2022

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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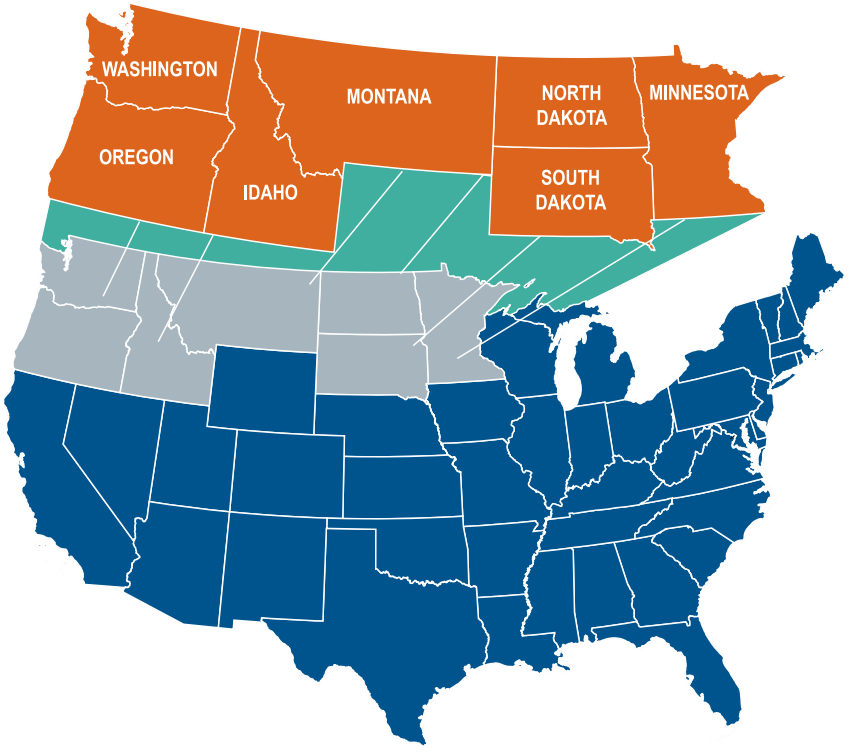
THE ARISTOCRAT OF WHEAT

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 2022 U.S. hard red spring wheat (HRS) crop made a significant rebound in production from the devastating drought of 2021, with total production estimated at 436 million bushels (12.1 MMT), 50 percent larger than last year. Despite historically late planting, overall yields were above average. The crop is very sound with low kernel moisture and little damage, thanks to minimal disease pressure and a dry harvest period. Protein content is lower than typical, on account of very strong yields in parts of the region, and some variance in kernel size exists across the region due to areas of moisture stress during kernel fill. Functional evaluation of the crop is showing dough quality parameters similar to the 5-year average, with high baked bread scores and slightly larger loaf volumes compared to 2021.

PRODUCTION DATA

	2022	2021	2017-21 AVERAGE
MILLION BUSHELS			
Minnesota	74	56	75
Montana	61	37	82
North Dakota	263	175	254
South Dakota	34	17	28
ID/OR/WA	14	12	25
U.S. Total	**446**	**297**	**464**
MILLION METRIC TON			
Minnesota	2.01	1.52	2.05
Montana	1.66	1.01	2.22
North Dakota	7.16	4.76	6.90
South Dakota	0.91	0.46	0.76
ID/OR/WA	0.38	0.33	0.68
U.S. Total	**12.1**	**8.08**	**12.6**

Source: USDA 2022 Small Grains Summary

The **CROP AVERAGES** a No. 1 Northern Spring, compared to a No. 1 Dark Northern Spring last year, due to lower vitreous kernel levels, primarily across the eastern half of the growing region. More than 90 percent of the survey samples graded a No. 1, which is exceptionally high and indicates very good kernel parameters. The crop average test weight is 62.1 lbs./bu. (81.7 kg/hl), higher than 2021 and the 5-year average, with 85percent of the crop above 60 lbs./bu. (78.9 kg/hl). Average damaged kernel levels are very low at 0.1 %, as disease pressures were minimal to non-existent. Shrunken and broken kernels at 0.8% on a crop average, are similar to the 5-yr average, but some western production areas did see higher levels. Overall vitreous kernel levels average 73%, down from 81% in 2021, but on par with the five-year average.

Crop average **PROTEIN** is 14.2% (12% moisture basis), down 1.4 percentage points from the drought impacted 2021 crop, and about a half point below the 5-year average. Distribution of protein is skewed lower than a year ago, but there is a better balance among protein segments, with roughly 60 percent of the crop falling between 13 and 15% protein. Moisture is very low, averaging just 11.9%.

THOUSAND KERNEL WEIGHTS (TKW) are similar to a year ago, but slightly lower than the 5-yr average, with the crop average at 30.9 grams. Distributions show sixty percent of the crop above 30 grams, compared to one-half last year. Lower TKW's are more prominent across western and southern production regions due to moisture stress. Crop average DON is 0.1 ppm, up slightly from last year, but below the 5-yr average. A dry, rapid harvest supported kernel soundness, with the crop average falling number of 390 seconds, and 96 percent of the samples exceeding 350 seconds.

MILLING analysis, based on a Buhler Lab Mill, averages 67.0% extraction, just slightly lower than 2021, but more notably below 5-year averages. The lab mill settings are not adjusted to account for kernel parameter shifts between crop years. Lighter TKW's and smaller kernel sizes in portions of the crop likely contributed to the lower than typical extraction. Average flour ash is 0.49%, similar to 2021, but lower than 5-yr averages. Protein recovery in the flour is lower than a year ago, with the crop average flour protein at 12.7%. Wet gluten values for the crop average 33.1%, about 2 percent below the 5-year average, paralleling the lower kernel protein levels. Flour viscosity is very high for a second straight year at 730 B.U. on the Amylograph.

PHYSICAL DOUGH tests, based on the Farinograph, indicate a weaker crop compared to 2021, but very comparable to the five-year average. The average Farinograph stability time of 12.5 minutes is four minutes lower than last year's strong crop, but similar to the average of 12.3 minutes. Farinograph absorption averages 63%, slightly higher than both last year and the five-year average. The 135-minute pull on the Extensograph shows the overall extensibility and resistance to extension is 14.4 cm and 804 B.U., compared to 12.4 and 1201 in 2021. The extensograph data confirms a weaker, slightly more extensible crop compared to last year. Alveograph W value of 412 is similar to last year.

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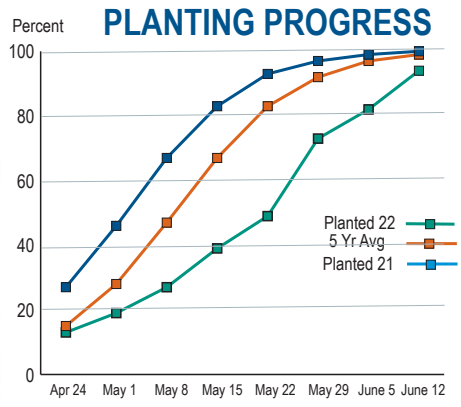
BAKING evaluations produced an average loaf volume of 931 cubic centimeters, slightly higher than last year's value of 918, but still below the five-year average. Dough handling properties scored slightly higher, rated at 8.9. Overall bread scores were rated similar to higher than a year ago for grain and texture and crumb color and showed improvements for crust color and symmetry.

With a nearly 50% increase in HRS production, **BUYERS** will appreciate higher supply levels. The crop has strong grading characteristics and sound kernel characteristics, but lower overall protein. While dough strength shows weaker than last year, buyers will find a crop that compares well with the five-year average with improved loaf volume and baking characteristics compared to 2021.

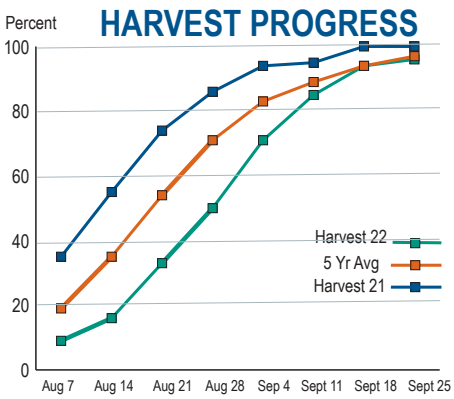
SEASONAL CONDITIONS - 2022

PLANTING conditions were quite different from a year ago, with excess moisture and cold conditions delaying the start of planting. Producers in Montana, portions of South Dakota and the PNW region had a fairly timely planting season due to drier conditions and started planting in mid-April. However, the remainder of the growing region struggled with consistent wet conditions and late season snow that pushed the start of planting into mid-May. Conditions dried out a bit in late May, allowing for better planting progress, but wet field conditions continued to be an issue. Nearly half of the spring wheat crop was planted in late May to early June.



