.52/0.60	0.53/0.62	0.55/0.64
Wet Gluten (%)	28.7	32.4	36.9
Gluten Index (%)	97	92	87
Falling Number (sec)	377	347	364
Amylograph Viscosity: 65g FL (BU)	450	348	425
BAKING DATA			
Farinograph: Absorption (%)	61.2	62.4	63.6
Peak Time (min)	6.6	7.3	8.9
Stability (min)	9.9	9.8	10.5
Alveograph: P (mm)	89	79	79
L (mm)	110	126	144
P/L Ratio	0.81	0.62	0.55
W (10^{-4} joules)	326	326	357
Extensograph (45/135 min): Resistance	457/686	476/591	448/652
Extensibility (sm)	18.2/16.1	17.2/15.7	18.3/15.4
Area (sq cm)	107/148	108/121	107/133
BAKING DATA			
Absorption (%)	65.9	67.3	68.5
Crumb Grain and Texture	7.0	7.7	8.0
Loaf Volume (cc)	918	998	1083
PRODUCTION %	**19**	**31**	**50**

PRODUCTION DISTRIBUTION BY PROTEIN

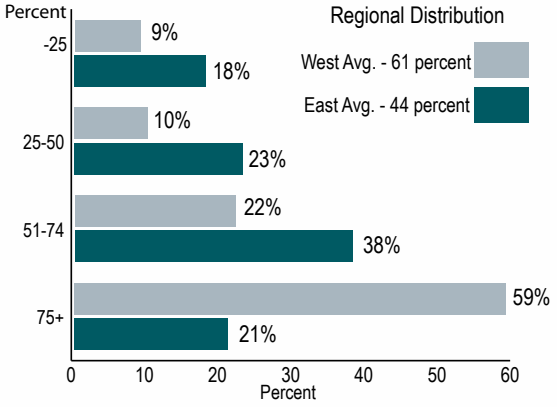


DISTRIBUTIONS BY EAST/WEST PRODUCTION REGIONS

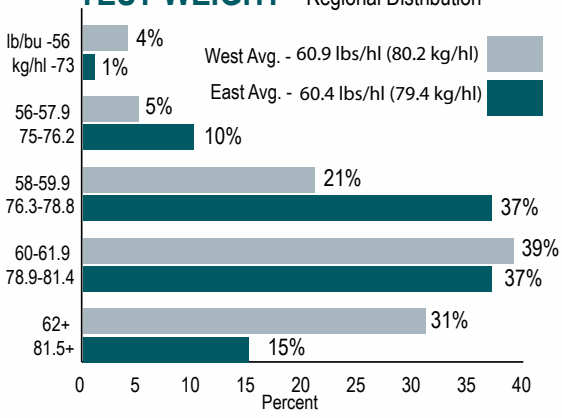
GRADE – Regional Distribution



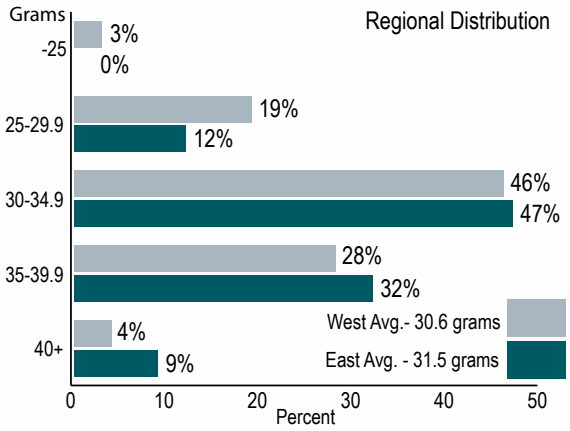
VITREOUS KERNEL



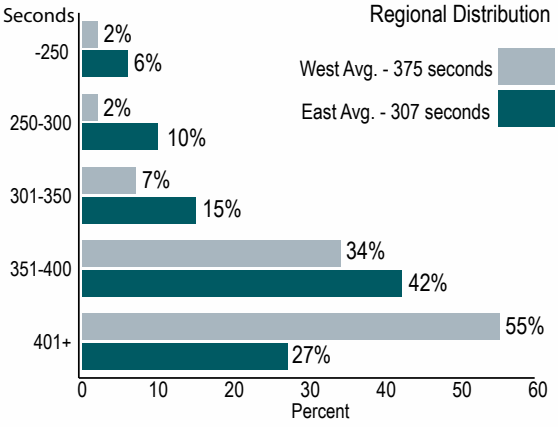
TEST WEIGHT – Regional Distribution



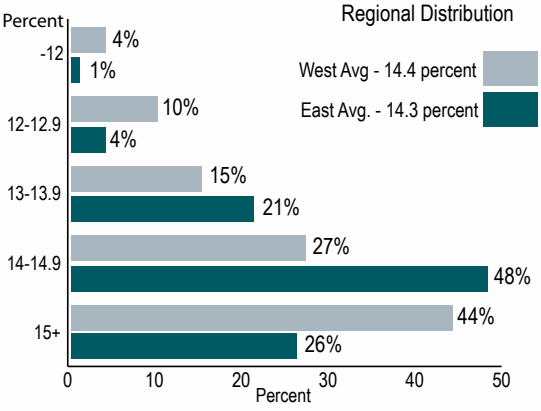
1000 KERNEL WEIGHT



FALLING NUMBER



PROTEIN - 12% MOISTURE



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.

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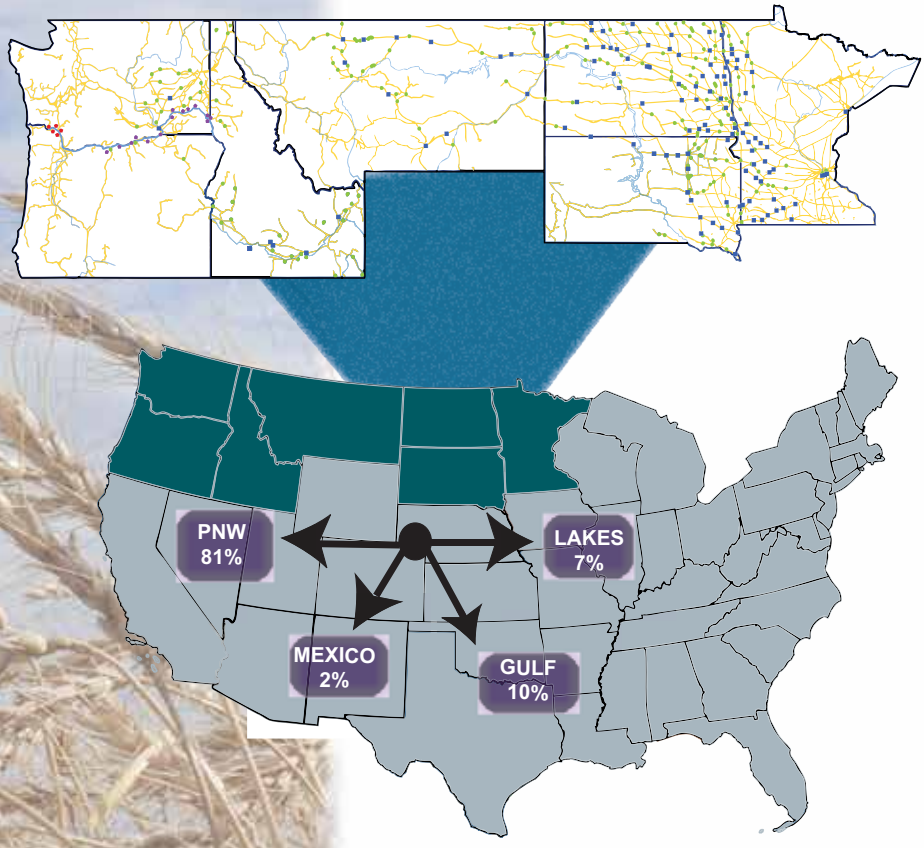
HANDLING AND TRANSPORTATION

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.

