2020 U.S. HARD RED SPRING WHEAT

Regional Quality Report

U.S. HARD RED SPRING Wheat

MINNESOTA | MONTANA
NORTH DAKOTA | SOUTH DAKOTA
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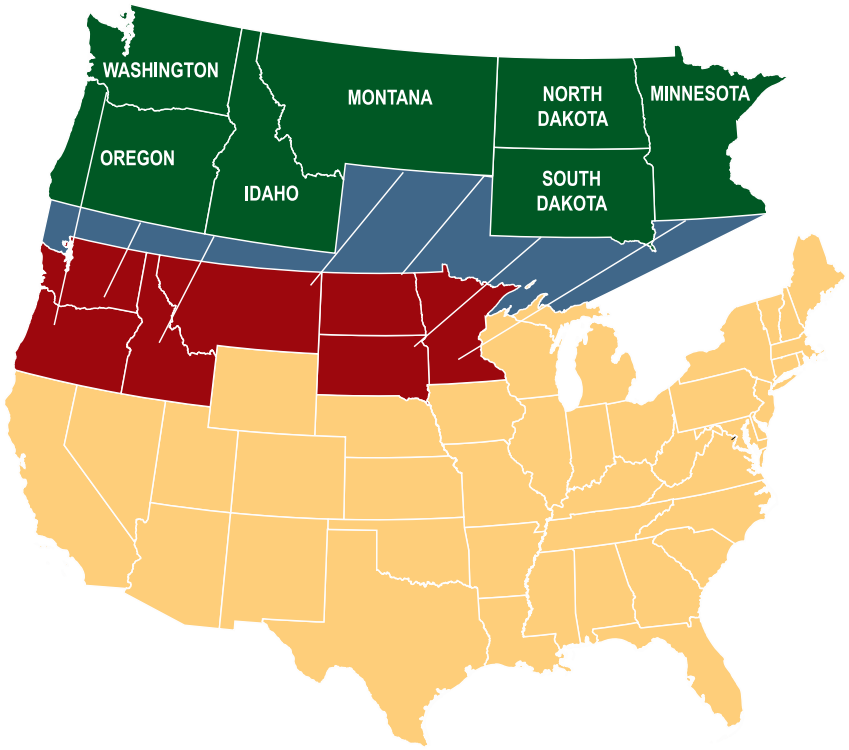
THE ARISTOCRAT OF WHEAT

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 2020 U.S. hard red spring wheat (HRS) crop boasts excellent kernel and grade qualities, with significantly improved kernel soundness compared to 2019. Timely mid-season rains, a dry latter part of the growing season, and a dry, rapid harvest period limited disease pressures and benefited kernel quality parameters. Production is estimated at 530 million bushels (14.4 MMT), slightly larger than a year ago and up 4 percent from 5-yr averages. Planted area fell in 2020, but total harvested area was actually higher, compared to 2019. Production was further enhanced due to a record national yield.

PRODUCTION DATA

	2020	2019	2015-20 AVERAGE
MILLION BUSHELS			
Minnesota	72	80	82
Montana	125	101	80
North Dakota	276	292	281
South Dakota	36	25	39
ID/OR/WA	20	19	24
U.S. Total	**530**	**520**	**510**
MILLION METRIC TON			
Minnesota	1.96	2.18	2.23
Montana	3.40	2.75	2.17
North Dakota	7.51	7.95	7.65
South Dakota	0.98	0.68	1.06
ID/OR/WA	0.54	0.52	0.65
U.S. Total	**14.4**	**14.2**	**13.9**

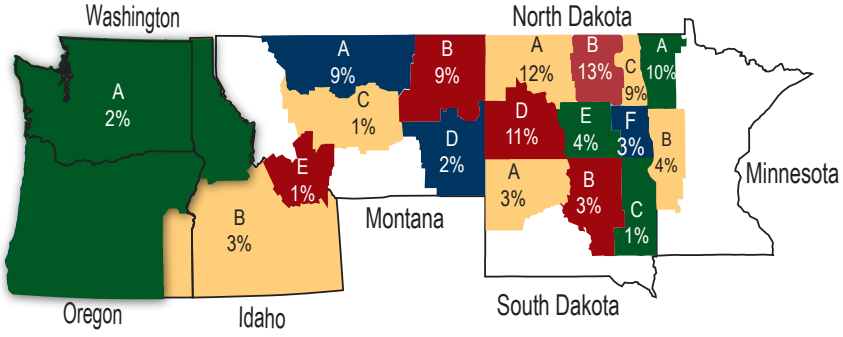
Source: USDA 2020 Small Grains Summary

The **CROP AVERAGES** a No. 1 Northern Spring, similar to 5-year averages. Grade distributions on survey samples, place 94 percent in the No. 1 grade with another 4 percent at No. 2 grade. The crop average test weight is 61.8 lbs/bu (81.3 kg/hl), up from last year and 5-yr averages. Eighty-six percent of the crop is above 60 lbs/bu (78.9 kg/hl), sharply higher than just 61% a year ago. Average damaged kernel levels are 0.1 percent, considerably lower than 0.7 last year. Overall vitreous kernel levels, averaging 72%, are notably higher than the 55% level from a year ago, but slightly below 5-year averages. Slightly more than 40 percent of the samples exceed the 75% minimum level for Dark Northern Spring. Western parts of the region are showing significantly higher vitreous kernel levels compared to eastern areas.

Crop average **PROTEIN** is 14.3% (12% moisture basis), slightly lower than both 2019 and 5-year averages. The highest protein levels are in southern parts of the region where protein is similar to a year ago. The more appreciable year-to-year decline is noted across some northern and western parts of the region where year-to-year yields were also higher. Distribution of protein on survey samples shows 65% above 14% protein, down from 73% a year ago, and a greater share of the crop falling below 13% protein in 2020. Kernel moisture is very low on much of the 2020 crop, due to the dry harvest conditions, averaging just 11.8 percent, well below 2019 and 5-year averages.

THOUSAND KERNEL WEIGHTS (TKW) are very high again in 2020, due to good kernel fill conditions, averaging 32 grams. Disease pressures from Fusarium headlight were relatively light, with the crop average DON at 0.2 ppm, down from 0.6 ppm in 2019, and similar to 5-year averages. One of the most significant improvements in the 2020 crop, compared to 2019, is kernel soundness with an average falling number of 389 seconds, with nearly 90% of the samples exceeding 350 seconds, and just two percent falling below 300.

APPROXIMATE SHARE OF REGIONAL PRODUCTION



MILLING analysis, based on a Buhler Lab Mill, averages 67.7 percent extraction, slightly lower than 2019 and 5-year averages. Commercial mills will likely see higher extractions, due to the high-test weights, TKW's, and low kernel damage levels, as the lab mill is not adjusted, or optimized for crop changes. Average flour ash is 0.52 percent, and starch damage averages 7.2 percent, both similar to 5-year averages. Wet gluten values for the crop average 33.1 percent, lower than both last year and 5-year averages, reflective of lower kernel protein levels. The flour is showing a significant improvement in viscosity with an average Amylograph value of 632 BU, compared to just 441 in 2019.

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PHYSICAL DOUGH tests indicate lower Farinograph absorption, compared to both 2019 and 5-year averages, at 61.6 percent. The average Farinograph stability time is 11.8 minutes, well above 2019, and higher than 5-year averages. Dough stability is improved over a broad part of the region in 2020. Extensigraph analysis of the crop indicate a slightly stronger, but less extensible crop compared to a year ago, whereas the Alveograph indicates similar strength. On the 135-minute pull on the Extensograph, the overall extensibility and resistance to extension is 13.9 cm and 750 B.U., compared to 16.2 and 682 in 2019. The average P/L ratio on the Alveograph is 0.61 with a w-value of 359.

BAKING evaluations produced an average loaf volume of 977 cubic centimeters, down from 2019, but similar to 5-year averages. Dough handling properties are improved, rated at 8.9 compared to 8.4 in 2019. Overall bread scores were rated higher for crumb grain and color, and crust color, with slightly lower symmetry scores compared to a year ago.

BUYERS will appreciate the significant improvement in overall grade profile and kernel soundness in the 2020 crop. Many factors routinely valued in contract specifications are broadly available across the crop, and the crop exhibits improved dough strength across the region with very high bread scores. The above-average supplies of U.S. HRS wheat, combined with the high-quality parameters in the 2020 crop will bring good value to buyers who are diligent in matching contract specifications with end-use quality needs.

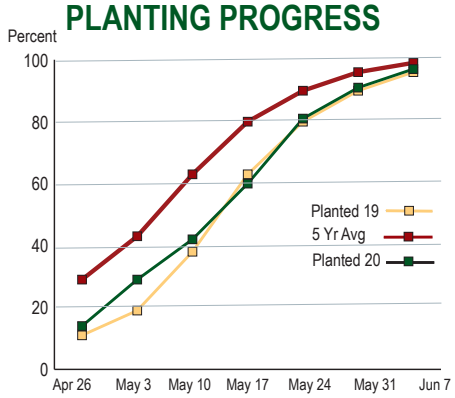
SEASONAL CONDITIONS - 2020

PLANTING of the 2020 U.S. spring wheat crop got off to a later than average start due to fall 2019 wet conditions that continued into spring. Cool conditions resulted in slow soil warming, adding to the delay, especially across eastern parts of the region where conditions were the wettest. Western growing regions had drier conditions and planting was completed in a timelier manner. Overall planting progress accelerated in later May when temperatures warmed up, and the bulk of the crop was planted by the first week of June, just slightly behind average.

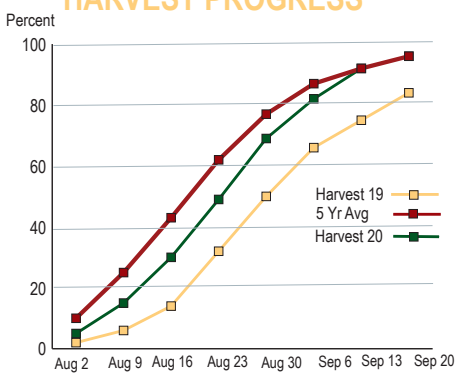
The **GROWING SEASON** offered variable conditions across the region. Emergence was slower than average due to cooler temperatures in parts of the region. In central growing areas, conditions remained very dry, with above-normal temperatures which stressed the earlier planted crop, and adversely affected crop condition ratings through June. In eastern and western parts of the region, early season moisture was mostly adequate. The second half of the growing season brought improved conditions, with timely rains and moderate temperatures region-wide, resulting in good kernel fill. Disease pressures were minimal across the region.