EMERGENCE and general development of the crop was behind average due to the late planting, in some cases 2-3 weeks behind normal. Temperatures were warmer in June, stressing crops in drier areas, but overall moisture levels were adequate. Crop development stages and yield potential throughout the region were quite variable depending on planting date and moisture levels. The condition rating on the spring wheat crop was high throughout the growing season. While there was more disease pressure than last year's drought afflicted season, it was not widespread and didn't cause major issues.

HARVEST Warm, dry conditions prevailed in August, pushing along crop development and helping to ripen and dry out the crop. Harvest was in full swing by mid-August. Precipitation and high humidity caused harvest delays at first, but drier conditions prevailed allowing for weeks of uninterrupted harvest progress. Harvest progressed swiftly with the majority finished by mid-September. Given the late planted crop, harvest was finished earlier than expected, but harvest of some of the later planted crop did extend into early October.



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	63.0	82.9	0.1	0.4	0.5	1 NS	61
Area B	62.4	82.1	0.1	0.6	0.7	1 NS	52
State Avg 2022	62.9	82.7	0.1	0.4	0.5	1 NS	59
State Avg 2021	62.8	82.5	0.0	0.4	0.4	1 DNS	83
MONTANA							
Area A	59.4	78.2	0.1	1.9	2.0	1 DNS	93
Area B	61.0	80.2	0.1	2.0	2.1	1 DNS	95
Area C	57.5	75.6	0.4	4.9	5.3	3 DNS	81
Area D	61.0	80.2	0.1	3.0	3.1	2 DNS	95
Area E	62.5	82.1	0.2	1.2	1.4	1 DNS	78
State Avg 2022	60.4	79.4	0.1	2.1	2.2	1 DNS	93
State Avg 2021	59.0	77.6	0.2	2.1	2.3	1 DNS	83
NORTH DAKOTA							
Area A	63.2	83.0	0.1	0.8	0.9	1 DNS	88
Area B	62.2	81.8	0.0	0.4	0.4	1 NS	68
Area C	62.0	81.5	0.0	0.3	0.3	1 NS	56
Area D	62.0	81.5	0.2	1.0	1.2	1 DNS	80
Area E	61.9	81.4	0.4	0.6	1.0	1 NS	60
Area F	62.1	81.7	0.4	0.6	1.0	1 NS	50
State Avg 2022	62.4	82.0	0.1	0.7	0.8	1 NS	73
State Avg 2021	61.6	81.1	0.1	0.8	0.9	1 DNS	81
SOUTH DAKOTA							
Area A	62.1	81.6	0.0	0.6	0.6	1 NS	72
Area B	61.9	81.4	0.2	0.8	1.0	1 NS	74
Area C	60.7	79.8	0.0	1.1	1.1	1 NS	42
State Avg 2022	61.7	81.2	0.1	0.8	0.9	1 NS	68
State Avg 2021	61.2	80.5	0.0	1.1	1.1	1 NS	71
IDAHO - OREGON - WASHINGTON							
Area A	62.6	82.3	0.0	0.8	0.8	1 DNS	93
Area B	61.4	80.7	0.0	0.7	0.7	1 NS	71
State Avg 2022	61.9	81.4	0.0	0.7	0.7	1 DNS	80
State Avg 2021	61.0	80.3	0.2	1.4	1.6	1 DNS	80
REGION AVERAGE							
Avg 2022	62.1	81.7	0.1	0.8	0.9	1 NS	73
Avg 2021	61.5	80.8	0.1	0.9	1.0	1 DNS	81
Five-Year Avg	61.6	81.0	0.3	0.8	1.1	1 NS	73

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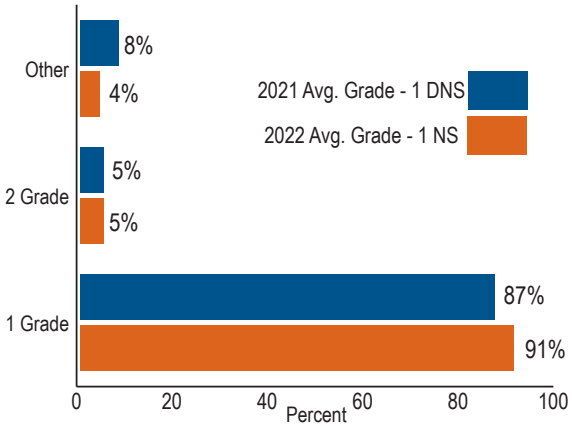
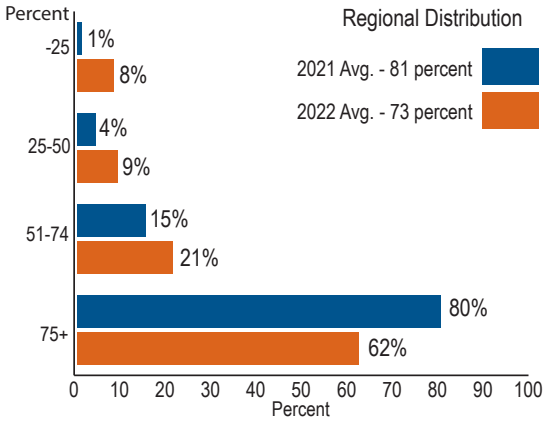
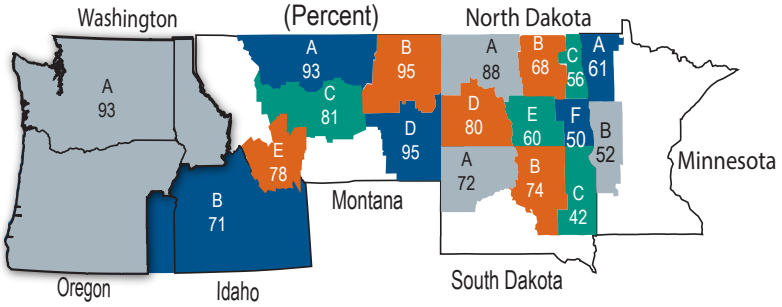
GRADE – Regional Distribution



