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North Dakota Hard Red Spring Wheat

Variety Trial Results for 2018 and Selection Guide

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Hard red spring (HRS) wheat was planted on 6.55 million acres in 2018, up 22 percent from 2017. The average yield of spring wheat was 49 bushels/acre (bu/a), up from last year's drought-impacted crop and represents the highest recorded yield for the state.

SY Ingmar was the most popular HRS wheat variety in 2018, occupying 20.3 percent of the planted acreage, followed by SY Valda (8.7), SY Soren (7.7), Barlow (6.4), Bolles (6.1), Faller (6.0), Linkert (5.8), Elgin-ND (4.6) and Glenn (3.9). SY Ingmar, SY Soren and SY Valda were released by Syngenta/AgriPro. Bolles and Linkert were released by the University of Minnesota. Barlow, Faller, Elgin-ND and Glenn are NDSU releases.

Successful wheat production depends on numerous factors, including selecting the right variety for a particular area. The information included in this publication is meant to aid in selecting that variety or group of varieties. Characteristics to consider in selecting a variety may include yield potential, protein content when grown with proper fertility, straw strength, plant height, response to problematic pests (diseases, insects, etc.) and maturity. Every growing season differs; therefore, when selecting a variety, we recommend using data that summarize several years and locations. Choose the variety that, on average, performs the best at multiple locations near your farm during several years.

Selecting varieties with good milling and baking quality also is important to maintain market recognition and avoid discounts. Hard red spring wheat from the northern Great Plains is known around the world for its excellent end-use quality.

Millers and bakers consider many factors in determining the quality and value of wheat they purchase. Several key parameters are: high test weight (for optimum milling yield and flour color), high falling number (greater than 300 seconds indicates minimal sprout damage), high protein content (the majority of HRS wheat export markets want at least 14 percent protein) and excellent protein quality (for superior bread-making quality as indicated by traditional strong gluten proteins, high baking absorption and large bread loaf volume).

Gluten strength, and milling and baking quality ratings are provided for individual varieties based on the results from the NDSU field plot variety trials in multiple locations in 2017. The wheat protein data often are higher than obtained in actual production fields but can be used to compare relative differences among varieties.

The agronomic data presented in this publication are from replicated research plots using experimental designs that enable the use of statistical analysis. These analyses enable the reader to determine, at a predetermined level of confidence, if the differences observed among varieties are reliable or if they might be due to error inherent in the experimental process.

The LSD (least significant difference) values beneath the columns in the tables are derived from these statistical analyses and apply only to the numbers in the column in which they appear. If the difference between two varieties exceeds the LSD value, it means that with 95 or 90 percent confidence (LSD probability 0.05 or 0.10), the higher-yielding variety has a significant yield advantage. When the difference between two varieties is less than the LSD value, no significant difference was found between those two varieties under those growing conditions.

NS is used to indicate no significant difference for that trait among any of the varieties at the 95 or 90 percent level of confidence. The CV stands for coefficient of variation and is expressed as a percentage. The CV is a measure of variability in the trial. Large CVs mean a large amount of variation that could not be attributed to differences in the varieties. Yield is reported at 13.5 percent moisture, while protein content is reported at 12 percent moisture content.

Presentation of data for the entries tested does not imply approval or endorsement by the authors or agencies conducting the test. North Dakota State University approves the reproduction of any table in the publication only if no portion is deleted, appropriate footnotes are given and the order of the data is not rearranged. Additional data from county sites are available from each Research Extension Center at www.ag.ndsu.edu/varietytrials/spring-wheat. Also consider using the online variety selection tool at www.ag.ndsu.edu/varietyselectiontool/, which allows you to generate tables of data from research locations nearest your farm and make head-to-head comparisons of varieties of interest.

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Table 1. North Dakota hard red spring wheat variety descriptions, agronomic traits, 2018.