HARVEST began in late July and continued at a steady and rapid pace. Most of the crop was harvested by mid-September, a marked change from the historic delays experienced in 2019. The vast majority of the crop was harvested under good weather conditions, resulting in little to no adverse impact on quality.

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.

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.

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	TEST WEIGHT KG/HL	DAMAGE %	SHRUNKEN/ BROKEN KERNELS %	TOTAL DEFECTS %	U.S GRADE SUBCLASS	VITREOUS KERNELS %
MINNESOTA							
Area A	61.1	80.3	0.6	0.5	1.1	1 NS	44
Area B	60.3	79.3	0.1	0.5	0.6	1 NS	40
State Avg 2020	60.9	80.1	0.5	0.5	1.0	1 NS	43
State Avg 2019	60.5	79.6	1.2	0.5	1.7	1 NS	46
MONTANA							
Area A	61.8	81.2	0.0	1.3	1.3	1 DNS	93
Area B	63.3	83.2	0.1	0.8	0.9	1 DNS	88
Area C	60.8	80.0	0.2	2.1	2.3	1 DNS	87
Area D	61.0	80.3	0.1	1.2	1.3	1 NS	73
Area E	61.7	81.2	0.0	0.8	0.8	1 DNS	95
State Avg 2020	62.4	82.1	0.1	1.1	1.2	1 DNS	90
State Avg 2019	60.5	79.6	0.2	1.2	1.4	1 NS	66
NORTH DAKOTA							
Area A	62.6	82.3	0.0	0.7	0.7	1 DNS	78
Area B	61.6	81.0	0.1	0.6	0.7	1 NS	70
Area C	61.4	80.7	0.0	0.4	0.4	1 NS	62
Area D	62.0	81.5	0.1	0.7	0.9	1 DNS	77
Area E	61.7	81.1	0.4	0.5	0.9	1 NS	70
Area F	60.3	79.3	0.1	0.5	0.6	1 NS	59
State Avg 2020	61.8	81.3	0.1	0.6	0.7	1 NS	71
State Avg 2019	60.7	79.9	0.8	0.7	1.5	1 NS	52
SOUTH DAKOTA							
Area A	60.6	79.7	0.1	0.6	0.7	1 NS	68
Area B	61.2	80.4	0.0	0.8	0.8	1 NS	63
Area C	60.6	79.8	0.1	1.0	1.1	1 NS	61
State Avg 2020	60.9	80.1	0.0	0.8	0.8	1 NS	64
State Avg 2019	59.5	78.2	0.8	0.8	1.6	1 NS	42
IDAHO - OREGON - WASHINGTON							
Area A	63.0	82.9	0.0	0.5	0.5	1 DNS	93
Area B	63.6	83.6	0.0	0.3	0.3	1 DNS	96
State Avg 2020	63.4	83.3	0.0	0.4	0.4	1 DNS	95
State Avg 2019	62.9	82.6	0.2	0.5	0.7	1 DNS	82
REGION AVERAGE							
Avg 2020	61.8	81.3	0.1	0.7	0.8	1 NS	72
Avg 2019	60.7	79.8	0.7	0.7	1.4	1 NS	55
Five-Year Avg	61.6	81.0	0.3	0.8	1.1	1 NS	74

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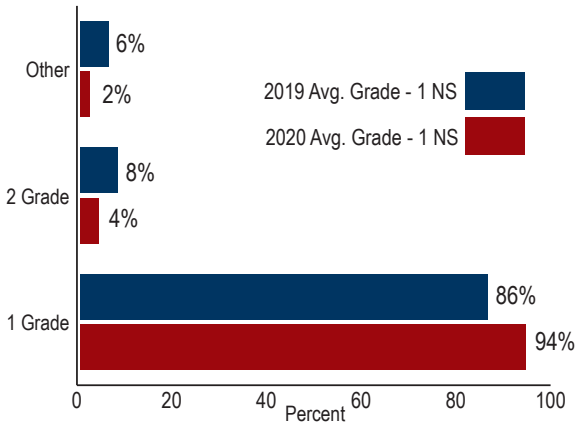
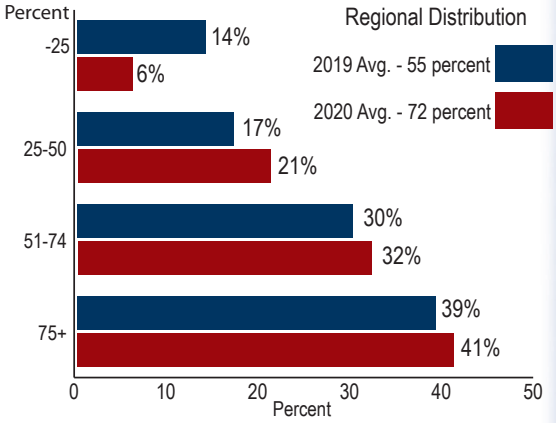
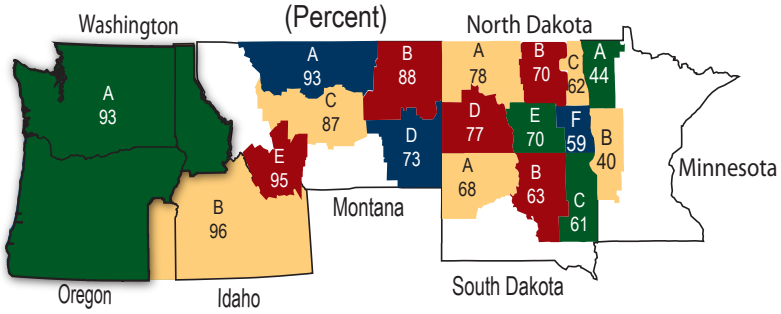
GRADE – Regional Distribution



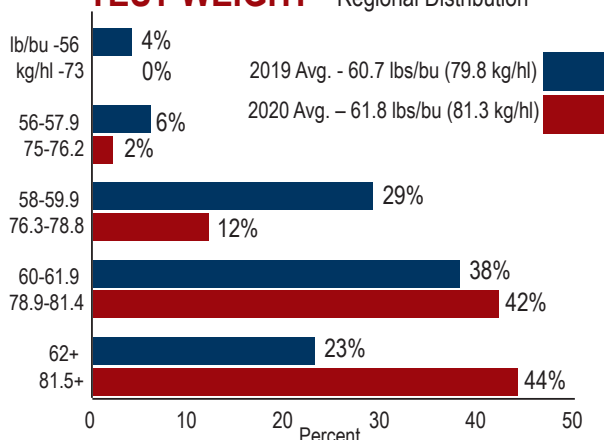
VITREOUS KERNEL



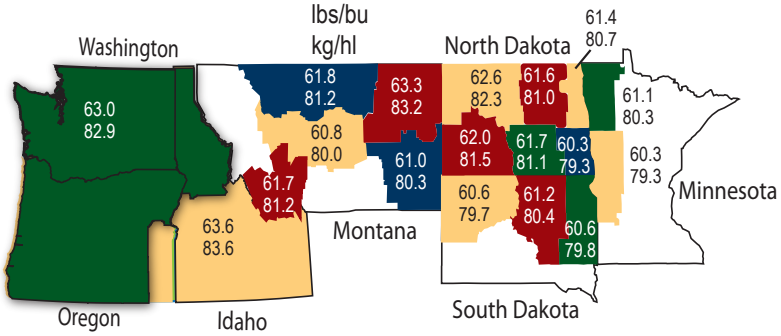
AVERAGE VITREOUS KERNEL BY AREA



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	13.0	33.1	44/54	13.5/15.3	0.2	1.54	398	64
Area B	0.6	13.1	31.2	48/50	13.9/16.1	0.1	1.63	386	65
State Avg 2020	0.5	13.0	32.7	45/53	13.6/15.4	0.2	1.56	396	64
State Avg 2019	0.5	13.2	34.0	39/60	14.2/16.1	0.7	1.57	271	68
MONTANA									
Area A	0.5	10.3	31.7	58/40	13.0/14.8	0.1	1.46	381	63
Area B	0.7	10.6	31.7	53/45	13.7/15.6	0.0	1.58	408	67
Area C	0.8	10.0	27.8	69/25	12.6/14.3	0.0	1.53	364	63
Area D	1.2	10.0	31.0	59/38	14.3/16.2	0.0	1.46	406	61
Area E	0.8	11.2	33.4	48/49	14.3/16.3	0.0	1.48	365	65
State Avg 2020	0.7	10.5	31.6	56/42	13.4/15.2	0.0	1.52	394	65
State Avg 2019	0.6	11.9	29.9	57/39	14.1/16.0	0.0	1.49	372	67
NORTH DAKOTA									
Area A	0.8	12.4	33.6	43/55	14.7/16.7	0.3	1.57	386	67
Area B	0.6	12.4	32.5	43/55	14.3/16.2	0.5	1.58	400	66
Area C	0.5	12.4	31.3	45/54	14.6/16.6	0.3	1.61	380	66
Area D	0.6	11.5	31.8	48/50	15.5/17.6	0.0	1.52	392	67
Area E	0.7	12.4	30.9	50/48	15.5/17.6	0.1	1.62	382	65
Area F	0.4	12.9	29.2	51/47	15.0/17.0	0.2	1.71	335	64
State Avg 2020	0.6	12.3	32.1	45/53	14.8/16.8	0.3	1.59	387	66
State Avg 2019	0.6	13.2	32.0	45/53	14.6/16.6	0.7	1.54	337	68
SOUTH DAKOTA									
Area A	0.5	11.9	29.6	58/39	15.1/17.2	0.0	1.63	415	68
Area B	0.6	12.3	28.9	63/35	15.0/17.0	0.2	1.65	373	63
Area C	0.5	12.8	29.2	64/33	14.8/16.8	0.1	1.67	369	54
State Avg 2020	0.6	12.3	29.1	62/36	15.0/17.0	0.1	1.65	383	62
State Avg 2019	0.8	13.0	29.8	52/46	15.1/17.1	1.2	1.72	333	61
IDAHO - OREGON - WASHINGTON									
Area A	0.3	9.2	36.6	35/64	14.0/15.9	0.2	1.50	378	67
Area B	0.3	9.9	33.8	39/60	14.1/16.0	0.0	1.56	378	67
State Avg 2020	0.3	9.6	34.9	37/62	14.0/16.0	0.1	1.54	378	67
State Avg 2019	0.2	10.5	35.1	42/56	14.3/16.2	0.1	1.49	406	66
REGION AVERAGE									
State Avg 2020	0.6	11.8	32.0	48/50	14.3/16.2	0.2	1.57	389	66
State Avg 2019	0.6	12.8	31.9	47/51	14.5/16.4	0.6	1.54	337	67
Five-Year Avg	0.6	12.2	31.5	50/47	14.4/16.4	0.2	1.53	381	64