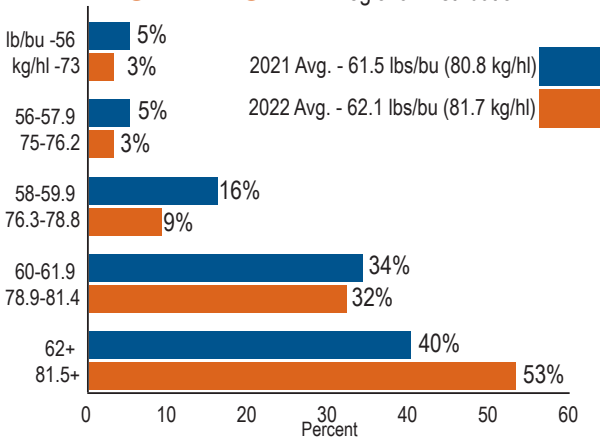
VITREOUS KERNEL



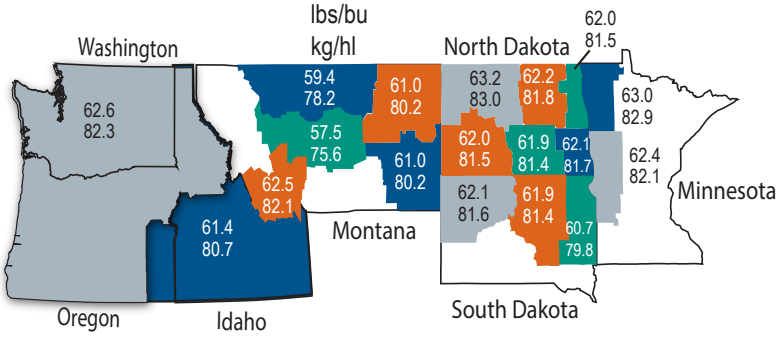
AVERAGE VITREOUS KERNEL BY AREA



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	0.4	12.8	34.4	34/64	13.7/15.5	0.0	1.45	397	62
Area B	0.3	13.0	29.9	56/41	13.9/15.8	0.0	1.56	386	63
State Avg 2022	0.4	12.9	33.5	38/59	13.7/15.6	0.0	1.47	395	62
State Avg 2021	0.3	12.4	33.9	49/49	14.8/16.8	0.0	1.43	406	67
MONTANA									
Area A	0.7	9.7	27.6	71/22	14.7/16.7	0.0	1.60	384	61
Area B	0.8	10.2	26.3	73/19	14.6/16.6	0.0	1.63	386	61
Area C	1.1	9.6	22.9	73/17	15.9/18.1	0.0	1.62	419	64
Area D	1.4	10.3	23.8	80/10	13.8/15.6	0.0	1.60	381	61
Area E	0.9	10.3	32.4	51/45	13.6/15.5	0.1	1.52	369	61
State Avg 2022	0.8	10.0	26.7	72/20	14.6/16.6	0.0	1.62	386	61
State Avg 2021	0.8	10.6	25.9	77/13	15.6/17.7	0.0	1.58	383	67
NORTH DAKOTA									
Area A	0.5	11.8	31.2	53/45	13.8/15.7	0.1	1.54	383	63
Area B	0.7	12.9	33.2	41/57	14.3/16.2	0.1	1.54	401	63
Area C	0.4	12.6	32.6	40/59	13.8/15.6	0.0	1.57	362	65
Area D	0.6	11.7	28.7	63/33	14.3/16.2	0.0	1.61	392	63
Area E	1.0	12.6	31.0	50/48	14.9/16.9	0.1	1.63	392	60
Area F	0.6	13.1	31.9	44/54	14.4/16.4	0.0	1.49	387	60
State Avg 2022	0.6	12.3	31.3	50/48	14.1/16.1	0.1	1.56	388	63
State Avg 2021	0.6	12.0	30.9	62/35	15.5/17.6	0.0	1.53	400	68
SOUTH DAKOTA									
Area A	0.3	11.0	27.6	74/22	14.1/16.0	0.0	1.62	385	54
Area B	0.8	12.5	29.8	62/35	14.9/17.0	0.2	1.68	386	50
Area C	0.9	12.8	29.5	54/43	14.4/16.4	0.3	1.67	400	53
State Avg 2022	0.7	12.2	29.1	64/33	14.6/16.6	0.2	1.66	388	52
State Avg 2021	0.6	11.6	28.2	72/24	15.3/17.3	0.0	1.55	390	63
IDAHO - OREGON - WASHINGTON									
Area A	0.3	8.7	34.2	41/55	14.2/16.2	0.1	1.61	392	49
Area B	0.3	8.9	28.1	68/29	14.5/16.4	0.0	1.65	431	65
State Avg 2022	0.3	8.8	30.5	57/39	14.4/16.3	0.0	1.63	415	59
State Avg 2021	0.4	9.8	29.6	67/30	15.7/17.8	0.0	1.62	398	67
REGION AVERAGE									
Avg 2022	0.6	11.9	30.9	52/45	14.2/16.1	0.1	1.56	390	62
Avg 2021	0.5	11.8	30.6	62/34	15.4/17.4	0.0	1.52	398	67
Five-Year Avg	0.6	12.1	31.4	52/45	14.6/16.6	0.2	1.54	382	66

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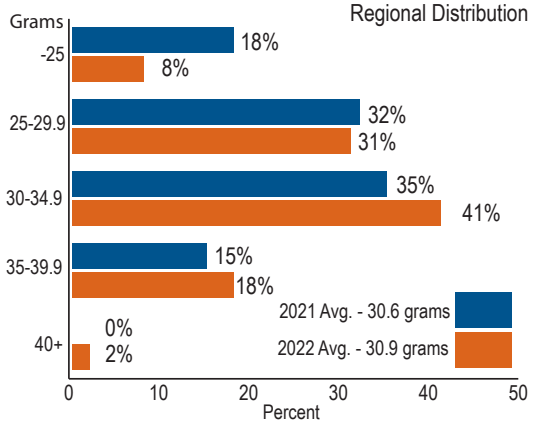
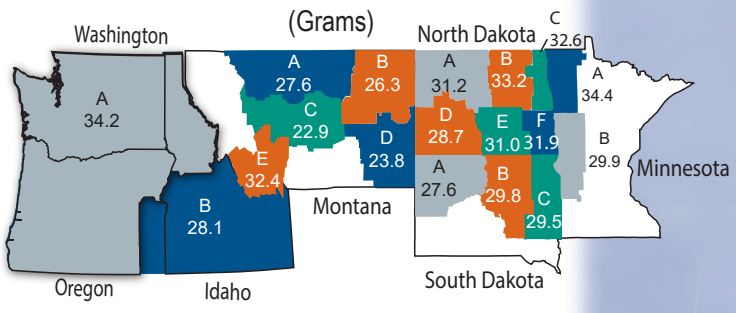
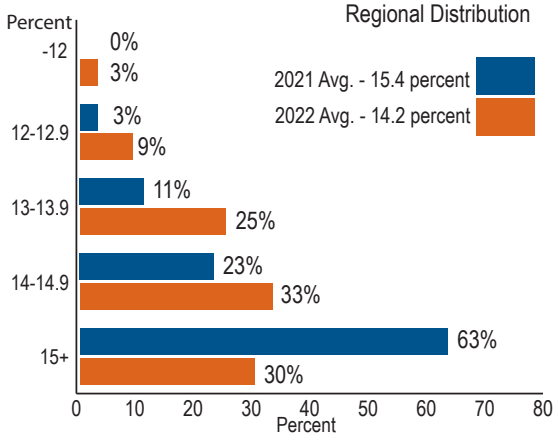
1000 KERNEL WEIGHT