Variety	Agent or Origin ¹	Year Released	Height (inches)	Reaction to Disease ⁴							
				Straw Strength ²	Days to Head ³	Stem Rust ⁵	Leaf Rust	Stripe Rust	Tan Spot	Bact. Leaf Streak	Head Scab
AAC Brandon	AAC	2014	31	5	47	NA	2	NA	NA	4	5
AAC Goodwin	AAC	2018	32	5	48	NA	2	NA	NA	7	5
AAC Penhold	AAC	2015	30	3	49	NA	3	NA	NA	6	6
Ambush	DynaGro	2016	30	5	46	1	4	3	NA	8	5
Barlow	ND	2009	32	6	47	1	6	4	6	7	5
Bolles	MN	2015	32	4	52	2	3	5	4	8	5
Boost	SD	2016	33	5	51	1	4	3	8	5	4
Caliber	DynaGro	2016	28	2	48	1	3	5	NA	7	8
Elgin-ND	ND	2012	34	5	48	1	6	5	6	7	5
Faller	ND	2007	32	5	50	1	7	8	7	7	5
Glenn	ND	2005	33	4	47	1	6	4	6	7	3
HRS 3100	Croplan	2016	30	4	48	1	4	6	8	7	6
HRS 3419	Croplan	2014	31	2	53	1	3	4	7	8	5
HRS 3504	Croplan	2015	30	3	50	1	1	6	8	7	7
HRS 3530	Croplan	2015	33	4	51	1	2	8	6	8	5
HRS 3616	Croplan	2016	31	4	49	1	5	5	4	8	7
HRS 3888	Croplan	2017	31	4	49	NA	1	NA	NA	8	4
Lang-MN	MN	2017	33	5	51	1	2	1	7	6	5
Lanning	MT	2017	29	3	51	NA	NA	NA	NA	8	5
LCS Breakaway	Limagrain	2011	30	5	45	1	3	6	4	8	5
LCS Cannon	Limagrain	2018	30	4	44	NA	7	NA	NA	8	5
LCS Rebel	Limagrain	2017	33	5	48	1	7	4	8	7	4
LCS Trigger	Limagrain	2016	33	5	53	1	1	2	6	5	4
Linkert	MN	2013	28	2	49	1	3	1	4	7	5
Mott ⁶	ND	2009	34	3	51	1	6	6	6	8	6
MS Barracuda	Meridian	2018	29	3	46	NA	2	NA	NA	NA	NA
MS Camaro	Meridian	2016	28	5	48	1	1	2	8	9	6
MS Chevelle	Meridian	2014	31	5	46	1	4	3	6	7	5
ND VitPro	ND	2016	31	3	48	1	4	3	7	7	4
Prosper	ND	2011	32	5	51	1	6	8	6	7	5
Rollag	MN	2011	30	3	49	1	4	2	3	7	3
Shelly	MN	2016	30	5	51	2	6	5	3	8	5
Surpass	SD	2016	31	5	46	1	4	6	8	7	5
SY Ingmar	Syngenta/AgriPro	2014	29	3	49	1	3	6	6	6	5
SY Rockford	Syngenta/AgriPro	2017	30	3	53	NA	NA	NA	NA	8	5
SY Soren	Syngenta/AgriPro	2011	28	3	48	1	2	7	2	7	5
SY Valda	Syngenta/AgriPro	2015	29	4	49	1	2	7	6	8	4
TCG-Climax	21 st Century Genetics	2017	32	2	53	1	6	3	8	8	6
TCG-Glenville	21st Century Genetics	2018	28	3	46	NA	1	NA	NA	7	6
TCG-Spitfire	21 st Century Genetics	2015	30	4	52	1	5	4	8	7	6
WB9479	WestBred	2017	28	4	49	1	1	1	6	9	6
WB9590	WestBred	2017	28	4	48	1	3	8	8	9	6
WB9653	WestBred	2015	28	4	48	2	3	8	6	8	6
WB9719	WestBred	2017	30	4	50	1	5	2	NA	7	6

¹Refers to agent or developer: AAC = Agriculture & Agri-Food Canada; MN = University of Minnesota; MT = Montana State University; ND = North Dakota State University; SD = South Dakota State University. Bold varieties are those recently released, so data is limited and rating values may change.

²Straw Strength = 1 to 9 scale, with 1 the strongest and 9 the weakest. These values are based on recent data and may change as more data become available.

³Days to Head = the number of days from planting to head emergence from the boot averaged based on data from several locations in 2018.