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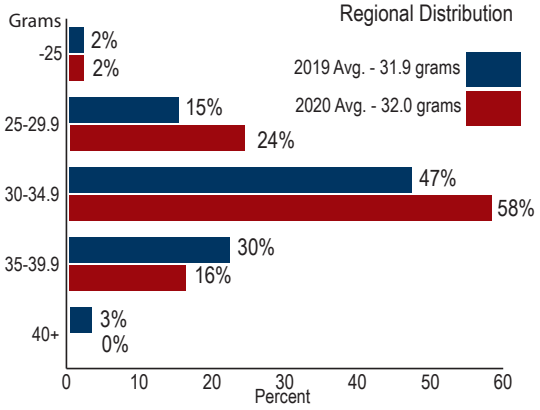
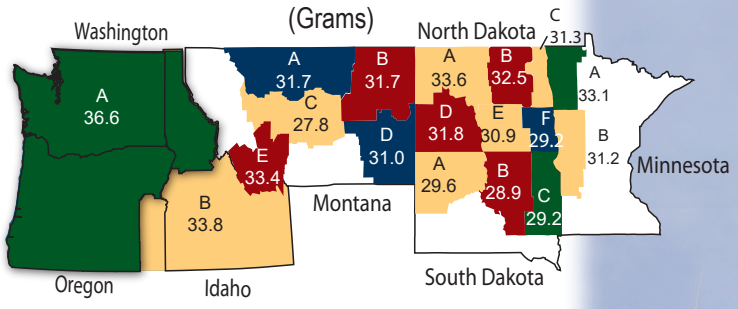
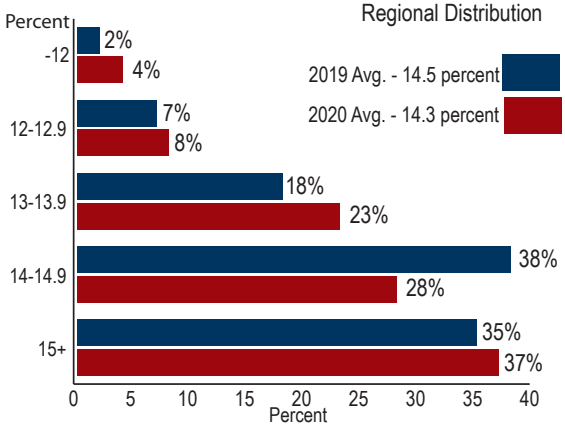
1000 KERNEL WEIGHT



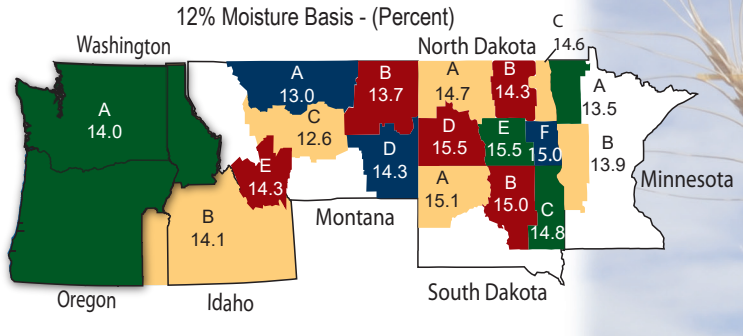
AVERAGE 1000 KERNEL BY AREA



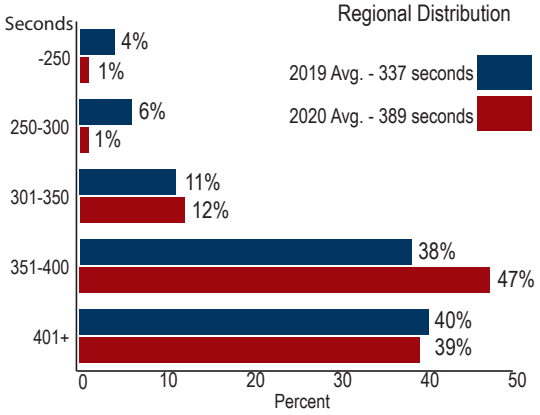
PROTEIN - 12% MOISTURE



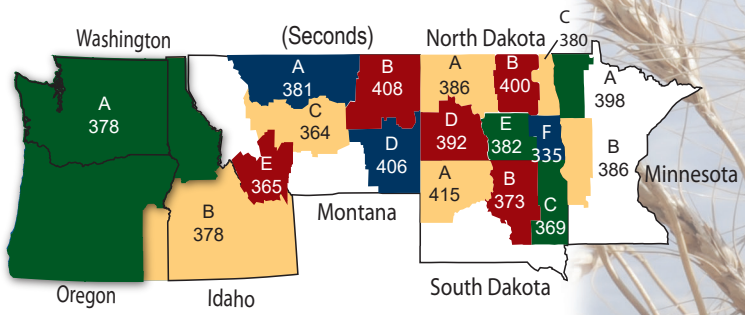
AVERAGE WHEAT PROTEIN BY AREA



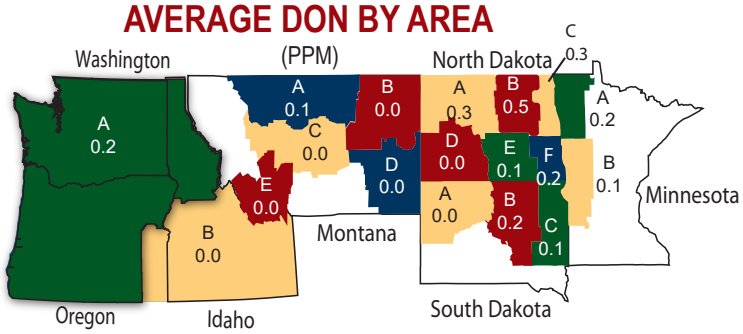
FALLING NUMBER



AVERAGE FALLING NUMBER BY AREA



AVERAGE DON BY AREA



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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	67.1	0.52	12.4	7.1	0.66	71/119	146/101	29.4	98	429	557
Area B	67.6	0.52	12.9	7.0	0.66	69/114	139/98	30.7	96	405	660
State Avg 2020	67.2	0.52	12.5	7.0	0.66	71/118	145/101	29.7	97	424	578
State Avg 2019	69.0	0.53	13.2	7.2	0.65	74/120	148/108	33.3	97	301	270
MONTANA											
Area A	68.0	0.51	12.2	7.7	0.63	74/124	149/112	28.6	98	417	705
Area B	67.3	0.51	12.9	7.1	0.64	73/122	148/109	30.8	92	410	700
Area C	65.9	0.50	12.0	7.4	0.59	74/123	141/114	28.9	92	434	751
Area D	67.4	0.51	13.2	7.7	0.63	75/122	144/108	30.6	76	425	794
Area E	66.4	0.51	13.4	7.8	0.61	78/132	154/119	35.0	84	398	720
State Avg 2020	67.5	0.51	12.6	7.5	0.63	73/123	148/111	29.9	94	414	708
State Avg 2019	68.2	0.52	13.2	7.4	0.63	74/123	147/109	34.0	89	393	572
NORTH DAKOTA											
Area A	68.6	0.51	13.8	7.0	0.69	71/118	151/101	34.5	86	399	651
Area B	68.2	0.52	13.4	7.2	0.69	71/117	148/100	34.2	92	403	587
Area C	66.8	0.51	13.4	7.0	0.69	70/115	147/98	34.7	83	395	643
Area D	67.7	0.52	14.5	7.0	0.67	73/121	151/103	37.8	84	410	667
Area E	68.1	0.53	14.3	7.1	0.66	72/118	145/101	37.1	87	391	619
Area F	66.9	0.54	13.8	6.8	0.67	70/116	145/101	32.5	97	340	307
State Avg 2020	67.9	0.52	13.8	7.1	0.68	71/118	149/101	35.1	88	397	612
State Avg 2019	69.0	0.53	13.7	7.4	0.66	73/122	150/106	34.1	91	345	432
SOUTH DAKOTA											
Area A	66.4	0.54	13.8	6.9	0.68	70/114	143/94	36.9	79	423	666
Area B	67.6	0.53	13.6	7.0	0.68	68/112	139/93	35.2	87	400	622
Area C	68.8	0.54	13.4	6.9	0.64	66/109	128/92	33.7	85	402	580
State Avg 2020	67.6	0.53	13.6	6.9	0.67	68/112	138/93	35.3	84	406	624
State Avg 2019	67.4	0.55	13.6	6.9	0.66	70/115	138/96	35.5	85	350	359
IDAHO - OREGON - WASHINGTON											
Area A	67.6	0.52	13.4	7.7	0.59	77/131	146/116	35.5	84	436	568
Area B	65.6	0.51	13.2	7.7	0.59	77/131	145/116	32.9	93	422	708
State Avg 2020	66.4	0.51	13.3	7.7	0.59	77/131	145/116	33.9	89	428	652
State Avg 2019	67.4	0.52	13.5	7.6	0.61	79/133	153/118	35.5	87	448	676
REGION AVERAGE											
Avg. 2020	67.7	0.52	13.3	7.2	0.66	72/119	147/103	33.1	90	407	632
Avg. 2019	68.7	0.53	13.5	7.4	0.65	74/122	149/107	34.1	91	352	441
Five-Year Avg.	68.4	0.53	13.4	7.2	0.65	72/120	144/101	35.1	90	396	599

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.