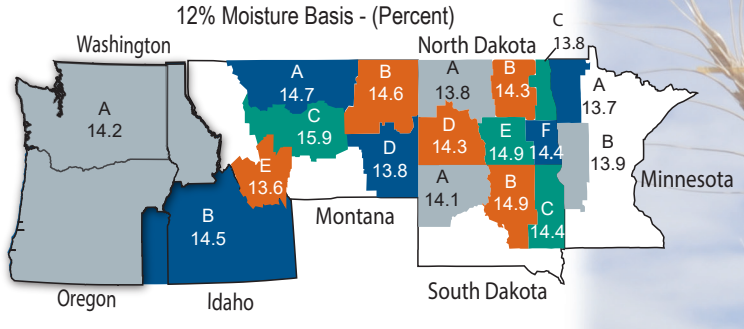
AVERAGE 1000 KERNEL BY AREA



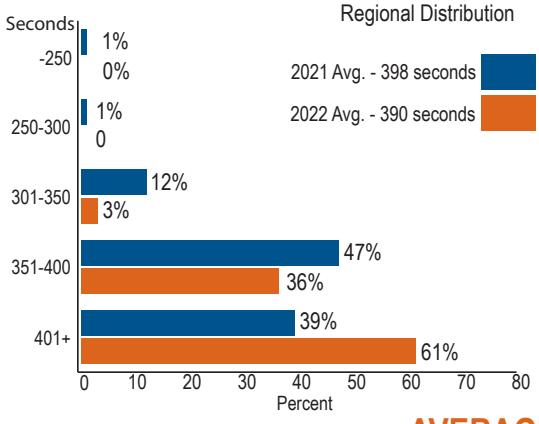
PROTEIN - 12% MOISTURE



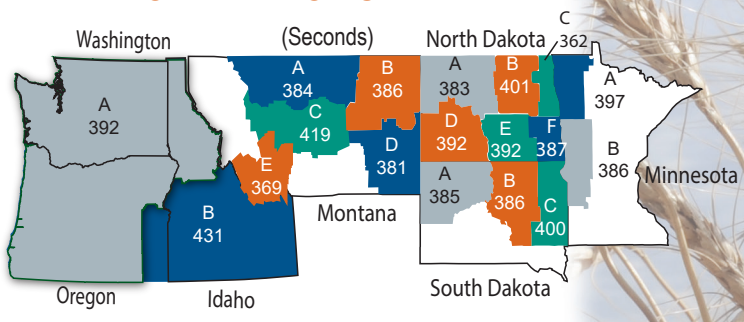
AVERAGE WHEAT PROTEIN BY AREA



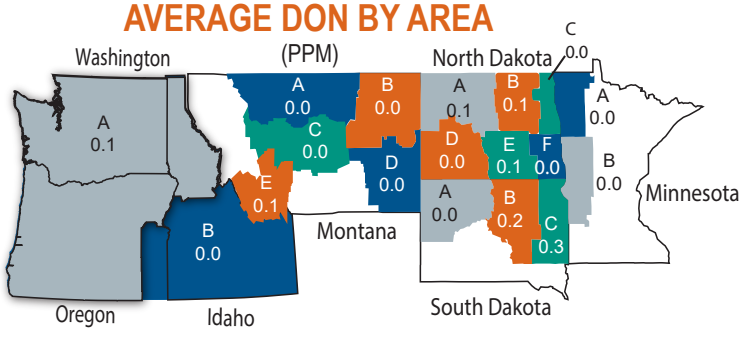
FALLING NUMBER



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	66.7	0.44	12.1	5.1	0.69	69/115	144/95	28.6	99	396	728
Area B	67.3	0.48	12.3	5.0	0.67	70/113	143/101	31.7	99	397	664
State Avg 2022	66.8	0.44	12.2	5.1	0.68	69/115	144/96	29.3	99	396	715
State Avg 2021	67.1	0.49	13.7	5.6	0.72	72/116	153/97	35.6	96	408	755
MONTANA											
Area A	66.8	0.53	13.7	6.0	0.68	73/120	145/94	36.7	92	397	812
Area B	66.2	0.51	13.5	5.0	0.67	71/116	147/102	36.2	91	397	884
Area C	66.3	0.55	15.1	5.0	0.61	74/125	141/106	40.2	94	484	830
Area D	66.8	0.49	12.7	5.9	0.62	72/124	143/105	32.3	96	395	775
Area E	66.3	0.48	12.3	6.2	0.64	70/125	151/112	32.5	94	405	786
State Avg 2022	66.4	0.52	13.5	5.4	0.67	72/119	146/99	36.2	92	400	850
State Avg 2021	66.0	0.51	14.5	5.3	0.64	74/128	148/102	37.6	92	405	754
NORTH DAKOTA											
Area A	67.7	0.51	12.5	6.0	0.65	73/122	149/106	31.5	98	391	701
Area B	67.5	0.47	12.8	5.7	0.69	71/116	149/99	32.0	98	386	665
Area C	66.5	0.45	12.1	6.0	0.70	74/115	150/98	32.9	99	384	675
Area D	66.5	0.47	12.8	5.6	0.68	70/118	148/98	35.3	90	380	801
Area E	67.2	0.53	13.2	5.8	0.66	69/111	136/95	34.7	90	406	709
Area F	67.2	0.50	12.8	5.7	0.57	71/119	123/97	34.5	94	394	691
State Avg 2022	67.2	0.49	12.7	5.8	0.67	72/118	146/100	33.0	96	388	711
State Avg 2021	67.9	0.50	14.5	5.6	0.67	73/121	148/100	37.5	92	407	678
SOUTH DAKOTA											
Area A	68.9	0.52	12.9	5.4	0.64	66/117	135/95	33.7	90	387	809
Area B	67.0	0.55	13.2	6.3	0.61	69/114	127/93	36.3	87	390	625
Area C	68.4	0.55	12.9	5.3	0.62	68/114	128/92	34.7	89	386	602
State Avg 2022	67.7	0.55	13.1	5.9	0.62	68/115	129/93	35.4	88	389	667
State Avg 2021	67.5	0.52	14.1	5.7	0.65	71/117	139/95	36.8	93	418	647
IDAHO - OREGON - WASHINGTON											
Area A	65.9	0.54	12.9	6.1	0.59	78/126	139/109	36.2	84	444	714
Area B	63.9	0.55	13.0	5.0	0.63	72/128	148/108	33.9	95	445	828
State Avg 2022	64.7	0.54	13.0	5.5	0.61	74/127	144/108	34.9	90	445	782
State Avg 2021	64.4	0.50	14.7	5.4	0.62	72/126	141/100	38.5	89	446	786
REGION AVERAGE											
Avg. 2022	67.0	0.49	12.7	5.6	0.67	71/117	144/99	33.1	95	393	730
Avg. 2021	67.4	0.50	14.3	5.6	0.67	72/121	148/100	37.1	93	409	705
Five-Year Avg.	68.6	0.53	13.7	7.1	0.66	73/121	148/103	35.3	91	399	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.

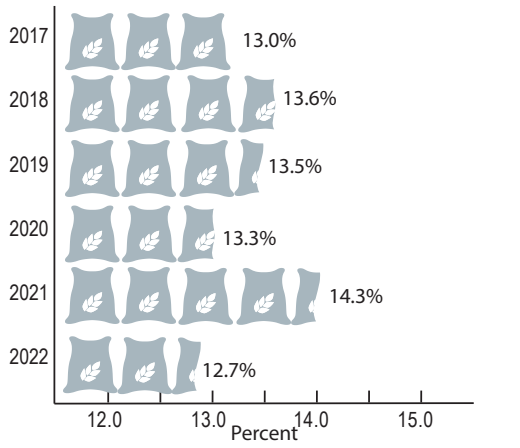
Another measure of milling efficiency and of flour grade is the ash content, or mineral residue, remaining after incineration of a sample.

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

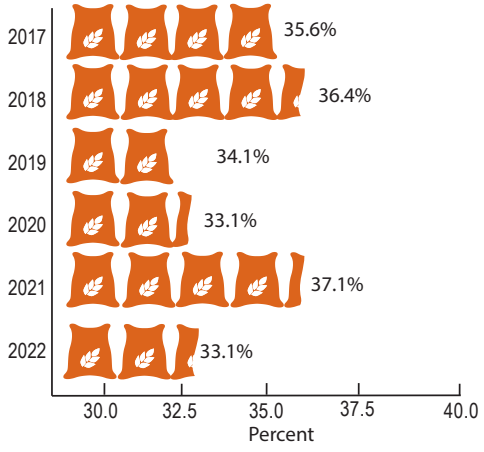
WET GLUTEN provides a quantitative measure of the gluten forming proteins in flour that are primarily responsible for its dough mixing and baking properties.

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

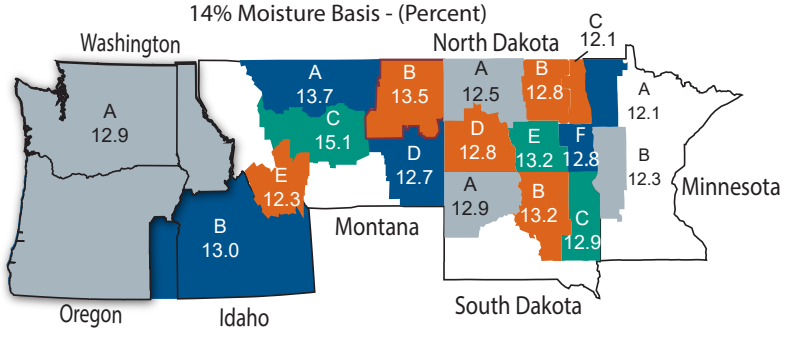


WET GLUTEN – Regional Average



AVERAGE FLOUR PROTEIN BY AREA

14% Moisture Basis - (Percent)



U.S. HARD RED SPRING WHEAT

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

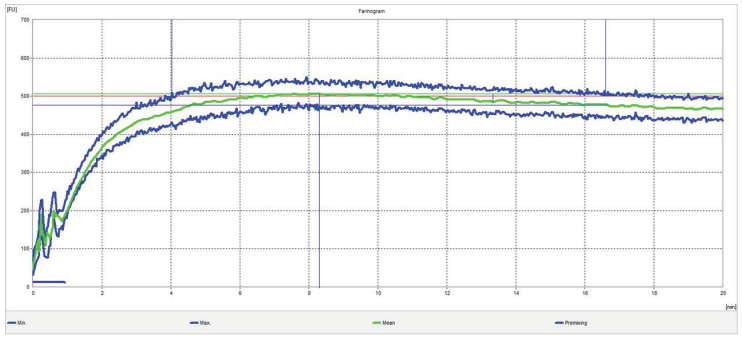
PHYSICAL DOUGH QUALITY

STATE AND CROP REPORTING AREA	FARINOGRAPH ABSORPTION %	PEAK TIME MIN	STABILITY MIN	MTI B.U.	QUALITY NUMBER MM
MINNESOTA					
Area A	61.8	6.8	15.5	19	168
Area B	60.6	7.3	13.9	23	153
State Avg 2022	61.6	6.9	15.2	20	165
State Avg 2021	61.9	7.4	21.2	15	260
MONTANA					
Area A	63.8	9.1	11.8	21	171
Area B	63.8	8.2	12.2	19	171
Area C	64.8	8.2	13.7	14	194
Area D	62.2	7.9	13.2	19	159
Area E	64.9	7.5	11.1	20	162
State Avg 2022	63.8	8.5	12.1	19	171
State Avg 2021	63.4	8.1	13.9	17	202
NORTH DAKOTA					
Area A	63.6	7.1	11.0	22	140
Area B	63.4	6.7	12.5	18	154
Area C	63.5	7.1	12.9	29	156
Area D	63.1	7.5	14.2	14	174
Area E	63.0	7.9	9.1	31	134
Area F	62.3	7.0	10.2	27	132
State Avg 2022	63.3	7.1	12.1	21	152
State Avg 2021	62.9	8.2	15.5	18	222
SOUTH DAKOTA					
Area A	61.5	8.2	11.9	23	160
Area B	62.2	6.7	8.6	30	127
Area C	61.8	7.4	8.9	31	125
State Avg 2022	62.0	7.2	9.4	28	135
State Avg 2021	62.7	8.6	14.8	17	206
IDAHO - OREGON - WASHINGTON					
Area A	64.8	7.1	8.5	29	134
Area B	64.5	10.3	20.0	14	256
State Avg 2022	64.6	9.0	15.4	20	207
State Avg 2021	63.9	10.1	13.2	20	194
REGION AVERAGE					
Avg. 2022	63.0	7.3	12.5	21	157
Avg. 2021	62.8	8.1	16.2	18	225
Five-Year Avg.	62.8	7.8	12.3	22	161

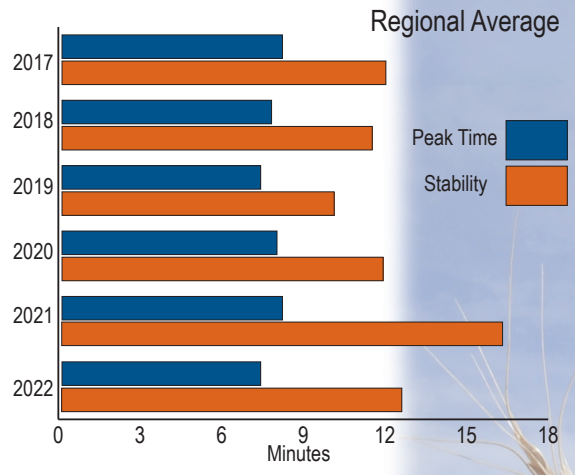
Physical characteristics of dough are evaluated to reveal useful information about variations in flour types, processing requirements and expected end-product quality.