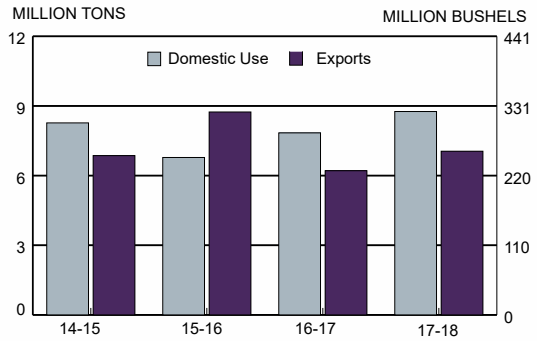


AVERAGE SHARE OF U.S. HRS EXPORTS BY PORT (2015-2018)

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

2015-2018 U.S. HRS DOMESTIC USE AND EXPORTS



2019 SURVEY BACKGROUND

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, DeLane Olsen, Kelly McMonagle, Kristin Whitney, Amber Walter and Gwen Thomas with the Hard Red Spring Wheat Quality Laboratory in the Department of Plant Science at North Dakota State University, Fargo, North Dakota, 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 mid August when approximately 10 percent of the hard red spring wheat had been harvested and continued until late September when about 90 percent of the region's crop was harvested. Due to the adverse and prolonged harvest,the survey does not represent the entire crop.

Sample collection was weighted by county production histories with a total of 781 samples being collected during harvest from Minnesota (131), Montana (153), North Dakota (380), South Dakota (78) and PNW (39).

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.

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 0f 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 International (AACCI) 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 AACCI 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.



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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 – AACCI (NIR) Method: 39.10.01 expressed on dry basis and 12 percent moisture basis.

ASH – AACCI 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 – AACCI Method 56.81.04; units of seconds (14 percent moisture basis).

SEDIMENTATION – AACCI Method 56.61.01, expressed in centimeters.

FLOUR

EXTRACTION – Samples are cleaned and tempered according to AACCI 26-01.02. 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. All mill settings are optimized to achieve maximum laboratory mill flour extraction with standardized ash content.

ASH – AACCI Method 08.01, expressed on a 14 percent moisture basis.

PROTEIN – AACCI Method 39.10.01 (NIR Method), expressed on a 14 percent moisture basis.

WET GLUTEN – AACCI Method 38.12.02, expressed on a 14 percent moisture basis determined with the glutomatic instrument.

GLUTEN INDEX – AACCI Method 38.12.02, determined with the glutomatic instrument as an indication of gluten strength.

FLOUR FALLING NUMBER – AACCI Method 56.81.03, units of seconds. Determination is performed on 7.0 g of Buhler milled flour (14 percent moisture basis).

AMYLOGRAM – (65 g) AACCI 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 – AACCI Method 76.31.02. Proportion of starch granules that have incurred physical damage from milling.

SOLVENT RETENTION CAPACITY (SRC) – AACCI 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 – AACCI 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 – AACCI 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.

EXTENSOGRAM – AACCI 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 – AACCI Method 54.30.02. Alveolab is used to measure 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 – AACCI 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.



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VARIETAL INFORMATION

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

	AGRONOMIC DESCRIPTION			REACTION TO DISEASE[3]			AVERAGE YIELD			
							EASTERN, ND[4]		WESTERN ND[5]	
VARIETY	AGENT OR ORIGIN[1]	YEAR RELEASED	STRAW STRENGTH[2]	DAYS TO HEAD	LEAF RUST	HEAD (SCAB)	BU/ACRE	MT/HECT	BU/ACRE	MT/HECT
Barlow	ND	2009	6	47	6	5	66.9	4.50	50.8	3.42
Bolles	MN	2015	4	52	3	5	67.7	4.55	46.5	3.13
Elgin-ND	ND	2012	5	48	6	5	70.4	4.73	52.3	3.52
Faller	ND	2007	5	50	7	5	76.3	5.13	52.8	3.55
Glenn	ND	2005	4	47	6	3	63.5	4.27	51.0	3.43
HRS 3530	Croplan	2015	4	51	2	5	75.9	5.10	50.9	3.42
Linkert	MN	2013	2	49	3	5	65.0	4.37	48.2	3.24
ND VitPro	ND	2016	3	48	4	4	64.8	4.36	48.0	3.23
Shelly	MN	2016	5	51	6	5	74.7	5.02	54.8	3.68
SY Ingmar	Syngenta/AgriPro	2011	3	49	3	5	70.1	4.71	49.0	3.29
SY Rockford	Syngenta/AgriPro	2017	3	53	n/a	5	n/a	n/a	52.5	3.53
SY Soren	Syngenta/AgriPro	2011	3	48	2	5	69.3	4.66	49.0	3.29
SY Valda	Syngenta/AgriPro	2015	4	49	2	4	76.8	5.16	51.3	3.45
TCG Spitfire	21st Century Genetics	2011	4	52	5	6	68.9	4.63	48.6	3.27
WB 9479	Westbred	2017	4	49	1	6	69.6	4.68	49.0	3.29
WB 9590	Westbred	2017	4	48	3	6	71.7	4.82	49.9	3.35