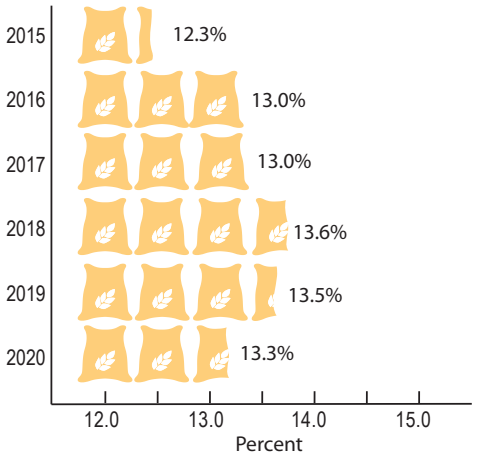
Another measure of milling efficiency and of flour grade is the ash content, or mineral residue, remaining after incineration of a sample.

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

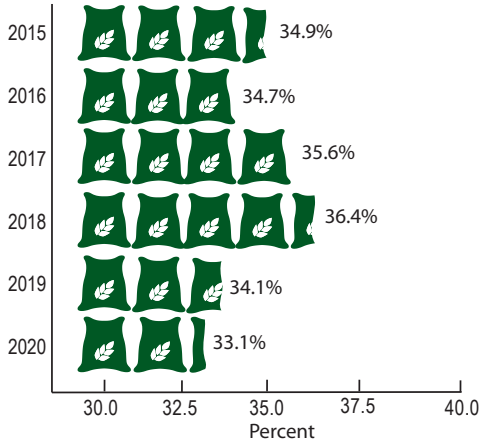
WET GLUTEN provides a quantitative measure of the gluten forming proteins in flour that are primarily responsible for its dough mixing and baking properties.

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

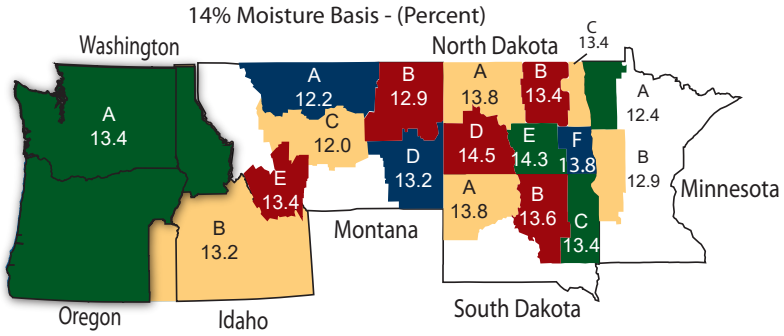


WET GLUTEN – Regional Average



AVERAGE FLOUR PROTEIN BY AREA

14% Moisture Basis - (Percent)



U.S. HARD RED SPRING WHEAT

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

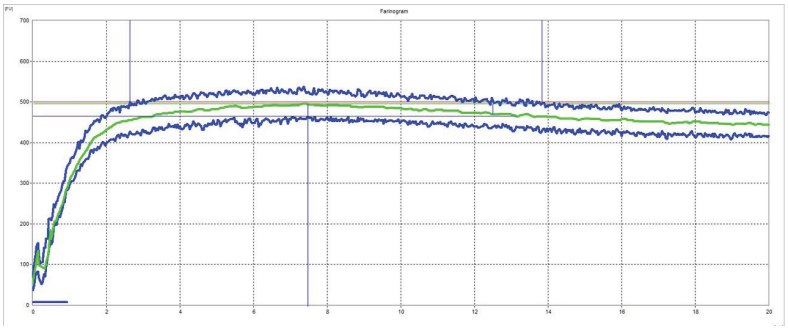
PHYSICAL DOUGH QUALITY

FARINOGRAPH					
STATE AND CROP REPORTING AREA	ABSORPTION %	PEAK TIME MIN	STABILITY MIN	MTI B.U.	QUALITY NUMBER MM
MINNESOTA					
Area A	59.0	7.3	16.9	24	148
Area B	59.0	7.7	14.3	23	145
State Avg 2020	59.0	7.4	16.4	24	147
State Avg 2019	61.3	6.5	11.0	22	133
MONTANA					
Area A	61.1	7.5	11.2	26	131
Area B	62.7	8.2	10.1	27	135
Area C	61.1	7.0	9.8	27	132
Area D	63.3	6.4	8.3	27	124
Area E	65.1	6.0	9.7	18	136
State Avg 2020	62.0	7.7	10.5	26	133
State Avg 2019	62.4	6.9	9.4	27	125
NORTH DAKOTA					
Area A	62.6	8.5	11.3	22	151
Area B	61.7	8.5	11.3	26	152
Area C	59.2	7.4	13.5	22	141
Area D	64.1	8.2	10.2	24	150
Area E	62.5	9.5	12.3	21	165
Area F	60.3	7.5	12.4	22	145
State Avg 2020	62.0	8.3	11.6	23	150
State Avg 2019	63.0	7.5	10.2	23	135
SOUTH DAKOTA					
Area A	62.6	7.0	9.3	24	127
Area B	61.1	7.5	10.6	22	140
Area C	59.8	7.7	9.1	32	124
State Avg 2020	61.2	7.4	10.0	25	133
State Avg 2019	61.5	7.2	8.3	37	112
IDAHO - OREGON - WASHINGTON					
Area A	64.9	7.2	10.2	21	139
Area B	64.7	7.0	10.8	19	158
State Avg 2020	64.8	7.1	10.6	20	150
State Avg 2019	65.2	8.0	10.5	21	149
REGION AVERAGE					
Avg. 2020	61.6	7.9	11.8	24	145
Avg. 2019	62.6	7.3	10.0	25	132
Five-Year Avg.	62.8	7.6	11.4	23	145

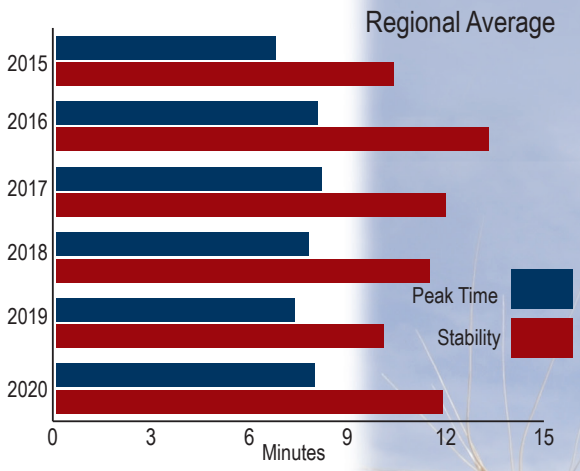
Physical characteristics of dough are evaluated to reveal useful information about variations in flour types, processing requirements and expected end-product quality.

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.