⁴Disease reaction scores from 1-9, with 1 = resistant and 9 = very susceptible, NA = not available.

⁵Fargo stem rust nursery inoculated with Puccinia graminis f. sp. Tritici races TPMK, TMLK, RTQQ, QFCQ and QTHJ.

⁶Solid stemmed or semisolid stem, imparting resistance to sawfly.

Table 2. Yield of hard red spring wheat varieties grown at five locations in eastern North Dakota, 2016-2018.

Variety	Carrington		Casselton		Langdon		Prosper		Steele Co.	Avg. eastern N.D.	
	2018	3 Yr.	2018	3 Yr.	2018	3 Yr.	2018	3 Yr.	2018	2018	3 Yr.
	------(bu/a)-----										
AAC Brandon	61.5	--	62.4	--	86.1	--	83.3	--	78.9	74.4	--
AAC Goodwin	71.4	--	65.5	--	89.4	--	78.3	--	85.5	78.0	--
AAC Penhold	72.0	--	65.2	--	88.3	--	76.2	--	78.7	76.1	--
Ambush	72.6	--	60.5	--	87.8	--	73.6	--	81.1	75.1	--
Barlow	66.4	52.7	57.1	76.2	85.2	73.0	79.9	77.4	75.0	72.7	69.8
Bolles	58.6	49.0	63.7	77.1	81.7	72.8	80.4	73.7	75.5	72.0	68.2
Boost	66.5	54.2	66.9	78.0	87.7	75.7	88.9	78.5	83.0	78.6	71.6
Caliber	61.8	--	49.9	--	76.2	--	66.9	--	70.5	65.1	--
Elgin-ND	62.6	52.1	60.4	76.6	88.7	78.3	85.2	80.3	77.2	74.8	71.8
Faller	75.8	54.8	70.4	79.0	97.5	86.2	89.8	87.5	88.5	84.4	76.9
Glenn	59.7	49.2	54.8	70.1	76.0	70.5	72.5	70.0	70.4	66.7	64.9
HRS 3100	70.5	--	68.1	--	86.5	77.1	83.8	--	82.4	78.3	--
HRS 3419	78.6	57.5	73.3	86.6	101.4	90.9	92.0	84.0	88.1	86.7	79.8
HRS 3504	74.9	58.2	66.9	83.1	91.6	80.5	85.7	87.0	85.2	80.9	77.2
HRS 3530	72.1	51.2	63.4	82.8	99.1	85.4	93.0	90.7	89.9	83.5	77.5
HRS 3616	66.0	54.8	62.7	78.9	81.3	74.3	78.7	76.1	76.8	73.1	71.0
HRS 3888	74.5	--	62.6	--	86.8	--	80.4	--	80.3	76.9	--
Lang-MN	71.0	54.2	58.3	76.7	79.1	72.3	82.6	78.3	76.8	73.6	70.4
LCS Breakaway	74.0	53.4	60.3	77.2	85.4	77.2	80.1	81.4	81.4	76.2	72.3
LCS Cannon	73.1	--	58.1	--	89.9	--	79.6	--	85.1	77.2	--
LCS Rebel	71.6	--	61.9	--	92.6	--	83.0	--	85.7	79.0	--
LCS Trigger	77.8	--	73.1	--	109.6	--	86.9	--	93.3	88.1	--
Linkert	63.5	51.2	58.8	72.9	75.0	67.2	75.2	75.7	73.6	69.2	66.8
MS Barracuda	67.0	--	63.4	--	93.1	--	82.8	--	--	61.3	--
MS Camaro	61.7	--	56.9	--	76.6	--	68.7	--	74.8	67.7	--
MS Chevelle	77.1	58.6	63.8	79.3	94.3	82.7	86.3	83.5	83.2	80.9	76.0
ND VitPro	55.6	48.2	56.7	70.9	78.4	71.0	79.8	71.7	71.8	68.4	65.5
Prosper	74.4	55.5	63.5	78.8	98.0	86.1	91.3	85.1	90.9	83.6	76.4
Rollag	61.1	52.0	57.8	74.3	78.0	75.0	74.3	77.1	74.3	69.1	69.6
Shelly	74.2	56.9	65.0	82.9	88.3	80.3	86.4	87.2	85.0	79.8	76.8
Surpass	73.4	--	65.8	85.0	91.1	76.6	94.6	90.1	82.3	81.4	--
SY Ingmar	74.2	56.4	65.0	80.6	91.1	78.4	79.5	79.8	78.3	77.6	73.8
SY Soren	65.5	53.6	59.8	76.8	80.0	74.9	73.7	76.4	74.7	70.7	70.4
SY Valda	71.9	57.5	66.0	84.7	100.4	87.8	88.3	92.8	89.2	83.2	80.7
TCG-Climax	66.9	--	58.8	--	82.4	--	71.0	--	81.8	72.2	--
TCG Glenville	53.1	--	54.3	--	70.7	--	67.5	--	70.9	63.3	--
TCG-Spitfire	70.4	58.1	62.2	78.1	91.6	75.3	89.1	85.0	89.3	80.5	74.1
WB9479	63.8	--	57.4	--	89.1	--	77.8	--	80.3	73.7	--
WB9590	73.7	--	61.9	--	91.9	--	83.8	--	88.2	79.9	--
WB9653	80.4	60.7	70.8	87.1	92.8	83.9	93.8	91.7	91.8	85.9	80.8
WB9719	60.2	--	56.4	--	89.4	--	73.4	--	91.4	74.2	--
Mean	68.5	54.3	61.6	78.9	87.2	78.1	81.1	81.7	87.9	76.0	73.1
CV%	9.3	--	6.0	--	4.1	--	6.8	--	3.5	4.7	--
LSD 0.05	8.8	--	5.0	--	4.9	--	7.5	--	4.5	4.5	--
LSD 0.10	7.4	--	3.9	--	4.1	--	5.8	--	3.8	3.8	--