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.

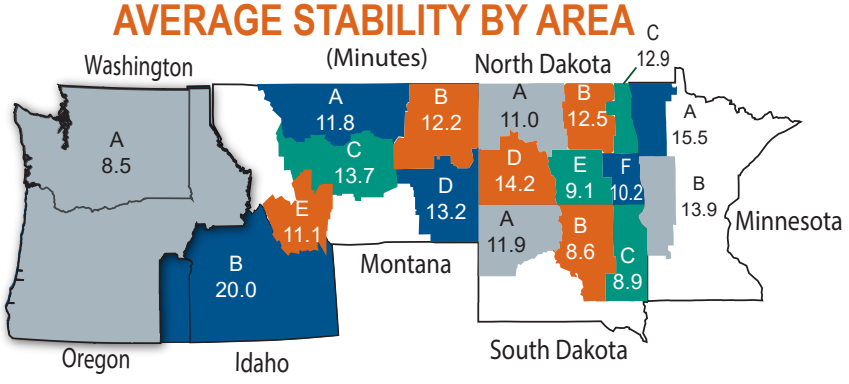
2022 AVERAGE FARINOGRAPH



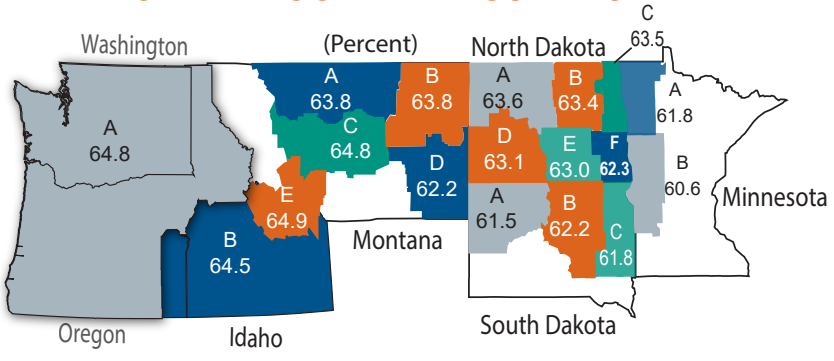
FARINOGRAPH RESULTS



AVERAGE STABILITY BY AREA



AVERAGE FARINOGRAPH ABSORPTION BY AREA



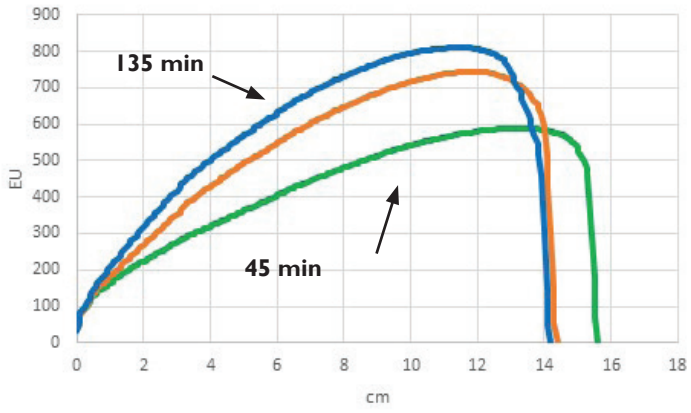
U.S. HARD RED SPRING WHEAT

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

PHYSICAL DOUGH QUALITY

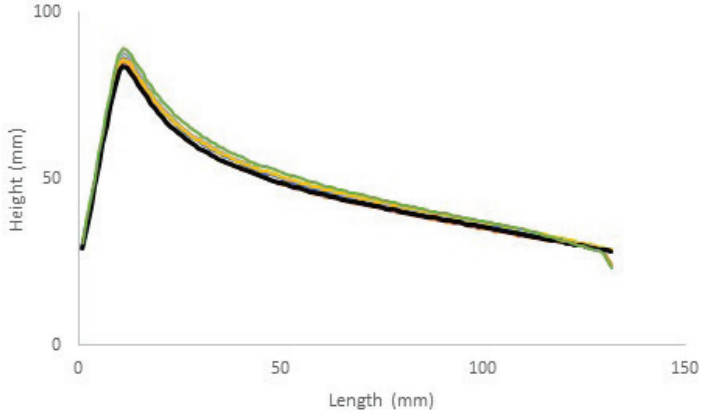
	EXTENSOGRAPH						ALVEOGRAPH			
STATE AND CROP REPORTING AREA	EXTENSIBILITY 45 MIN CM	RESISTANCE 45 MIN B.U.	AREA SQ CM	EXTENSIBILITY 135 MIN CM	RESISTANCE 135 MIN B.U.	AREA SQ CM	P MM	L MM	P/L RATIO	W JOULES X 10^4
MINNESOTA										
Area A	15.6	581	114	15.0	734	147	100	122	0.82	433
Area B	16.0	607	126	13.9	867	156	88	134	0.66	404
State Avg 2022	15.7	586	116	14.8	761	149	98	124	0.78	427
State Avg 2021	17.7	607	132	13.7	1117	200	86	125	0.69	395
MONTANA										
Area A	15.8	492	99	13.4	817	145	95	131	0.73	413
Area B	16.1	523	108	13.5	878	154	96	125	0.77	405
Area C	17.5	579	128	14.1	1008	187	89	159	0.56	446
Area D	17.8	592	138	14.4	846	155	98	111	0.88	402
Area E	16.3	430	93	13.8	783	138	108	117	0.92	402
State Avg 2022	16.1	514	106	13.5	856	151	96	127	0.75	409
State Avg 2021	17.6	560	126	13.1	999	169	85	141	0.60	397
NORTH DAKOTA										
Area A	15.6	522	105	14.8	887	174	95	136	0.70	417
Area B	18.5	567	130	15.8	702	144	101	125	0.81	436
Area C	15.6	589	117	14.2	810	148	101	127	0.80	432
Area D	16.1	571	117	13.0	964	155	99	128	0.77	435
Area E	17.0	424	92	14.2	673	124	80	133	0.60	323
Area F	15.8	584	122	14.3	789	149	86	137	0.63	380
State Avg 2022	16.5	549	115	14.5	828	154	97	130	0.74	419
State Avg 2021	16.3	635	132	12.0	1277	177	86	144	0.60	431
SOUTH DAKOTA										
Area A	17.2	465	109	13.6	667	118	77	136	0.57	338
Area B	16.2	392	87	15.3	616	124	82	127	0.65	320
Area C	17.0	448	103	15.9	564	113	78	136	0.57	326
State Avg 2022	16.6	420	95	15.0	619	121	80	131	0.61	326
State Avg 2021	16.5	586	124	11.5	1171	170	82	135	0.61	376
IDAHO - OREGON - WASHINGTON										
Area A	15.3	452	91	12.7	620	102	99	121	0.82	377
Area B	17.1	610	140	12.4	947	159	108	118	0.92	456
State Avg 2022	16.4	547	120	12.5	816	136	104	119	0.88	424
State Avg 2021	17.0	572	124	12.3	1161	186	82	144	0.57	387
REGION AVERAGE										
Avg. 2022	16.3	541	113	14.4	804	150	96	129	0.74	412
Avg. 2021	16.8	615	130	12.4	1201	180	85	140	0.61	415
Five-Year Avg.	16.8	539	117	14.1	863	154	83	134	0.62	370

2022 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.

2022 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

*Dough handling, grain and texture, crumb color, crust color, symmetry all have a scale of 1-10. The highest rating is 10.