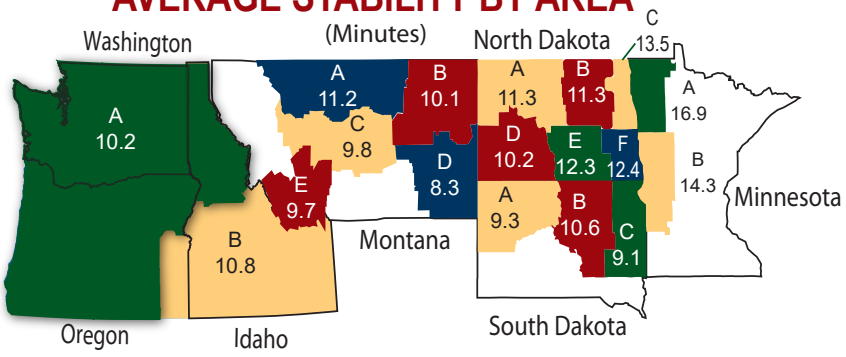
2020 AVERAGE FARINOGRAPH



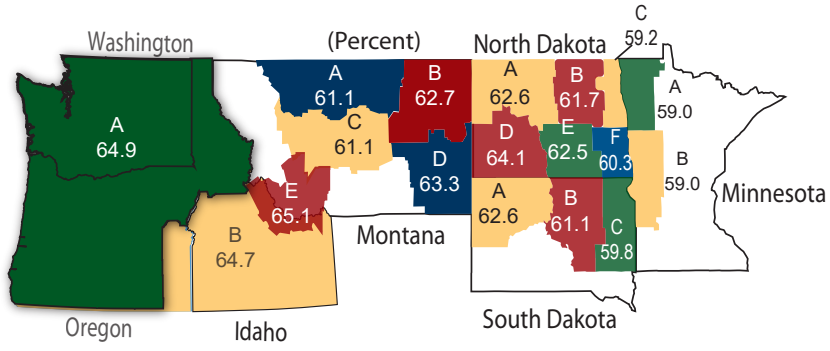
FARINOGRAPH RESULTS



AVERAGE STABILITY BY AREA



AVERAGE FARINOGRAPH ABSORPTION BY AREA



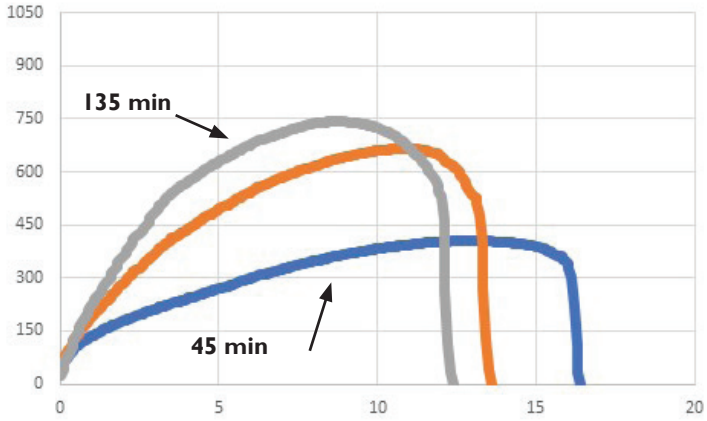
U.S. HARD RED SPRING WHEAT

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

PHYSICAL DOUGH QUALITY

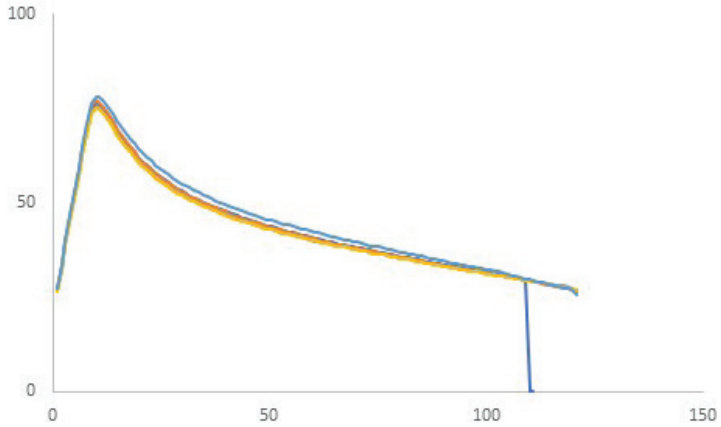
	EXTENSOGRAPH						ALVEOGRAPH			
STATE AND CROP REPORTING AREA	EXTENSIBILITY 45 MIN CM	RESISTANCE 45 MIN B.U.	AREA SQ CM	EXTENSIBILITY 135 MIN CM	RESISTANCE 135 MIN B.U.	AREA SQ CM	P MM	L MM	W P/L RATIO	JOULES X 10^4
MINNESOTA										
Area A	17.0	553	122	14.0	778	141	83	137	0.61	404
Area B	15.8	582	115	13.9	710	128	74	138	0.54	356
State Avg 2020	16.8	559	121	14.0	764	138	81	137	0.59	394
State Avg 2019	18.9	571	138	17.6	733	170	83	135	0.62	389
MONTANA										
Area A	14.2	544	100	11.9	760	115	88	112	0.79	342
Area B	16.3	501	110	14.3	771	149	91	115	0.79	354
Area C	15.7	420	85	12.7	677	113	88	105	0.84	311
Area D	16.4	406	90	12.4	743	123	86	121	0.71	328
Area E	16.6	360	82	13.9	673	120	94	123	0.76	353
State Avg 2020	15.4	511	103	13.1	760	131	89	114	0.79	347
State Avg 2019	16.9	470	105	15.1	746	146	86	124	0.69	349
NORTH DAKOTA										
Area A	14.7	473	88	13.9	844	152	75	154	0.49	363
Area B	16.9	489	108	13.4	680	117	73	139	0.53	328
Area C	17.8	512	119	15.5	725	174	84	138	0.61	400
Area D	15.6	511	105	11.7	968	135	84	144	0.58	378
Area E	16.8	493	110	16.2	625	135	77	141	0.55	362
Area F	18.0	558	129	16.8	738	164	73	146	0.50	366
State Avg 2020	16.3	497	106	14.0	779	142	77	144	0.54	362
State Avg 2019	18.1	498	118	16.1	668	141	81	139	0.58	361
SOUTH DAKOTA										
Area A	17.4	505	115	14.4	675	124	80	126	0.63	324
Area B	16.7	405	92	16.8	444	99	76	125	0.61	305
Area C	17.6	430	102	14.3	627	122	68	144	0.47	288
State Avg 2020	17.1	435	100	15.7	540	110	75	129	0.58	306
State Avg 2019	17.7	384	93	17.3	447	104	70	137	0.51	282
IDAHO - OREGON - WASHINGTON										
Area A	19.2	270	69	15.6	397	81	93	130	0.72	358
Area B	15.0	406	80	12.6	795	133	95	123	0.77	364
State Avg 2020	16.7	352	76	13.8	636	112	94	126	0.75	362
State Avg 2019	17.5	473	111	15.8	685	143	103	118	0.87	397
REGION AVERAGE										
Avg. 2020	16.2	498	105	13.9	750	135	81	134	0.61	359
Avg. 2019	17.9	497	117	16.2	682	144	83	135	0.61	360
Five-Year Avg.	16.8	512	112	14.2	829	152	83	129	0.64	355

2020 AVERAGE EXTENSOGRAPH



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.

2020 AVERAGE ALVEOGRAPH

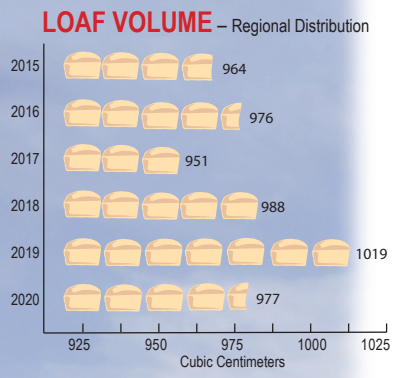


An alveograph traces a curve that measures the air pressure necessary to inflate a piece of dough to the point of rupture. The overpressure (P) value reflects the maximum pressure needed to deform the piece of dough during the inflation process and is an indication of resistance, or dough stability.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

U.S. HARD RED SPRING WHEAT

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

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	64.3	9.0	955	7.8	7.5	9.5	9.0
Area B	64.3	9.0	940	7.5	8.0	9.5	8.5
State Avg 2020	64.3	9.0	952	7.7	7.6	9.5	8.9
State Avg 2019	64.7	8.8	1031	7.2	7.9	9.8	8.8
MONTANA							
Area A	66.6	9.0	860	8.0	8.0	10.0	8.5
Area B	67.3	9.0	920	7.3	7.5	10.0	7.5
Area C	66.9	9.0	900	8.0	7.8	10.0	7.5
Area D	68.5	8.5	945	8.0	8.0	10.0	8.0
Area E	71.5	9.0	998	7.5	7.8	10.0	9.0
State Avg 2020	67.2	9.0	896	7.6	7.8	10.0	8.0
State Avg 2019	67.0	8.9	975	7.8	7.6	10.0	9.0
NORTH DAKOTA							
Area A	68.2	8.5	1018	7.8	7.8	10.0	9.5
Area B	67.1	9.0	1003	8.0	7.5	10.0	8.5
Area C	64.5	9.0	980	7.8	7.5	10.0	8.5
Area D	69.8	9.0	1053	8.0	8.0	10.0	9.0
Area E	68.4	8.5	995	8.0	7.8	10.0	9.0
Area F	65.8	9.0	1040	8.0	7.8	10.0	9.5
State Avg 2020	67.5	8.8	1014	7.9	7.7	10.0	8.9
State Avg 2019	67.9	8.2	1031	7.8	7.5	9.7	9.2
SOUTH DAKOTA							
Area A	66.6	9.0	983	7.5	7.5	9.5	9.5
Area B	65.3	9.0	978	7.5	8.0	10.0	8.0
Area C	64.7	9.0	1023	8.0	8.3	10.0	10.0
State Avg 2020	65.5	9.0	988	7.6	7.9	9.9	8.8
State Avg 2019	65.5	8.0	1009	7.6	7.9	10.0	9.2
IDAHO - OREGON - WASHINGTON							
Area A	70.7	8.0	1003	7.8	8.0	10.0	9.0
Area B	70.5	8.5	1065	7.8	8.0	10.0	10.0
State Avg 2020	70.6	8.3	1040	7.8	8.0	10.0	9.6
State Avg 2019	70.8	9.0	1025	7.8	8.0	10.0	10.0
REGION AVERAGE							
Avg 2020	67.0	8.9	977	7.8	7.7	9.9	8.7
Avg 2019	67.2	8.4	1019	7.7	7.6	9.8	9.1
Five-Year Avg	67.6	9.0	980	7.6	7.7	9.8	9.1

RECENT QUALITY TRENDS

SUMMARY INFORMATION							
CROP YEAR	2020	2019	2018	2017	2016	2015	FIVE-YEAR AVERAGE
WHEAT GRADING							
Test Weight (lbs/bu)	61.8	60.7	62.2	61.7	61.6	61.6	61.6
Test Weight (kg/hl)	81.3	79.8	81.8	81.1	81.0	81.0	81.0
Vitreous Kernels (%)	72	55	86	71	77	83	74
1000 Kernel Weight (gm)	32.0	31.9	31.2	31.5	30.9	31.3	31.5
Protein: 12%/0% moisture	14.3/16.2	14.5/16.4	14.5/16.5	14.5/16.5	14.2/16.1	14.1/16.0	14.4/16.4
Ash: 14% moisture (%)	1.57	1.54	1.57	1.50	1.53	1.53	1.53
Falling Number (sec)	389	337	399	389	406	372	381
FLOUR DATA							
Extractions (%)	67.7	68.7	68.1	71.2	66.9	67.1	68.4
Ash: 14% moisture (%)	0.52	0.53	0.52	0.57	0.53	0.52	0.53
Protein: 14% moisture (%)	13.3	13.5	13.6	13.8	13.0	13.0	13.4
Wet Gluten (%)	33.1	34.1	36.4	35.6	34.7	34.9	35.1
Falling Number (sec)	407	352	421	407	415	386	396
Amylograph Peak Viscosity							
65g FL (B.U.)	632	441	649	570	659	676	599
PHYSICAL DOUGH PROPERTIES							
***FARINOGRAPH:**							
Absorption (%)	61.6	62.6	64.2	62.6	62.7	61.9	62.8
Peak Time (min)	7.9	7.3	7.7	8.1	8.0	6.7	7.6
Stability (min)	11.8	10.0	11.4	11.9	13.2	10.3	11.4
EXTENSOGRAPH:							
Extensibility-45 min (cm)	16.2	17.9	16.1	16.8	16.6	16.5	16.8
Resistance-45 min (B.U.)	498	497	570	513	536	442	512
Area-45 min (sq cm)	105	117	120	113	115	95	112
ALEOGRAPH:							
P (mm)	81	83	88	80	84	80	83
L (mm)	134	135	119	141	130	120	129
W (joules x10^4)	359	360	345	372	376	324	355
BAKING DATA							
Absorption (%)	67.0	67.2	69.5	66.2	67.6	67.5	67.6
Dough Handling Properties	8.9	8.4	9.0	9.0	9.3	9.5	9.0
Loaf Volume (CC)	977	1019	988	951	976	964	980
Grain and Texture	7.8	7.7	7.6	7.8	7.6	7.4	7.6
Crumb Color	7.7	7.6	7.7	7.8	7.7	7.5	7.7
Crust Color	9.9	9.8	10.0	9.8	9.8	9.4	9.8
Symmetry	8.7	9.1	9.3	9.1	9.1	9.0	9.1