Table 3. Yield of hard red spring wheat varieties grown at five locations in western North Dakota, 2016-2018.

Variety	Dickinson		Hettinger		Mandan	Minot		Williston		Avg. western N.D.	
	2018	3 Yr.	2018	3 Yr.	2018	2018	3 Yr.	2018	3 Yr.	2018	3 Yr.
	------(bu/a)-----										
AAC Brandon	65.1	--	55.5	--	41.7	83.1	--	50.2	--	59.1	--
AAC Goodwin	67.4	--	54.5	--	50.9	78.0	--	51.0	--	60.4	--
AAC Penhold	62.7	--	49.0	--	49.0	89.5	--	52.6	--	60.6	--
Ambush	61.6	--	55.0	--	50.5	87.7	--	46.2	--	60.2	--
Barlow	60.2	48.9	55.6	48.0	46.2	82.4	64.7	52.4	44.4	59.4	51.5
Bolles	65.0	48.9	36.0	37.6	48.6	81.8	66.9	43.2	38.2	54.9	47.9
Boost	57.5	48.2	38.3	40.0	50.5	86.1	67.1	38.7	38.8	54.2	48.5
Caliber	58.1	--	44.4	--	52.7	90.4	--	61.2	--	61.4	--
Elgin-ND	60.1	48.3	60.8	49.2	48.9	82.8	71.2	59.4	48.4	62.4	54.3
Faller	72.1	51.2	53.0	46.0	45.6	101.7	78.6	53.8	44.1	65.2	55.0
Glenn	63.5	49.9	54.0	45.1	56.0	82.2	69.7	54.6	45.5	62.1	52.6
HRS 3100	62.3	--	39.9	--	52.4	87.0	--	52.3	--	58.8	--
HRS 3419	74.8	55.3	34.8	43.6	51.2	95.3	77.5	40.2	40.7	59.3	54.3
HRS 3504	70.3	56.7	52.9	44.6	46.2	93.3	73.5	53.5	48.0	63.2	55.7
HRS 3530	63.1	51.7	52.4	44.0	48.2	92.3	72.4	53.7	45.1	61.9	53.3
HRS 3616	69.1	50.3	51.0	46.1	46.5	81.2	68.4	57.1	46.1	61.0	52.7
HRS 3888	65.5	--	50.0	--	51.5	90.2	--	46.3	--	60.7	--
Lang-MN	61.3	--	53.3	46.5	51.3	77.6	68.4	39.5	--	56.6	--
Lanning	69.5	--	63.5	--	46.3	94.3	--	63.0	--	67.3	--
LCS Breakaway	49.6	44.5	41.6	41.6	49.6	76.5	66.1	50.1	42.8	53.5	48.7
LCS Cannon	56.6	--	51.3	--	50.0	84.5	--	50.8	--	58.6	--
LCS Rebel	60.4	--	55.5	--	52.0	74.5	--	49.4	--	58.4	--
LCS Trigger	76.0	--	69.9	56.7	43.5	97.3	--	60.9	--	69.5	--
Linkert	58.8	48.2	42.0	39.9	45.9	84.5	67.1	54.0	44.3	57.0	49.9
Mott	60.1	45.0	43.8	42.3	45.1	76.0	61.9	--	--	45.0	--
MS Barracuda	51.1	--	33.4	--	51.6	94.6	--	44.3	--	55.0	--
MS Camaro	54.0	--	59.1	48.1	49.8	85.3	--	52.0	--	60.0	--
MS Chevelle	67.3	53.4	48.6	--	50.2	85.1	72.3	48.7	45.3	60.0	--
ND VitPro	59.6	46.1	52.6	44.2	47.1	77.1	63.9	56.8	46.0	58.6	50.1
Prosper	59.5	49.4	53.0	42.8	53.0	97.7	82.3	54.2	43.5	63.5	54.5
Rollag	60.2	50.0	46.3	41.7	48.6	85.8	71.3	56.4	47.2	59.5	52.6
Shelly	70.4	52.8	53.1	49.3	51.8	97.7	72.0	57.8	45.9	66.2	55.0
Surpass	65.1	52.3	40.4	42.3	51.4	78.4	62.6	52.3	45.7	57.5	50.7
SY Ingmar	61.8	51.8	40.3	42.8	55.4	82.3	71.5	41.7	40.5	56.3	51.7
SY Rockford	64.9	--	54.0	47.3	46.0	102.0	--	55.5	--	64.5	--
SY Soren	61.9	48.1	43.7	43.4	48.0	84.6	68.0	49.4	44.6	57.5	51.0
SY Valda	62.9	55.0	51.0	45.2	46.0	88.7	69.8	53.2	46.0	60.4	54.0
TCG-Climax	62.3	--	52.7	--	54.8	84.5	--	52.6	--	61.4	--
TCG-Glenville	56.0	--	35.9	--	53.3	73.3	--	50.2	--	53.7	--
TCG-Spitfire	66.1	53.6	54.0	47.9	49.2	85.6	79.1	61.6	48.6	63.3	57.3
WB9479	62.7	--	51.4	--	51.9	88.5	--	52.7	--	61.4	--
WB9590	67.5	--	50.7	--	52.2	87.2	--	54.3	--	62.4	--
WB9653	69.2	56.1	50.2	45.1	45.3	87.2	74.1	56.1	48.0	61.6	55.8
WB9719	71.3	--	52.2	--	49.9	90.8	--	65.2	--	65.9	--
Mean	63.1	50.7	49.4	44.9	49.3	86.1	70.4	52.2	44.7	60.0	52.6
CV %	8.5	--	12.2	--	12.2	10.2	--	9.5	--	9.3	--
LSD 0.05	7.5	--	8.4	--	8.4	14.3	--	8.1	--	7.0	--
LSD 0.10	6.2	--	7.1	--	7.0	11.9	--	6.7	--	5.9	--

Table 4. Protein at 12 percent moisture of hard red spring wheat varieties grown at 10 locations in North Dakota, 2018.