1. ND – North Dakota State University (Public), MN – University of Minnesota (Public), Croplan – (Private), Syngenta/AgriPro – (Private), 21st Century Genetics, (Private), and Westbred (Private).
2. Straw Strength: 1 to 9 scale, with 1 the strongest and 9 the weakest.
3. Disease reaction scores from 1 - 9, with 1 = resistant and 9 = very susceptible.
4. 2017-18 ND average yield data from five locations in eastern North Dakota.
5. 2017-18 ND average yield data from four locations in western North Dakota.



VARIETAL INFORMATION

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

			QUALITY FACTORS[6]					
VARIETY	TEST WEIGHT LB/BU	TEST WEIGHT KG/HL	WHEAT PROTEIN %	VITREOUS KERNELS %	FARINOGRAM STABILITY (MIN)	ABSORPTION %	LOAF VOLUME CC	MILL & BAKE QUALITY RATING[7]
Barlow	62.5	82.2	15.0	90.6	10.9	67.4	1015	★★★
Bolles	61.0	80.3	16.2	88.0	24.5	65.6	1059	★★★★
Elgin-ND	61.1	80.4	14.8	87.4	11.6	66.7	994	★★★
Faller	60.7	79.9	14.4	83.4	11.3	64.5	1008	★★★
Glenn	63.6	83.6	15.1	88.3	18.2	65.3	1031	★★★★★
HRS 3530	60.9	80.1	14.4	82.4	10.5	65.1	1000	★★★
Linkert	61.8	81.3	15.6	82.1	26.4	65.1	1022	★★★★
ND VitPro	63.3	83.2	15.3	88.9	9.8	65.8	1000	★★★
Shelly	61.6	81.0	13.8	73.0	19.4	61.1	917	★★
SY Ingmar	62.1	81.6	14.6	82.6	11.1	62.8	1002	★★★
SY Rockford	60.3	79.4	14.3	84.8	10.7	65.3	987	★★★★
SY Soren	62.1	81.7	14.9	78.6	10.6	63.9	1024	★★★
SY Valda	61.6	81.0	14.0	88.8	8.8	63.0	956	★★
TCG Spitfire	61.3	80.6	13.8	78.4	16.6	64.8	990	★★
WB 9479	62.4	82.0	15.4	79.3	24.3	63.1	968	★★★
WB 9590	61.9	81.4	14.9	75.4	15.5	63.8	909	★★★

6. Source: NDSU Plant Science Department, Hard Red Spring Wheat Quality Laboratory, 2017-2018 drill strip trials across ND locations.
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.