U.S. HARD RED SPRING WHEAT

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

2020 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)	62.7/82.5	62.8/82.6	62.0/81.5
Damage (%)	0.1	0.0	0.0
Shrunken/Broken (%)	1.0	0.6	1.0
Total Defects (%)	1.1	0.6	1.0
Vitreous Kernels (%)	81	87	81
Grade	1 DNS	1 DNS	1 DNS
WHEAT DATA			
Dockage (%)	0.6	0.4	0.7
Moisture (%)	10.7	11.1	11.3
Protein:12%/0% moisture (%)	12.6/14.3	14.1/16.1	15.6/17.7
Ash: 14%/0% moisture (%)	1.49/1.73	1.51/1.76	1.59/1.85
1000 Kernel Weight	31.5	33.1	31.3
Falling Number (sec)	379	365	371
Sedimentation (cc)	63	64	67
FLOUR DATA			
Extraction (%)	67.2	67.9	66.3
Color: L	91.0	90.8	90.6
a/b	-1.4/10	-1.3/9.7	-1.3/9.8
Protein: 14%/0% moisture (%)	11.7/13.6	13.0/15.2	14.4/16.8
Ash: 14%/0% moisture (%)	0.50/0.58	0.49/0.57	0.51/0.60
Wet Gluten (%)	28.5	34.0	37.1
Gluten Index (%)	95	90	82
Falling Number (sec)	397	393	395
Amylograph Viscosity: 65g FL (BU)	752	681	698
DOUGH DATA			
Farinograph: Absorption (%)	61.8	62.9	64.3
Peak Time (min)	7.3	7.9	8.7
Stability (min)	10.6	10.6	12.4
Alveograph: P (mm)	100	91	82
L (mm)	100	125	149
P/L Ratio	1.0	0.73	0.55
W (10^{-4} joules)	350	364	375
Extensograph (45/135 min): Resistance	447/682	435/804	469/1007
Extensibility (sm)	16.5/13.2	14.2/12.1	15.3/11.6
Area (sq cm)	95/120	81/126	94/153
BAKING DATA			
Absorption (%)	68.1	68.8	70.1
Crumb Grain and Texture	7.5	8.0	7.8
Loaf Volume (cc)	855	940	1055
SAMPLE %	**26**	**24**	**50**

Data contained on pages 18-21 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)	61.5/80.9	61.3/80.6	61.3/80.6
Damage (%)	0.1	0.0	0.1
Shrunken/Broken (%)	0.8	0.6	0.7
Total Defects (%)	1.0	0.6	0.8
Vitreous Kernels (%)	46	55	70
Grade	1 NS	1 NS	1 NS
WHEAT DATA			
Dockage (%)	0.7	0.5	0.5
Moisture (%)	12.6	12.6	12.5
Protein:12%/0% moisture (%)	12.5/14.3	13.9/15.8	15.2/17.3
Ash: 14%/0% moisture (%)	1.59/1.85	1.62/1.89	1.65/1.92
1000 Kernel Weight	31.2	31.7	31.0
Falling Number (sec)	374	376	378
Sedimentation (cc)	62	63	67
FLOUR DATA			
Extraction (%)	68.5	68.3	67.2
Color: L	91.0	90.8	90.3
a/b	-1.2/9.2	-1.2/9.2	-1.1/9.5
Protein: 14%/0% moisture (%)	11.7/13.6	12.9/15.0	14.2/16.5
Ash: 14%/0% moisture (%)	0.51/0.59	0.52/0.60	0.53/0.62
Wet Gluten (%)	28.5	31.9	35.6
Gluten Index (%)	99	91	94
Falling Number (sec)	374	394	374
Amylograph Viscosity: 65g FL (BU)	597	587	572
DOUGH DATA			
Farinograph: Absorption (%)	59.2	60.1	61.3
Peak Time (min)	6.2	7.8	8.2
Stability (min)	12.0	12.7	12.9
Alveograph: P (mm)	84	80	71
L (mm)	127	139	168
P/L Ratio	0.66	0.58	0.42
W (10^{-4} joules)	353	369	380
Extensograph (45/135 min): Resistance	549/698	544/705	588/1009
Extensibility (sm)	15.5/14.9	16.5/14.1	15.5/12.2
Area (sq cm)	112/138	117/131	114/161
BAKING DATA			
Absorption (%)	64.6	65.0	66.7
Crumb Grain and Texture	7.5	7.8	7.5
Loaf Volume (cc)	858	933	1055
SAMPLE %	**21**	**34**	**45**

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

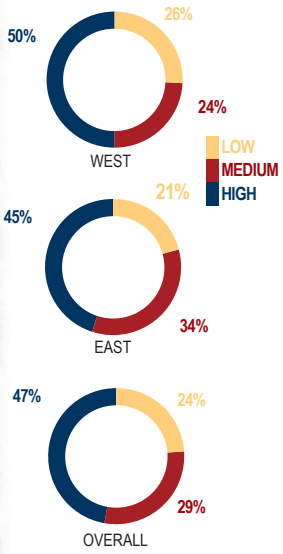
To illustrate the correlation between higher protein and other quality parameters, samples of the regional crop were segregated by protein levels:

LOW
<13.5%

MEDIUM
13.5 to 14.5 %

HIGH
> 14.5%
* (12% moisture basis)

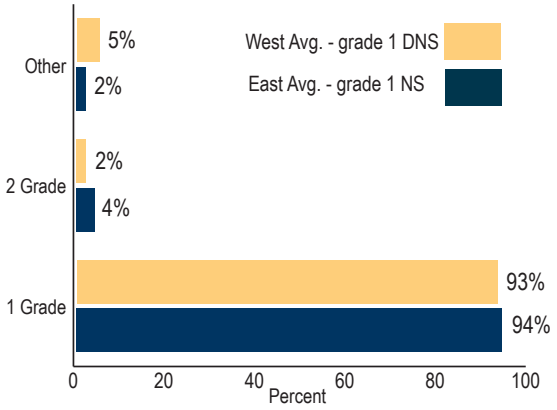
PRODUCTION DISTRIBUTION BY PROTEIN



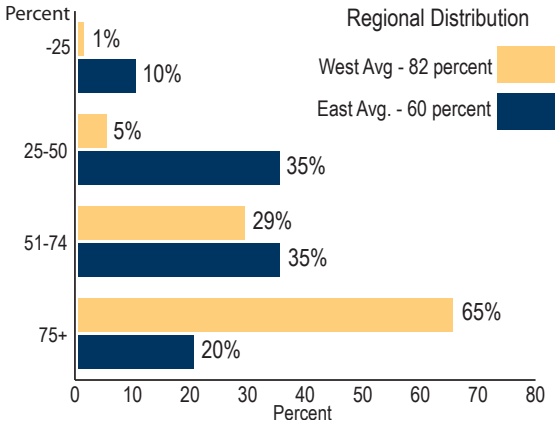
PROTEIN RANGES			
WHEAT GRADING DATA	LOW	MEDIUM	HIGH
WHEAT GRADING DATA			
Test Weight (lbs/bu/kg/hl)	62.2/81.8	61.9/81.4	61.6/81.0
Damage (%)	0.1	0.0	0.0
Shrunken/Broken (%)	0.9	0.6	0.9
Total Defects (%)	1.0	0.6	0.9
Vitreous Kernels (%)	65	67	76
Grade	1 NS	1 NS	1 DNS
WHEAT DATA			
Dockage (%)	0.6	0.5	0.6
Moisture (%)	11.6	12.0	11.9
Protein:12%/0% moisture (%)	12.6/14.3	14.0/15.9	15.4/17.5
Ash: 14%/0% moisture (%)	1.54/1.79	1.58/1.84	1.62/1.88
1000 Kernel Weight	31.4	32.2	31.2
Falling Number (sec)	377	372	374
Sedimentation (cc)	62	63	67
FLOUR DATA			
Extraction (%)	67.8	68.2	66.7
Color: L	91.0	90.8	90.4
a/b	-1.3/9.6	-1.2/9.4	-1.2/9.6
Protein: 14%/0% moisture (%)	11.7/13.6	13.0/15.1	14.3/16.6
Ash: 14%/0% moisture (%)	0.50/0.58	0.51/0.59	0.52/0.61
Wet Gluten (%)	28.5	32.7	36.4
Gluten Index (%)	97	91	88
Falling Number (sec)	386	394	385
Amylograph Viscosity: 65g FL (BU)	679	624	635
DOUGH DATA			
Farinograph: Absorption (%)	60.6	61.2	62.8
Peak Time (min)	6.8	7.8	8.5
Stability (min)	11.3	11.9	12.6
Alveograph: P (mm)	92	84	77
L (mm)	113	134	158
P/L Ratio	0.82	0.63	0.48
W (10^{-4} joules)	351	367	377
Extensograph (45/135 min): Resistance	495/690	501/744	528/1008
Extensibility (sm)	16.0/14.0	15.6/13.3	15.4/11.9
Area (sq cm)	103/128	103/129	104/157
BAKING DATA			
Absorption (%)	66.5	66.5	68.4
Crumb Grain and Texture	7.5	7.8	7.6
Loaf Volume (cc)	856	935	1055
SAMPLE %	**24**	**29**	**47**