Variety	Carrington	Casselton	Langdon	Prosper	Steele Co.	Dickinson	Hettinger	Mandan	Minot	Williston	State Avg.
------(%)-----											
AAC Brandon	16.3	16.0	13.7	16.1	16.0	14.2	17.3	12.4	14.6	14.2	15.1
AAC Goodwin	14.0	15.0	14.1	15.6	15.4	13.9	16.6	12.6	13.7	15.1	14.6
AAC Penhold	14.3	14.6	13.3	15.1	15.2	13.6	17.0	12.4	14.6	13.6	14.4
Ambush	14.4	15.4	14.2	16.3	15.9	14.0	16.4	12.1	13.5	13.9	14.6
Barlow	14.6	15.4	14.2	15.2	15.5	14.2	16.0	13.1	15.3	14.0	14.8
Bolles	16.1	16.4	14.9	16.3	16.6	15.6	19.0	13.2	14.9	15.4	15.8
Boost	14.5	15.0	13.7	15.0	15.4	14.4	17.3	12.8	15.2	14.8	14.8
Caliber	15.9	16.0	14.5	16.3	15.7	15.7	17.1	14.2	15.2	14.5	15.5
Elgin-ND	14.0	13.4	13.6	15.3	15.0	13.5	16.8	12.7	14.9	15.1	14.4
Faller	13.7	14.5	12.7	13.9	14.8	13.6	15.8	11.3	13.5	13.3	13.7
Glenn	15.0	15.6	14.4	15.8	16.0	15.2	16.6	13.1	15.6	14.5	15.2
HRS 3100	14.1	14.4	13.4	14.8	14.9	13.7	17.3	12.5	14.1	14.3	14.4
HRS 3419	12.9	13.3	11.6	13.5	13.9	12.7	17.3	10.5	13.9	13.5	13.3
HRS 3504	13.1	13.8	12.9	14.1	14.7	13.5	16.3	11.7	14.4	13.8	13.8
HRS 3530	14.0	16.1	13.0	15.4	15.8	14.9	17.1	12.9	13.2	14.6	14.7
HRS 3616	15.0	16.3	14.4	16.9	16.2	15.5	17.2	13.0	15.2	13.8	15.4
HRS 3888	13.8	15.0	13.8	15.2	15.4	14.0	16.9	12.5	14.5	14.9	14.6
Lang-MN	13.9	15.4	14.3	15.4	15.9	14.4	17.0	12.0	15.0	15.1	14.8
Lanning	14.5	--	--	--	16.1	14.1	16.6	12.8	15.6	13.4	--
LCS Breakaway	15.0	15.5	14.0	15.4	15.7	14.6	17.9	13.1	14.0	15.0	15.0
LCS Cannon	14.5	15.0	13.7	15.0	15.3	12.7	17.1	13.1	13.4	14.7	14.4
LCS Rebel	14.9	15.7	13.6	15.5	15.5	14.8	16.7	12.9	14.6	15.2	14.9