STATE AND CROP REPORTING AREA	BAKING ABSORPTION %	*DOUGH HANDLING PROPERTIES	LOAF VOLUME CC	GRAIN AND TEXTURE	CRUMB COLOR	CRUST COLOR	SYMMETRY
MINNESOTA							
Area A	67.0	9.0	900	8.0	8.0	10.0	8.0
Area B	66.1	9.0	960	7.0	8.0	10.0	7.0
State Avg 2022	66.8	9.0	912	7.8	8.0	10.0	7.8
State Avg 2021	65.3	9.0	860	7.4	8.0	9.0	7.8
MONTANA							
Area A	72.6	9.0	920	7.5	8.0	10.0	9.0
Area B	72.4	9.0	940	7.5	7.5	10.0	8.0
Area C	72.1	9.0	1010	8.5	8.0	10.0	9.0
Area D	69.8	9.0	900	8.0	7.5	10.0	8.0
Area E	72.8	9.0	925	8.0	7.5	10.0	8.0
State Avg 2022	72.4	9.0	933	7.6	7.7	10.0	8.4
State Avg 2021	68.3	8.9	925	7.3	7.8	10.0	7.6
NORTH DAKOTA							
Area A	71.5	9.0	1015	7.5	8.0	10.0	10.0
Area B	71.3	9.0	970	8.5	8.5	10.0	9.0
Area C	71.1	8.0	845	7.5	7.5	10.0	8.0
Area D	73.2	9.0	900	8.0	8.0	10.0	8.0
Area E	69.7	9.0	900	7.5	8.0	10.0	8.0
Area F	69.6	9.0	850	8.0	8.5	10.0	7.0
State Avg 2022	71.5	8.9	940	7.9	8.1	10.0	8.8
State Avg 2021	67.6	8.6	927	7.9	8.0	10.0	8.0
SOUTH DAKOTA							
Area A	67.7	8.0	870	7.5	7.5	10.0	7.0
Area B	68.5	9.0	880	7.5	8.0	10.0	8.0
Area C	68.1	8.0	925	8.0	8.0	10.0	9.0
State Avg 2022	68.3	8.6	886	7.6	7.9	10.0	7.9
State Avg 2021	65.6	9.0	923	7.9	8.2	10.0	8.4
IDAHO - OREGON - WASHINGTON							
Area A	72.5	8.0	950	8.0	8.5	10.0	9.0
Area B	70.7	8.0	945	7.5	8.0	10.0	8.0
State Avg 2022	71.4	8.0	947	7.7	8.2	10.0	8.4
State Avg 2021	69.0	9.0	1027	8.2	8.5	10.0	8.6
REGION AVERAGE							
Avg 2022	70.6	8.9	931	7.8	8.0	10.0	8.5
Avg 2021	67.2	8.7	918	7.8	8.0	9.8	8.0
Five-Year Avg.	67.4	8.8	971	7.7	7.8	9.9	8.8

RECENT QUALITY TRENDS

SUMMARY INFORMATION							
CROP YEAR	2022	2021	2020	2019	2018	2017	FIVE-YEAR AVERAGE
WHEAT GRADING							
Test Weight (lbs/bu)	62.1	61.5	61.8	60.7	62.2	61.7	61.6
Test Weight (kg/hl)	81.7	80.8	81.3	79.8	81.8	81.1	81.0
Vitreous Kernels (%)	73	81	72	55	86	71	73
1000 Kernel Weight (gm)	30.9	30.6	32.0	31.9	31.2	31.5	31.4
Protein: 12%/0% moisture	14.2/16.1	15.4/17.4	14.3/16.2	14.5/16.4	14.5/16.5	14.5/16.5	14.6/16.6
Ash: 14% moisture (%)	1.56	1.52	1.57	1.54	1.57	1.50	1.54
Falling Number (sec)	390	398	389	337	399	389	382
FLOUR DATA							
Extractions (%)	67.0	67.4	67.7	68.7	68.1	71.2	68.6
Ash: 14% moisture (%)	0.49	0.50	0.52	0.53	0.52	0.57	0.53
Protein: 14% moisture (%)	12.7	14.3	13.3	13.5	13.6	13.8	13.7
Wet Gluten (%)	33.1	37.1	33.1	34.1	36.4	35.6	35.3
Falling Number (sec)	393	409	407	352	421	407	399
Amylograph Peak Viscosity							
65g FL (B.U.)	730	705	632	441	649	570	599
PHYSICAL DOUGH PROPERTIES							
***FARINOGRAPH:**							
Absorption (%)	63.0	62.8	61.6	62.6	64.2	62.6	62.8
Peak Time (min)	7.3	8.1	7.9	7.3	7.7	8.1	7.8
Stability (min)	12.5	16.2	11.8	10.0	11.4	11.9	12.3
EXTENSOGRAPH:							
Extensibility-45 min (cm)	16.3	16.8	16.2	17.9	16.1	16.8	16.8
Resistance-45 min (B.U.)	541	615	498	497	570	513	539
Area-45 min (sq cm)	113	130	105	117	120	113	117
ALEOGRAPH:							
P (mm)	96	85	81	83	88	80	83
L (mm)	129	140	134	135	119	141	134
W (joules x10^4)	412	415	359	360	345	372	370
BAKING DATA							
Absorption (%)	70.6	67.2	67.0	67.2	69.5	66.2	67.4
Dough Handling Properties	8.9	8.7	8.9	8.4	9.0	9.0	8.8
Loaf Volume (CC)	931	918	977	1019	988	951	971
Grain and Texture	7.8	7.8	7.8	7.7	7.6	7.8	7.7
Crumb Color	8.0	8.0	7.7	7.6	7.7	7.8	7.8
Crust Color	10.0	9.8	9.9	9.8	10.0	9.8	9.9
Symmetry	8.5	8.0	8.7	9.1	9.3	9.1	8.8

U.S. HARD RED SPRING WHEAT

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

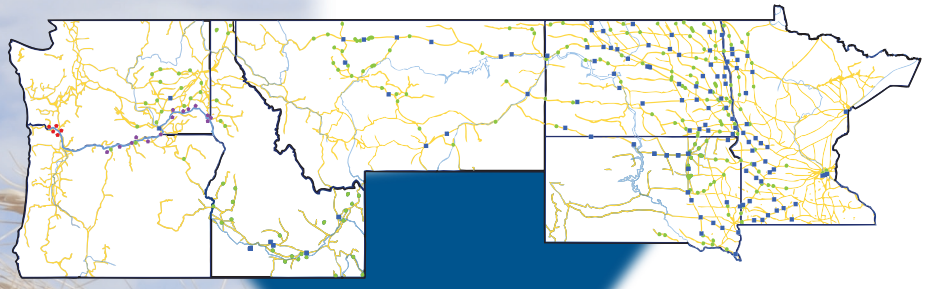
HANDLING AND TRANSPORTATION

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

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

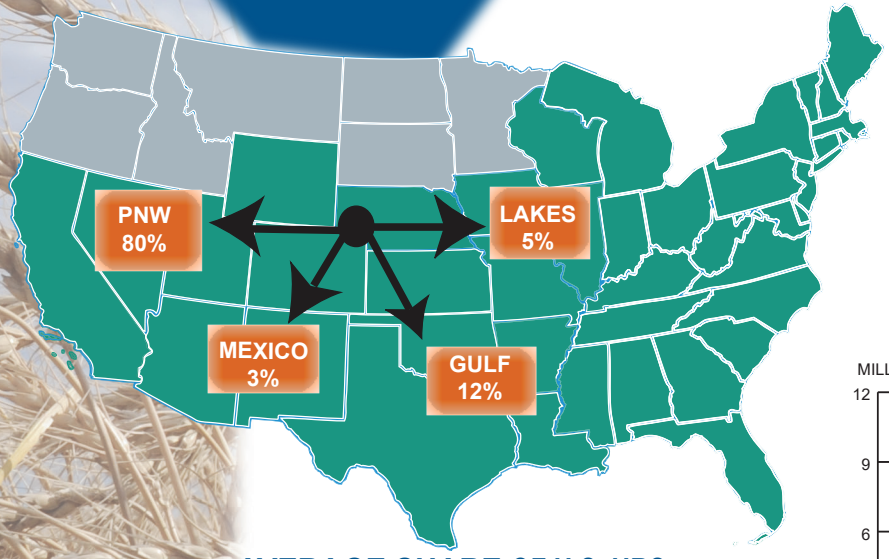
The diverse rail and water shipping capacities and a widespread network of elevators are strengths that buyers can capitalize on, especially as their demand heightens for more precise quality specifications and consistency between shipments. Buyers are encouraged to explore origin-specific shipments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

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



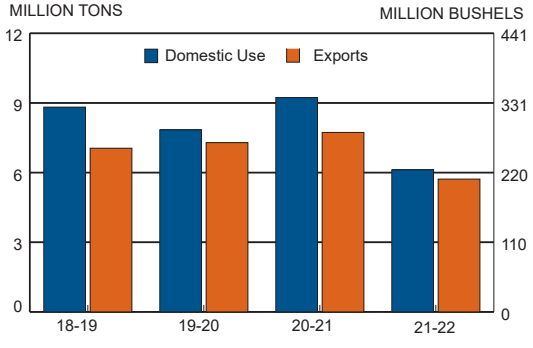
Grain Handling and Transportation Facilities in the U.S. HRS Region

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



AVERAGE SHARE OF U.S. HRS EXPORTS BY PORT (2018-2021)