DISTRIBUTIONS BY EAST/WEST PRODUCTION REGIONS

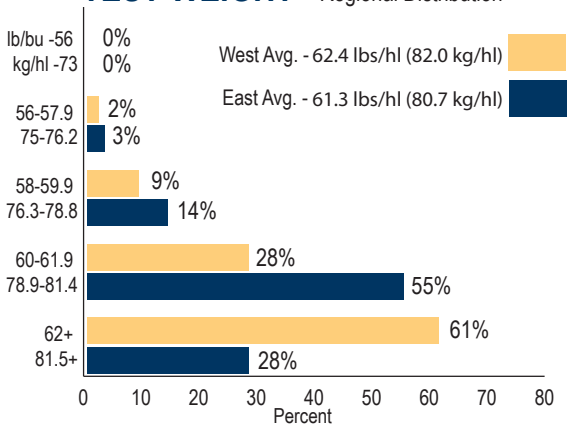
GRADE – Regional Distribution



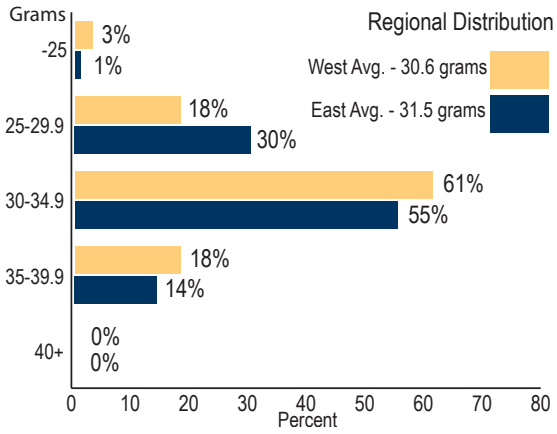
VITREOUS KERNEL



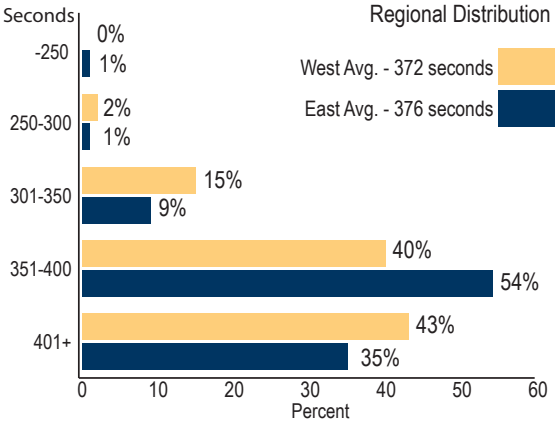
TEST WEIGHT – Regional Distribution



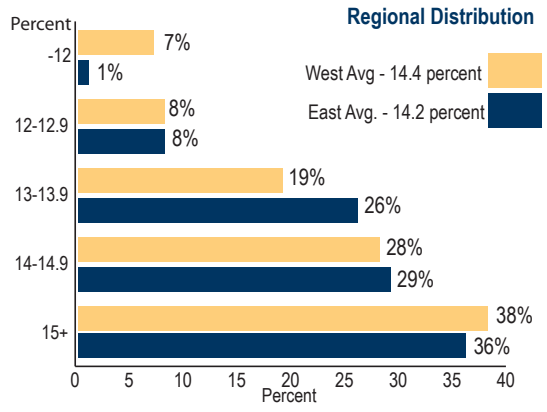
1000 KERNEL WEIGHT



FALLING NUMBER



PROTEIN - 12% MOISTURE



The same base collection samples as shown in the area specific data displayed on pages 6-17 were used for the West/East and protein splits.

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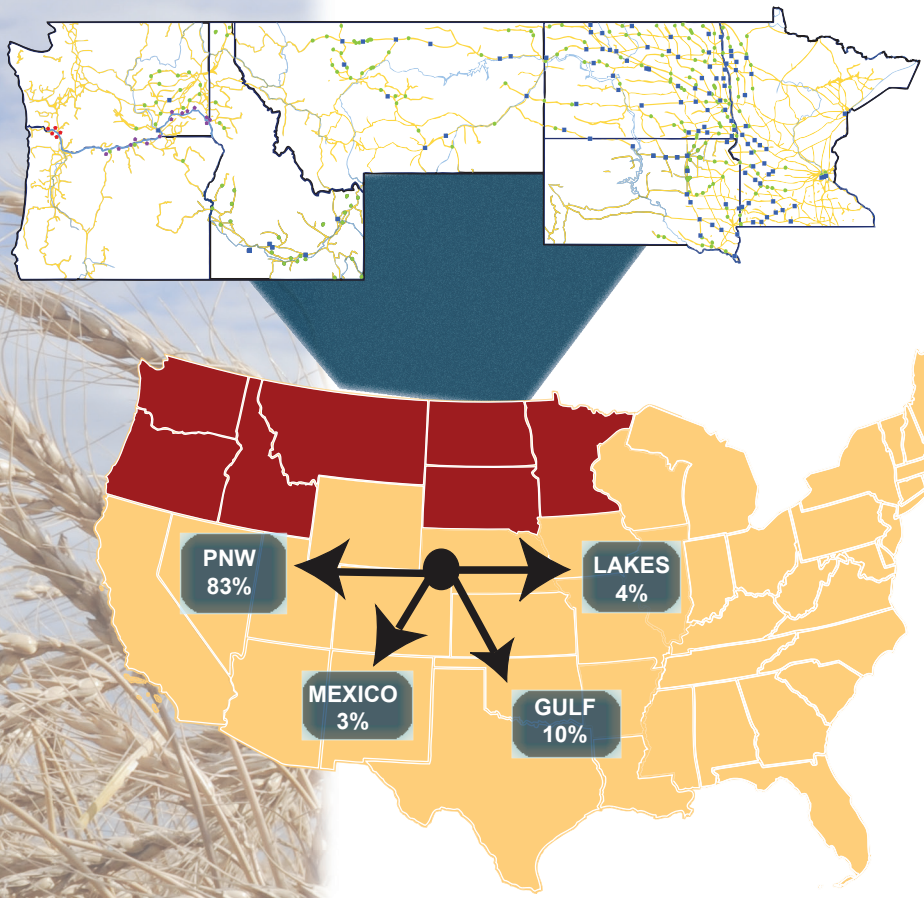
HANDLING AND TRANSPORTATION

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.

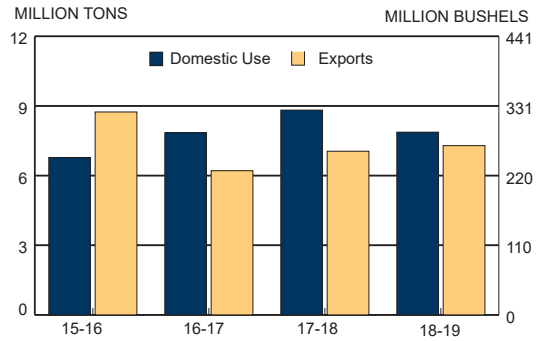


AVERAGE SHARE OF U.S. HRS EXPORTS BY PORT (2016-2019)

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

2016-2019 U.S. HRS DOMESTIC USE AND EXPORTS



2020 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, Edil Vidal Torres, Gwen Thomas, Sean McMonagle, Kaitlyn Peterson and Kathy Christianson 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 early August and continued until late September. Sample collection was weighted by county production histories with a total of 793 samples being collected during harvest from Minnesota (130), Montana (148), North Dakota (386), South Dakota (89) and PNW (40).

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.

VARIETAL INFORMATION

2020 MAJOR VARIETIES PRODUCED • 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	4	68.2	4.59	46.9	3.15
Bolles	MN	2015	4	52	3	5	71.6	4.81	44.0	2.96
CP 3530	Croplan	2015	4	51	2	4	74.3	5.0	49.8	3.35
Elgin-ND	ND	2012	5	48	6	4	69.6	4.68	49.5	3.33
Faller	ND	2007	5	50	7	4	75.5	5.08	52.0	3.50
Glenn	ND	2005	4	47	6	3	63.7	4.28	46.0	3.09
Linkert	MN	2013	2	49	3	5	64.6	4.34	43.8	2.94
ND VitPro	ND	2016	3	48	4	4	64.8	4.36	44.3	2.98
Shelly	MN	2016	5	51	6	5	72.6	4.88	50.3	3.38
SY Ingmar	Syngenta/AgriPro	2011	3	49	3	5	70.8	4.76	46.2	3.11
SY Soren	Syngenta/AgriPro	2011	3	48	2	7	67.6	4.54	48.1	3.23
SY Valda	Syngenta/AgriPro	2015	4	49	2	5	76.6	5.15	47.4	3.19
WB 9479	Westbred	2017	4	49	1	6	n/a	n/a	n/a	n/a
WB 9590	Westbred	2017	4	48	3	6	n/a	n/a	n/a	n/a

1. ND – North Dakota State University (Public), MN – University of Minnesota (Public), Croplan – (Private), Syngenta/AgriPro – (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. 2017-19 ND average yield data from four locations in eastern North Dakota.
5. 2017-19 ND average yield data from five locations in western North Dakota.

VARIETAL INFORMATION

2020 MAJOR VARIETIES PRODUCED • 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	62.2	81.8	15.2	81.0	12.0	66.9	1014	★★★
Bolles	60.8	80.0	16.7	77.0	25.2	65.7	1059	★★★★
CP 3530	60.3	79.3	14.5	64.0	10.4	64.9	1009	★★★
Elgin-ND	61.0	80.2	15.1	78.0	10.8	66.3	991	★★★
Faller	60.7	79.9	14.5	70.0	11.2	64.2	1004	★★★
Glenn	63.5	83.5	15.5	89.0	16.7	65.3	1037	★★★★★
Linkert	61.5	80.9	15.9	75.0	24.0	65.0	1027	★★★★
ND VitPro	63.1	83.0	15.6	90.0	9.7	65.6	995	★★★
Shelly	61.4	80.8	14.1	60.0	20.5	61.0	920	★★
SY Ingmar	61.8	81.3	15.1	76.0	11.3	63.3	1023	★★★
SY Soren	61.9	81.4	15.5	66.0	10.2	64.0	1042	★★★
SY Valda	61.3	80.6	14.3	84.0	8.8	62.9	954	★★
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, 2017-2019 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.

* Averages are 2017 & 2018 only.