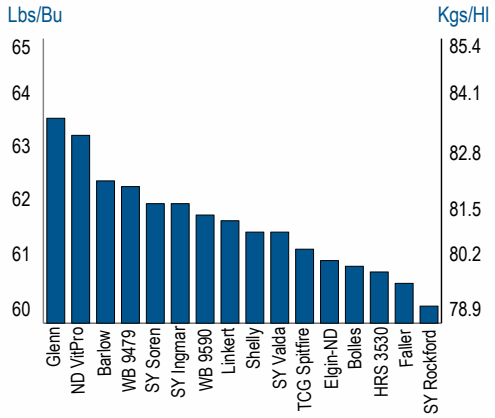


U.S. HARD RED SPRING WHEAT

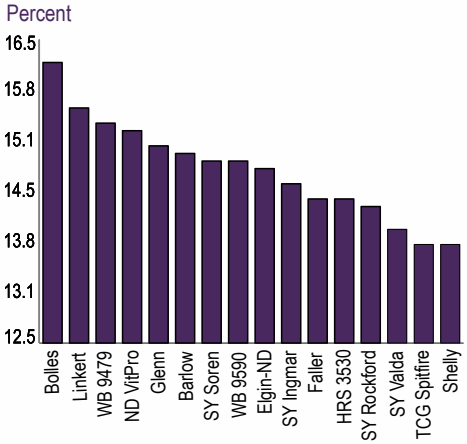
MINNESOTA | MONTANA | NORTH DAKOTA | SOUTH DAKOTA | IDAHO | OREGON | WASHINGTON

QUALITY COMPARISON BY POPULAR VARIETIES

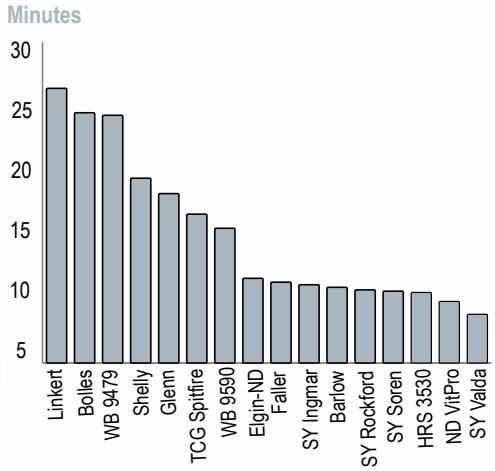
TEST WEIGHT



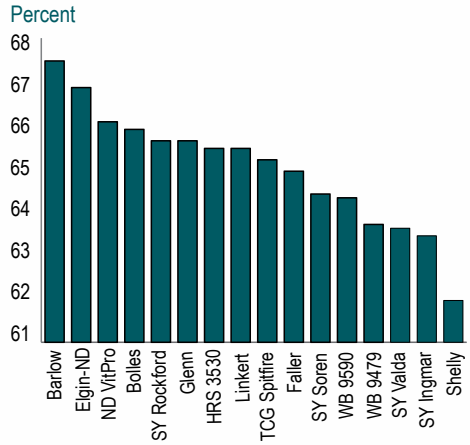
PROTEIN - 12% MOISTURE BASIS



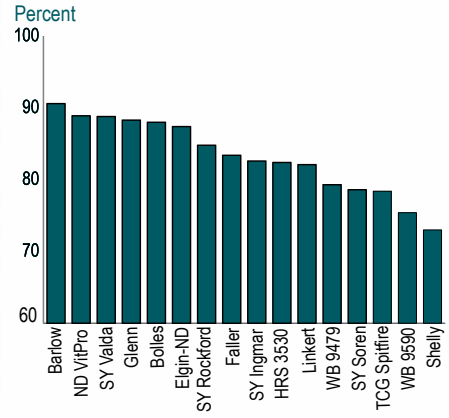
FARINOGRAPH STABILITY



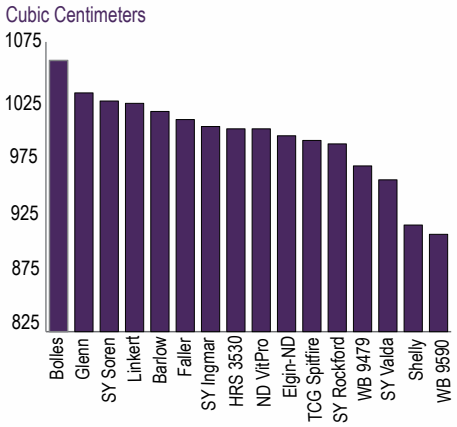
FARINOGRAPH ABSORPTION



VITREOUSNESS



LOAF VOLUME



THE ACCOMPANYING tables illustrate the quality evaluation of some of the most popular varieties (cultivars), for key kernel and end-use parameters during the 2017-2018 growing seasons. A commitment to extensive end-use quality testing of new cultivars during the development stages is a major priority for producers in the region. The goal is to develop and release cultivars that excel in numerous kernel, milling and end-product parameters, across a broad environment.

NORTH DAKOTA

SY INGMAR remains the dominant variety planted in the state in 2019 with one-fifth of the acres, similar to 2018. It has been the top variety for three straight years, being most popular across the western and central regions. In Montana, it accounts for roughly 10 percent of the acres, ranking it fourth. SY Ingmar is a 2014 release from Syngenta/AgriPro with broad appeal because of high yield potential, very good straw strength, a high level of disease resistance and moderate to high protein levels. It has very good milling and baking quality.