2018-2021 U.S. HRS DOMESTIC USE AND EXPORTS



2022 SURVEY BACKGROUND

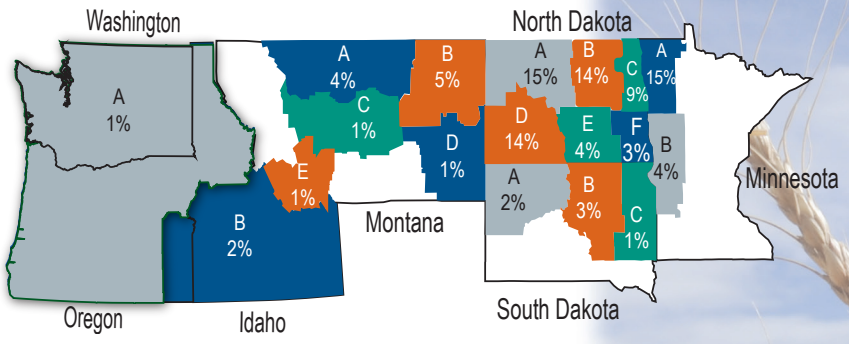
All quality data contained in this report are the result of testing and analysis conducted under the supervision of Dr. Shahidul Islam, Wheat Quality Specialist, and by his team members, DeLane Olsen, Kelly McMonagle, Amber Walter, and Gwen Thomas, with the Hard Red Spring Wheat Quality Laboratory at 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, and the NDSU Extension Service obtained samples during harvest directly from growers either in the fields or farm bins and local elevators. PNW samples were obtained from the Wheat Marketing Center. These samples reflect the condition of the grain at the point of origin. Sample collection is based on county production histories. A total of 810 samples were collected. Minnesota (117), Montana (159), North Dakota (393), South Dakota (86) and PNW (55).

ANALYSIS - Approximately 60 percent of the total wheat samples collected were analyzed for grade and other physical kernel characteristics, to generate distribution data. Distribution averages may differ from data averages in the various tables, because the latter are derived from all samples.

All samples collected are represented in the composite for each crop reporting area. All state and regional averages have been adjusted to reflect current year production.

APPROXIMATE SHARE OF REGIONAL PRODUCTION



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 76.31.01. Amperometric method using SDmatic.

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).

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

2022 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]	LEAF RUST	BACTERIAL LEAF STREAK	HEAD (SCAB)	BU/ACRE	MT/HECT	BU/ACRE	MT/HECT
AP Murdock	Syngenta/AgriPro	2019	4	5	6	6	69.3	4.66	49.0	3.29
Elgin ND	ND	2012	5	6	6	4	63.8	4.29	52.0	3.50
Faller	ND	2007	5	7	5	4	70.7	4.75	53.8	3.62
Glenn	ND	2005	4	6	4	4	58.6	3.94	48.5	3.26
Lanning	MSU	2017	4	7	8	6	62.0	4.17	52.3	3.52
Linkert	MN	2013	2	3	6	5	60.3	4.05	47.6	3.20
MN Torgy	MN	2020	3	4	3	3	67.4	4.53	51.2	3.44
ND VitPro	ND	2016	3	4	5	4	59.0	3.97	47.9	3.22
Shelly	MN	2016	4	6	7	5	66.5	4.47	52.6	3.54
SY Ingmar	Syngenta/AgriPro	2014	3	3	4	5	65.0	4.37	48.6	3.27
SY Valda	Syngenta/AgriPro	2015	4	2	6	5	69.4	4.67	50.4	3.39
WB 9479	Westbred	2017	2	1	8	6	60.6	4.07	50.5	3.40
WB 9590	Westbred	2017	3	3	8	6	64.1	4.31	50.9	3.42

1. ND – North Dakota State University (Public), MN – University of Minnesota (Public), MSU - Montana State University (Public), 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. Means were obtained using mixed model analysis to account for unbalanced and occasional missing data. Data source was 2018-2021 North Dakota statewide variety trials.
   East locations: Carrington, Casselton, Langdon, Prosper, Thompson, Sargent, and Steel county.
5. West locations: Dickinson, Hettinger, Mandan, Minot and Williston.

VARIETAL INFORMATION

2022 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]
AP Murdock	61.0	80.2	14.8	59	14.9	63.9	913	★★★
Elgin ND	61.0	80.2	15.4	70	9.1	65.5	973	★★★
Faller	60.8	80.0	14.6	58	11.1	63.6	925	★★★
Glenn	63.5	83.4	15.7	89	15.9	64.5	971	★★★★★
Lanning	60.7	79.9	15.9	81	12.6	63.6	1016	★★★★
Linkert	61.5	80.8	16.1	78	20.9	64.3	983	★★★★★
MN Torgy	61.9	81.4	15.3	61	17.5	61.9	924	★★★
ND VitPro	62.9	82.7	15.8	87	10.5	64.9	956	★★★
Shelly	61.2	80.5	14.5	60	15.0	61.2	910	★★
SY Ingmar	62.0	81.5	15.6	72	14.2	63.3	978	★★★★
SY Valda	61.5	80.9	14.7	82	8.4	62.6	886	★★
WB 9479	63.5	83.5	15.9	94	21.4	63.5	989	★★★
WB 9590	63.2	83.1	15.3	92	14.9	64.0	923	★★★

6. Source: NDSU Plant Science Department, Hard Red Spring Wheat Quality Laboratory, 2018-2021 drill strip trials across ND locations. WB 9479 and 9590 are 2018 and 2021; Elgin, Shelly and Linkert 2018-2020; all other are 2019-2021.
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.

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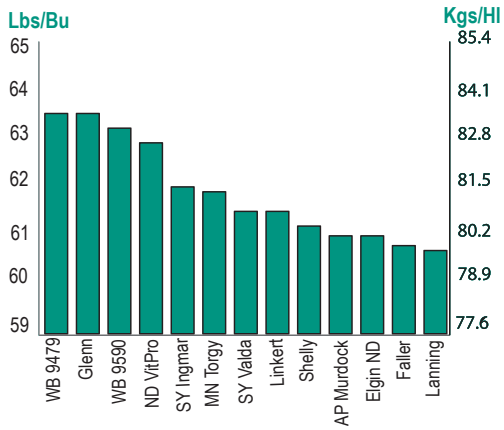
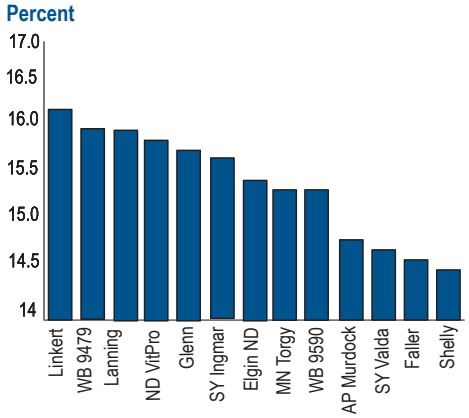
QUALITY COMPARISON BY POPULAR VARIETIES

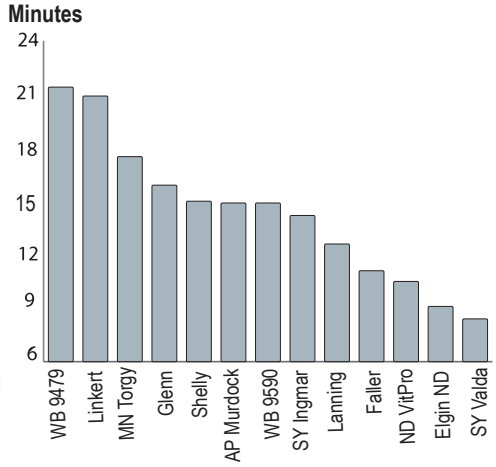
TEST WEIGHT



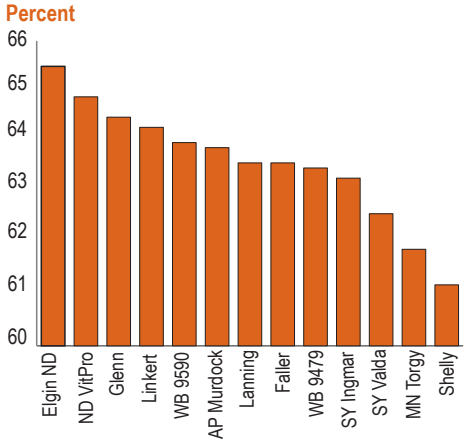
PROTEIN - 12% MOISTURE BASIS



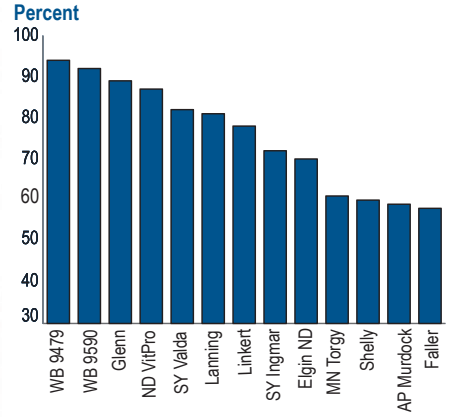
FARINOGRAPH STABILITY



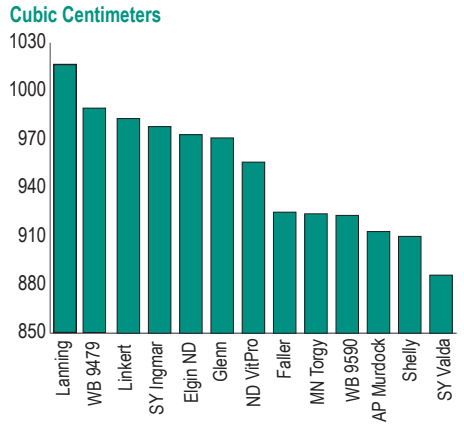
FARINOGRAPH ABSORPTION



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. 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.