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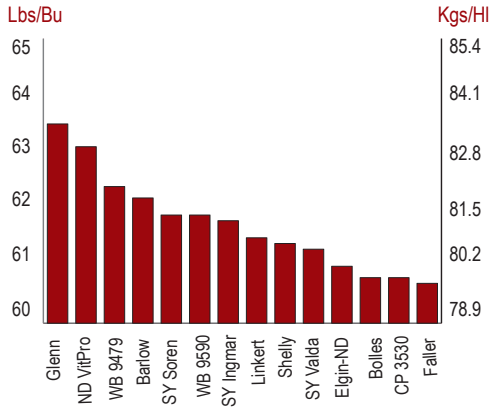
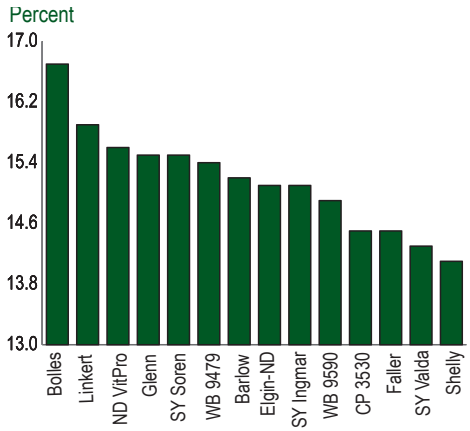
QUALITY COMPARISON BY POPULAR VARIETIES

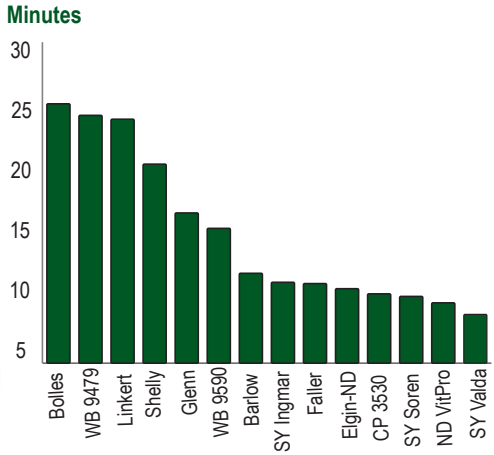
TEST WEIGHT



PROTEIN - 12% MOISTURE BASIS



FARINOGRAPH STABILITY



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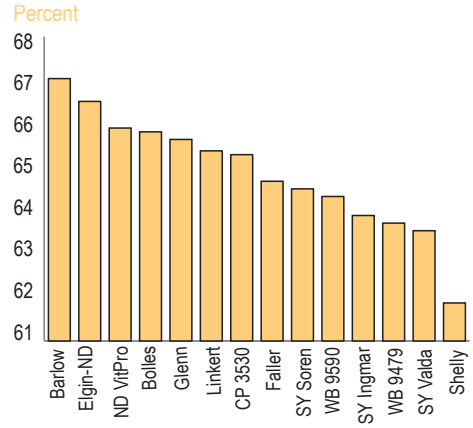
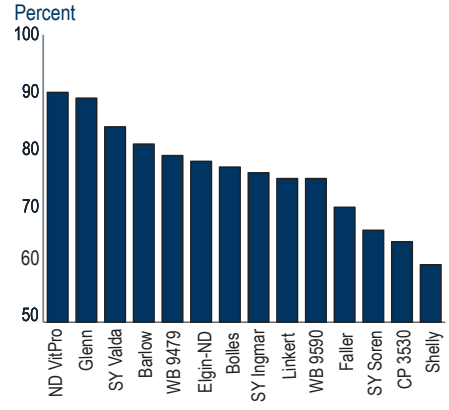
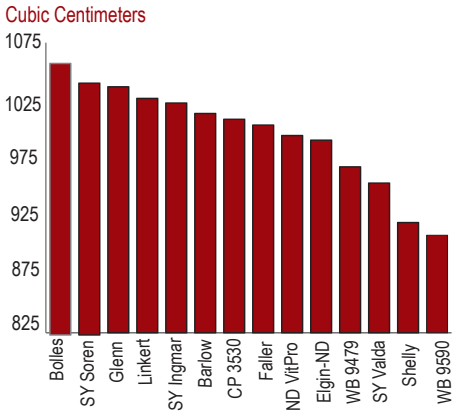


VITREOUSNESS



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 2017-2019 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 top variety planted in the state in 2020 with 19 percent of the acres. It has been the top variety for four straight years, being most popular across the western and central regions. In Montana, it accounts for nearly 9 percent of the acres, ranking it second. 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.

SY VALDA held onto second place in both North Dakota and Minnesota in 2020 with 12.5 and 16 percent acreage shares, respectively, and steady with a year ago in both states. It is a 2015 release from Syngenta/AgriPro and is popular in the eastern half of the two-state production region for its elite yield potential and strong disease tolerance, especially for Fusarium headblight. It is rated as average for milling and baking quality.

SY SOREN is the fourth most popular variety in North Dakota in 2020 with 4 percent of the acres, and is third in Montana with a 6.1 percent acreage share. 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.

GLENN is the fifth most popular variety with a 3.6 percent acreage share, up slightly from 2019. A 2005 release from NDSU, it is a variety with balanced agronomic traits, a high level of resistance to Fusarium headblight and excellent kernel quality. Glenn has superior milling and baking quality characteristics, and is often the "check" or reference variety for quality within the Hard Red Spring wheat class.

NORTH DAKOTA VARIETY SHARE OF PLANTED ACRES[3]

Variety	2020%[1]	2019%[1]
SY Ingmar	19.2	20.6
SY Valda	12.5	12.5
WB 9590	6.1	1.4
SY Soren	4.1	4.7
Glenn	3.6	2.9
Faller	3.5	3.7
Bolles	3.3	5.0
WB 9479	3.2	2.7
Shelly	2.9	2.5
Elgin-ND	2.7	4.2
Other[2]	38.9	39.8

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)
   2020 – 5,700,000 planted acres
   2019 – 6,700,000 planted acres

TOP 3 NORTH DAKOTA VARIETIES BY CROP DISTRICT

	First	Second	Third
	PERCENTAGE (%)		
Northwest	SY Ingmar 28.2	Glenn 8.0	SY Valda 7.9
North Central	SY Ingmar 22.8	SY Valda 20.5	SY Soren 4.5
Northeast	SY Valda 20.1	Faller 13.1	WB 9590 8.7
West Central	SY Ingmar 25.3	SY Soren 6.4	Glenn 5.7
Central	SY Ingmar 25.6	SY Valda 9.5	WB 9590 9.5
East Central	SY Valda 20.0	WB 9590 16.2	SY Ingmar 11.9
Southwest	SY Ingmar 16.3	Shelly 11.2	Barlow 7.2
South Central	SY Ingmar 28.7	SY Soren 9.6	Elgin-ND 6.9
Southeast	SY Valda 12.5	SY Ingmar 10.8	Bolles 10.5

U.S. HARD RED SPRING WHEAT

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

MINNESOTA

MINNESOTA VARIETY SHARE OF SURVEYED ACRES[3]

VARIETY	2020%[1]	2019%[1]
Linkert	20.6	22.3
SY Valda	14.2	15.5
WB 9590	18.1	13.8
WB 9479	12.8	9.2
Shelly	6.0	7.1
MN- Washburn	3.9	0.3
WB Mayville	3.5	5.4
SY Ingmar	1.5	2.8
Bolles	1.1	4.4
Other[2]	18.3	19.5

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)
   2020 – 1,430,000 planted acres
   2019 – 1,450,000 planted acres

TOP 3 MINNESOTA VARIETIES BY CROP DISTRICT

	First	Second	Third
	PERCENTAGE (%)		
North	Linkert 20.6	WB 9590 18.1	SY Valda 14.2
Central	SY Valda 22.4	Linkert 15.9	WB 9479 10.4
South	Linkert 24.8	Bolles 20.6	SY Ingmar 19.1

LINKERT remains the leading variety in Minnesota in 2020 with nearly 20 percent of the acres, but down from the past two years. A 2013 release from the University of Minnesota, it 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.

WB 9590 held onto third place in Minnesota in 2020 with nearly 16 percent of the acres, and advanced into third place in North Dakota with 6 percent of the acres. A 2017 release from Westbred, it provides producers with strong straw characteristics, very high resistance to leaf rust disease, high yield potential and moderately high protein content. WB 9590 is rated as good for milling and baking qualities.

WB 9479 remained the fourth most popular variety in Minnesota in 2020 with 12 percent of the acres, and advanced to eighth in North Dakota with a 3 percent acreage share. It is a 2017 release from Westbred with high protein content, strong straw, a high level of leaf rust resistance and high yield potential. WB 9479 has especially strong dough properties, and is rated as good for milling and baking qualities.

MONTANA

VIDA remains the dominant variety in Montana, accounting for nearly one-third of acres in 2020. 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.

REEDER remains tied for third in 2020 with a 6.1 percent share of acres, down from 10 percent in 2019. 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.

CORBIN also tied for third in 2020 with a 6.1 percent share of acres, similar to 2019. It is mostly planted in the north central part of the state. Corbin is a 2006 release from Westbred, which was developed for resistance to the wheat stem sawfly.

SOUTH DAKOTA - no survey in 2020.

PNW VARIETAL INFORMATION

MAJOR VARIETIES PRODUCED 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]
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	14.9	18.4	68.1	1108	MD
Expresso	Westbred	2000	62.6	82.2	14.7	5.1	68.5	1032	*Not Rated
Glee	WSU	2012	62.6	82.3	13.6	16.0	65.7	1073	MD
SY Gunsight	Syngenta	2018	62.6	82.2	13.2	24.9	65.5	980	D
Jefferson	ID	1997	62.3	82.0	13.6	20.9	66.0	977	D
Kelse	WSU	2008	62.0	81.4	14.5	19.0	67.8	1090	D
AP Renegade	Syngenta	2017	61.9	81.4	13.0	28.9	64.8	931	MD
SY605CL	Syngenta	2010	62.9	82.7	15.4	12.0	68.4	1033	MD
WB 9518	Westbred	2013	61.9	61.4	15.0	12.7	69.4	1125	D
WB 9662	Westbred	2014	62.5	82.2	14.4	5.5	67.4	1011	*Not Rated
WB 9668	Westbred	2014	62.7	82.3	15.2	14.3	69.5	1124	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

MONTANA VARIETY SHARE OF SURVEYED ACRES[3]

VARIETY	2020%[1]	2019%[1]
Vida	31.5	23.8
SY Ingmar	8.6	9.6
Reeder	6.1	10.4
SY Soren	6.1	11.5
Corbin	6.1	6.8
Brennan	4.9	3.9
WB Gunnison	4.4	5.5
Duclair	4.1	5.1
Lanning	3.9	1.5
Mott	1.7	2.5
Other[2]	22.6	19.5

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)
   2020 – 3,300,000 planted acres
   2019 – 2,900,000 planted acres

TOP 2 MONTANA VARIETIES BY CROP DISTRICT

	FIRST	SECOND
	PERCENTAGE (%)	
North Central	Vida 40.9	Corbin 10.7
North East	Vida 18.5	SY Soren 15.2
Central	Vida 26.6	Lanning 17.8
South Central	Vida 35.8	Lanning 16.4

2020 Regional Quality Report

U.S. HARD RED SPRING WHEAT

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