BOLLES is the third most popular variety in North Dakota with a 5 percent acreage share, up from fifth in 2018. In Minnesota it ranks seventh with a 4 percent acreage share, but in both states its share of planted acres fell from 2018. Released in 2015 from the University of Minnesota, Bolles is popular for its ability to produce high kernel protein content, along with competitive yields and agronomic traits. It is rated as excellent for milling and baking qualities with strong dough properties.

SY SOREN slipped to fourth place in 2019 with nearly 5 percent of ND acres, down from 7.7 percent last year. Conversely, in Montana it advanced to second place in 2019, doubling its acreage share to 11.5 percent. A 2011 release from Syngenta/AgriPro, SY Soren provides a balance of yield potential, moderately high protein levels, disease resistance and straw strength. It is rated as good for milling and baking quality.

ELGIN-ND is the fifth most popular variety with a 4 percent acreage share, down just slightly from 2018. It is most popular with producers in the southwest part of ND. Elgin-ND is a 2012 release from North Dakota State University which has high yield potential and moderate protein levels, but a lower level of disease resistance compared to other varieties. It is rated as good for milling and baking qualities.

NORTH DAKOTA VARIETY SHARE OF PLANTED ACRES[3]

VARIETY	2019%[1]	2018%[1]
SY Ingmar	20.6	20.3
SY Valda	12.5	8.7
Bolles	5.0	6.1
SY Soren	4.7	7.7
Elgin-ND	4.2	4.6
Faller	3.7	6.0
Barlow	3.7	6.4
Glenn	2.9	3.9
SY Rockford	2.7	0.5
WB 9479	2.7	0.6
Other[2]	37.3	35.2

1. Percentage 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)
   2019 – 6,700,000 planted acres
   2018 – 6,550,000 planted acres

TOP 3 NORTH DAKOTA VARIETIES BY CROP DISTRICT

	First	Second	Third
	PERCENTAGE (%)		
Northwest	SY Ingmar 28.5	SY Valda 9.7	SY Rockford 7.7
North Central	SY Ingmar 26.4	SY Valda 19.0	HRS 3530 6.9
Northeast	SY Valda 20.7	Faller 14.2	Linkert 8.1
West Central	SY Ingmar 23.5	SY Soren 9.7	Glenn 7.0
Central	SY Ingmar 26.1	SY Valda 11.5	Bolles 6.9
East Central	SY Valda 17.2	SY Ingmar 12.9	WB 9479 7.8
Southwest	SY Ingmar 20.7	Elgin-ND 10.1	SY Soren 9.4
South Central	SY Ingmar 28.7	Elgin-ND 11.1	Bolles 12.8
Southeast	SY Valda 15.6	SY Ingmar 13.5	Bolles 12.8



U.S. HARD RED SPRING WHEAT

MINNESOTA

MINNESOTA VARIETY SHARE OF SURVEYED ACRES[3]

VARIETY	2019%[1]	2018%[1]
Linkert	22.3	27.3
SY Valda	15.5	8.9
WB 9590	13.8	2.5
WB 9479	9.2	3.5
Shelly	7.1	8.2
WB Mayville	5.4	9.6
Bolles	4.4	10.5
TCG Spitfire	3.9	3.1
SY Ingmar	2.8	3.7
Lang-MN	2.0	4.4
Other	13.8	18.4

1. Percentage 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)
   2019 – 1,450,000 planted acres
   2018 – 1,610,000 planted acres

TOP 3 MINNESOTA VARIETIES BY CROP DISTRICT

	FIRST	SECOND	THIRD
	PERCENTAGE (%)		
North	Linkert 23.9	WB 9590 15.9	SY Valda 13.8
Central	SY Valda 22.1	Linkert 16.5	Bolles 10.4
South	Bolles 25.5	Linkert 18.3	Lang-MN 11.9

LINKERT remains the leading variety in Minnesota in 2019 with 22 percent of the acres, down from 27 percent in 2018. It is a 2013 release from the University of Minnesota, and is sought after by producers for its very strong straw, high protein levels and disease resistance traits. It has excellent milling and baking qualities, with especially strong dough properties.