Source: NDSU Growing season data for AP Murdock is 2020-21; Westbred is 2018 and 2021; Elgin ND, Linkert & Shelly are 2018-2020; and all others are 2019-21.

NORTH DAKOTA

SY VALDA advanced to the top spot in North Dakota with an 11 percent share of acres, up slightly from 2021, but fell to third place in Minnesota, also at an 11 share, although down slightly from a year ago. A 2015 release from Syngenta/AgriPro, it is popular in eastern parts of the HRS region for its elite yield potential and strong disease tolerance, especially for Fusarium head-blight. It is rated as average for milling and baking quality

SY INGMAR slipped to second place with a 9.4 percent share of acres, down from 13.2 percent in 2021. It had been the top variety planted in the state for the five previous years. SY Ingmar is most popular across the western and central regions of ND, and ranks seventh in Montana with 4 percent of the acres. 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.

AP MURDOCK moved into third place in North Dakota with 8.8 percent of the acres, and ranks fourth in Minnesota with 7.6 percent of the acres. Released in 2019 by Syngenta/AgriPro, AP Murdock provides excellent yield potential, good straw strength, moderately high protein levels. It is rated as good for milling and baking quality.

WB 9719 and SHELLY account for about a four percent acreage share each, with both showing gains in 2022. WB 9719 is 2017 release from Westbred, and has broad acceptance across the state, due to it's balanced agronomic traits. Shelly is a 2016 release from the University of Minnesota with mid-late maturity, and balanced agronomic traits. It is the leading variety in the southwest part of the state.

NORTH DAKOTA VARIETY SHARE OF PLANTED ACRES[3]

Variety	2022%[1]	2021%[1]
SY Valda	11.0	9.5
SY Ingmar	9.4	13.2
AP Murdock	8.8	4.7
WB 9590	8.8	7.5
WB 9719	4.1	2.2
Shelly	3.9	3.3
ND Vitpro	3.0	2.9
Elgin ND	3.0	2.2
Faller	2.9	4.2
Glenn	2.7	4.4
Other[2]	45.9	42.4

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)
   2022 – 5,300,000 planted acres
   2021 – 5,500,000 planted acres

TOP 3 NORTH DAKOTA VARIETIES BY CROP DISTRICT

	First	Second	Third
Northwest	SY Ingmar 19.2	SY Valda 8.2	AP Murdock 6.9
North Central	SY Valda 22.9	SY Ingmar 15.8	AP Murdock 11.5
Northeast	AP Murdock 15.1	SY Valda 14.4	WB 9590 12.0
West Central	SY Ingmar 13.7	ND Vitpro 10.2	Elgin ND 9.4
Central	AP Murdock 18.0	WB 9590 15.6	SY Valda 7.2
East Central	WB 9590 22.3	AP Murdock 15.4	SY Valda 8.9
Southwest	Shelly 18.6	Elgin ND 7.4	Glenn 6.0
South Central	SY Valda 19.1	WB 9590 15.6	Elgin ND 6.9
Southeast	SY Valda 18.9	AP Murdock 11.2	WB 9590 9.2

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MINNESOTA

MINNESOTA VARIETY SHARE OF SURVEYED ACRES[3]

VARIETY	2022%[1]	2021%[1]
MN Torgy	21.7	9.7
WB 9590	19.4	18.0
SY Valda	11.0	12.8
WB 9479	7.9	10.3
AP Murdock	7.6	8.4
Linkert	6.3	11.9
Shelly	4.0	4.2
Other[2]	22.0	24.7

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)
   2022 – 1,250,000 planted acres
   2021 – 1,210,000 planted acres

TOP 3 MINNESOTA VARIETIES BY CROP DISTRICT

	First	Second	Third
North	WB 9590 22.0	MN Torgy 18.0	SY Valda 11.0
Central	MN Torgy 36.0	SY Valda 13.0	WB 9590 9.0
South	MN Torgy 26.0	Bolles 13.0	Linkert 8.0

MN TORGY made significant gains in acreage share in 2022 and moved into the top position in Minnesota with nearly 22 percent of the acres. It is a 2020 release from the University of Minnesota, that is most popular in central and southern production areas of the state. MN Torgy has excellent disease resistant traits, very strong straw, and high yield potential. It is rated as good for milling and baking quality.

WB 9590 fell to second position in Minnesota in 2022, but garnered a slight increase in acreage share to 19.4 percent. It is the fourth most popular variety in North Dakota with 8.8 percent of the acres, also up slightly from a year ago. 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 2022 with 7.9 percent of the acres, down from slightly more than 10 percent a year ago. 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.

LINKERT slipped into sixth position in Minnesota in 2022, with a 6.3 percent acreage share, down from 11.9 percent in 2021. A 2013 release from the University of Minnesota, it was once the dominant variety in the state, and is sought after by producers for its very strong straw, high protein levels and disease resistance traits. Linkert has excellent milling and baking qualities, with especially strong dough properties.

MONTANA

VIDA remains the leading variety planted in Montana, with 21.8 percent of the acres, steady with 2021. It has been the top variety in the state for eleven straight years, due to it's high yield and moderate resistance to leaf rust and stripe rust. A 2005 release from the, Vida is most popular across northern and central areas, and is rated as good for milling and baking quality.

SY LONGMIRE is the second most popular variety in Montana, with 8.6 percent of the acres in 2022, more than double from a year ago. It is a 2019 release from Syngenta/AgriPro. SY Longmire is a solid stem variety that is highly tolerant to the wheat stem sawfly which is a persistent pest challenge in parts of Montana. It has very good yield potential and good protein levels.

BRENNAN moved into third position with 8.4 percent of the acres, up from just 3 percent in 2021. It is a 2009 release from Syngenta/AgriPro. Brennan is an early maturity variety with a high level of resistance to leaf spotting disease, high yield potential and good protein potential. It is rated as average for milling and baking traits.

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]
Alum	WSU	2014	62.7	82.4	13.9	25.2	66.5	1076	MD
Buck Pronto	Buck Semilas S.A.	2001	61.5	80.9	15.3	21.7	67.9	937	A
Chet	WSU	2014	63.3	83.2	14.7	18.4	68.0	1106	MD
Expresso	Westbred	2000	62.6	82.3	14.7	5.1	68.5	1032	*NR
Glee	WSU	2012	62.6	82.3	13.5	16.0	65.6	1058	MD
Jefferson	ID	1997	62.3	81.9	13.6	20.9	66.1	977	MD
Kelse	WSU	2008	62.0	81.5	14.4	19.0	67.7	1082	D
AP Renegade	Syngenta	2017	61.9	81.4	13.3	28.9	65.2	922	D
WB 9303	Westbred	2021	62.6	82.3	15.6		66.8	968	*NR
WB 9518	Westbred	2013	61.9	81.4	14.9	12.7	69.3	1118	*NR
WB 9662	Westbred	2014	62.4	82.0	14.5	5.5	67.7	998	LD
WB 9668	Westbred	2014	62.9	82.7	14.9	13.5	69.3	1096	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	2022%[1]	2021%[1]
Vida	21.8	22.6
SY Longmire	8.6	4.0
Brennan	8.4	3.0
Reeder	7.2	12.2
Corbin	6.7	5.6
Lanning	6.2	6.5
SY Ingmar	4.2	5.9
Barlow	3.6	3.7
SY Soren	3.3	3.8
SY McCloud	2.6	0.8
Other[2]	27.4	31.9

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)
   2022 – 2,700,000 planted acres
   2021 – 2,900,000 planted acres

TOP 2 MONTANA VARIETIES BY CROP DISTRICT

	FIRST	SECOND
	PERCENTAGE (%)	
North Central	Vida 30.3	Corbin 16.7
North East	Brennan 16.3	Vida 16.1
Central	Vida 22.8	SY Ingmar 13.6

SOUTH DAKOTA - no survey results in 2022.

2022 Regional Quality Report
U.S. HARD RED SPRING WHEAT

Funding & Support Provided by

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