LCS Trigger	12.1	12.6	11.1	12.3	12.9	12.6	14.9	10.2	12.7	12.7	12.4
Linkert	15.5	16.0	14.3	16.0	16.0	15.6	17.2	13.1	15.2	15.1	15.4
Mott	--	--	--	--	--	14.3	17.2	12.9	15.3	--	--
MS Barracuda	14.1	15.8	14.2	15.4	16.0	14.9	17.5	12.3	14.2	14.5	14.9
MS Camaro	15.4	15.1	13.7	15.4	15.1	14.9	15.4	13.7	14.5	15.4	14.9
MS Chevelle	13.4	14.2	12.6	13.9	14.5	13.0	17.5	12.0	12.1	13.4	13.7
ND VitPro	15.6	16.1	14.1	15.7	15.8	15.0	16.8	13.7	15.8	13.6	15.2
Prosper	14.2	14.5	13.2	14.4	14.8	13.2	15.9	11.2	14.1	13.1	13.9
Rollag	15.0	15.9	14.2	16.1	16.2	15.0	17.3	13.7	15.2	14.7	15.3
Shelly	13.5	14.5	13.1	14.3	14.7	13.1	16.8	11.0	14.3	13.3	13.9
Surpass	14.1	15.5	13.6	15.6	15.5	13.9	16.9	11.8	15.1	14.2	14.6
SY Ingmar	15.8	15.0	14.2	15.4	15.6	13.6	17.6	12.5	14.8	15.4	15.0
SY Rockford	--	--	--	--	--	14.0	16.9	11.9	14.7	13.4	--
SY Soren	15.3	15.0	13.4	15.8	15.3	14.4	17.6	12.7	14.7	15.0	14.9
SY Valda	13.2	14.5	13.1	14.4	15.1	14.1	16.6	11.6	14.1	13.4	14.0
TCG-Climax	15.1	16.3	14.6	15.4	16.2	15.7	18.3	12.7	14.6	14.9	15.4
TCG-Glenville	17.3	15.7	14.2	16.0	15.8	15.3	17.5	13.6	15.4	15.5	15.6
TCG-Spitfire	14.3	14.3	12.9	14.2	14.5	14.1	16.4	11.4	14.2	13.9	14.0
WB9479	16.3	16.0	14.5	16.0	16.1	14.7	17.2	13.1	14.9	14.9	15.4
WB9590	15.4	15.7	13.7	16.0	15.7	14.0	17.2	12.8	15.2	13.7	14.9
WB9653	13.1	14.2	13.0	13.8	14.6	12.7	16.5	11.1	14.3	12.9	13.6
WB9719	15.8	14.8	13.1	14.6	14.8	13.6	16.7	11.3	14.5	13.5	14.3
Mean	14.6	15.2	13.7	15.2	15.3	14.2	17.0	12.5	14.5	14.3	14.6
CV%	4.2	--	2.8	--	1.3	4.6	2.1	6.0	2.3	4.9	3.5
LSD 0.05	0.8	--	0.5	--	0.3	1.1	0.5	1.0	0.5	1.1	0.4
LSD 0.10	0.7	--	0.4	--	0.2	0.9	0.4	0.9	0.4	1.0	0.4