SY VALDA held onto second place in North Dakota in 2019, and moved into second place in Minnesota, up from fourth, with 12.5 and 15.5 percent acreage shares, respectively. It is the leading variety in eastern regions of ND, and had acreage gains in both states compared to 2018. SY Valda is a 2015 release from Syngenta/AgriPro which touts elite yield potential and strong disease tolerance, especially for Fusarium headblight. It is rated as average for milling and baking quality.

WB 9590 AND WB9479 made notable gains in acreage share in Minnesota in 2019, moving into third and fourth place, with a 13.8 and 9.2 percent share, respectively. Both varieties are 2017 releases from Westbred, and provide producers with strong straw characteristics, very high resistance to leaf rust disease, high yield potential and moderately high protein content. WB 9479 has especially strong dough properties, and both are rated as good for milling and baking qualities.

SOUTH DAKOTA

SOUTH DAKOTA VARIETY SHARE OF SURVEYED ACRES

VARIETY	STATE %	YEAR RELEASED
Surpass	17.0	2016
Prevail	15.0	2013
Advance	5.0	2011
Focus	5.0	2015
Select	5.0	2009

* All varieties were developed by South Dakota State University.

MONTANA

VIDA remains the dominant variety in Montana, accounting for nearly one-fourth of acres in 2019. It has been the leading variety since 2011. Vida is a 2005 release from the Montana Agricultural Experiment Station, and it is popular with producers for its high yield and moderate resistance to leaf and stripe rust. It is most popular across northern and central areas. Vida is rated as good for milling and baking quality.

PNW VARIETAL INFORMATION

MAJOR VARIETIES GROWN IN WASHINGTON, OREGON AND IDAHO • QUALITY & END-USE FACTORS

VARIETY	AGENT OR ORIGIN[1]	YEAR RELEASED	QUALITY FACTORS[2] TEST WEIGHT LB/BU	TEST WEIGHT KG/HL	WHEAT PROTEIN %	FARINOGRAM STABILITY (MIN)	ABSORPTION %	LOAF VOLUME CC	MILL & BAKE QUALITY RATING[3]
Alum	WSU	2014	62.8	82.6	14.2	24.1	66.8	1103	MD
Buck Pronto	Buck Semilas S.A.	2001	61.5	80.9	15.3	21.7	67.9	937	A
Chet	WSU	2014	63.4	83.3	15.1	18.4	68.3	1116	MD
Expresso	Westbred	2000	62.6	82.2	14.7	5.1	68.5	1032	*Not Rated
Glee	WSU	2012	62.6	82.3	13.8	16.0	65.8	1080	MD
Jefferson	ID	1997	62.3	82.0	13.7	20.9	66.1	978	D
Kelse	WSU	2008	61.9	81.4	14.6	19.0	68.0	1098	D
SY Selway	Syngenta	2015	60.8	80.0	14.4	19.1	67.2	1033	MD
SY605CL	Syngenta	2010	62.9	82.7	15.4	12.0	68.4	1034	MD
WB 9662	Westbred	2014	62.5	82.2	14.7	5.5	68.1	1012	*Not Rated
WB 9668	Westbred	2014	62.6	82.3	15.6	10.8	69.9	1144	D

1. ID – University of Idaho (Public), WSU – Washington State University (Public), Buck Semillas S.A. (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).

* Insufficient data exists to produce rating scores

REEDER slipped to third in 2019 with a 10 percent share of acres, down from nearly 18 percent in 2018. It is most popular in the northeast district. Reeder remains popular for its high protein content and stay-green trait which allows for longer head fill. A 1999 release from NDSU, it is rated as average for milling and baking quality.

TOP 3 MONTANA VARIETIES BY CROP DISTRICT

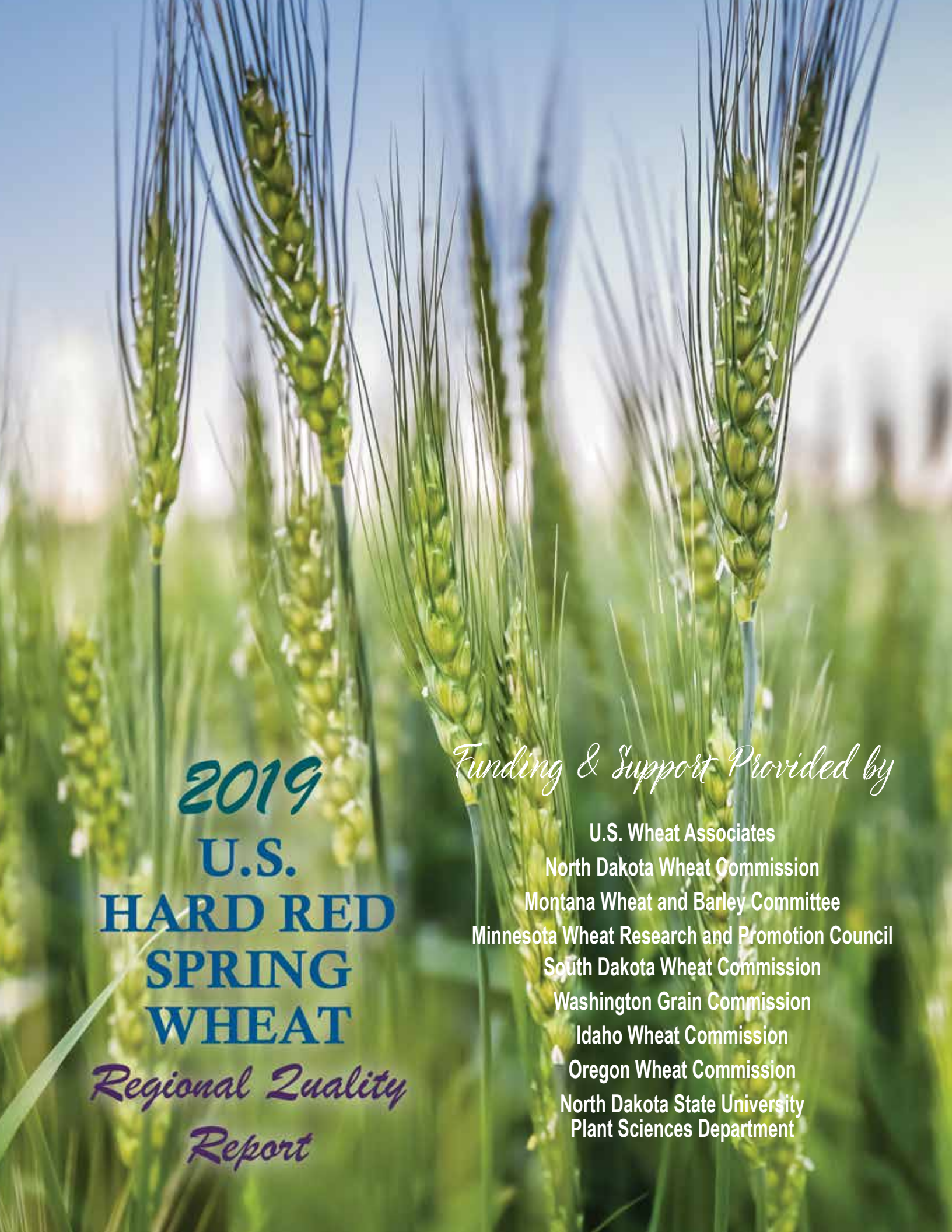
	FIRST	SECOND
	PERCENTAGE (%)	
North Central	Vida 36.6	Corbin 13.9
North East	SY Soren 22.3	Reeder 19.4
Central	SY Ingmar 19.9	WB 9879 15.9

MONTANA VARIETY SHARE OF SURVEYED ACRES[3]

VARIETY	2019%[1]	2018%[1]
Vida	23.8	24.6
SY Soren	11.5	5.0
Reeder	10.4	17.6
SY Ingmar	9.6	7.6
Corbin	6.8	6.6
WB Gunnison	5.5	3.8
Duclair	5.1	7.7
Brennan	3.9	8.2
Mott	2.5	1.7
WB 9879	2.0	0.0
Other	19.0	17.4

1. Percentage 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)
   2019 – 2,900,000 planted acres
   2018 – 2,900,000 planted acres





2019 U.S. HARD RED SPRING WHEAT

Regional Quality Report

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U.S. Wheat Associates
North Dakota Wheat Commission
Montana Wheat and Barley Committee
Minnesota Wheat Research and Promotion Council
South Dakota Wheat Commission
Washington Grain Commission
Idaho Wheat Commission
Oregon Wheat Commission
North Dakota State University
Plant Sciences Department