Table 5. Test weight of hard red spring wheat varieties grown at 10 locations in North Dakota, 2018.

Variety	Carrington	Casselton	Langdon	Prosper	Steele Co.	Dickinson	Hettinger	Mandan	Minot	Williston	State Avg.
	------(lb/bu)-----										
AAC Brandon	63.2	62.1	62.5	60.3	61.6	61.1	57.6	54.4	60.0	60.0	60.3
AAC Goodwin	63.8	62.5	63.1	60.4	62.7	62.1	57.8	55.4	60.8	62.8	61.1
AAC Penhold	63.2	61.7	62.7	60.4	60.6	62.1	57.6	54.6	60.6	62.7	60.6
Ambush	63.9	62.4	63.2	60.1	62.1	61.7	57.5	56.1	61.8	63.1	61.2
Barlow	63.9	62.6	62.6	61.8	62.3	60.4	58.4	54.7	60.9	63.5	61.1
Bolles	62.8	60.3	61.3	59.8	61.9	60.8	54.4	55.3	60.7	61.7	59.9
Boost	62.2	61.5	61.9	60.3	61.3	59.6	56.8	54.5	59.6	61.1	59.9
Caliber	63.0	60.9	60.8	59.3	60.8	60.4	55.9	55.9	59.1	62.6	59.9
Elgin-ND	62.9	61.5	61.7	59.0	60.6	60.3	57.8	55.8	59.8	60.6	60.0
Faller	63.3	62.1	62.3	60.6	62.2	61.5	56.7	55.6	60.6	61.2	60.6
Glenn	64.8	63.2	62.9	61.4	62.6	62.5	57.8	54.9	62.9	65.1	61.8
HRS 3100	62.3	61.0	61.3	57.5	61.0	60.5	55.8	54.5	59.8	61.6	59.5
HRS 3419	62.7	61.2	62.2	59.9	61.9	60.2	54.1	54.9	59.7	60.2	59.7
HRS 3504	62.5	61.5	61.4	60.0	60.7	61.0	57.7	53.4	58.8	61.0	59.8
HRS 3530	62.6	61.5	62.2	60.7	61.8	60.4	56.9	55.3	59.4	62.3	60.3
HRS 3616	63.1	61.2	61.2	56.6	60.0	61.2	56.1	55.9	60.7	63.3	59.9
HRS 3888	62.6	60.7	61.6	58.8	60.8	61.5	56.5	54.5	59.7	62.3	59.9
Lang-MN	63.6	61.9	61.9	59.6	63.0	61.7	57.2	55.3	61.0	60.7	60.6
Lanning	61.8	--	--	--	60.7	59.1	56.7	55.1	58.6	61.9	--
LCS Breakaway	64.3	62.9	63.0	61.3	62.5	61.9	57.5	54.3	61.6	63.7	61.3
LCS Cannon	64.6	63.2	63.5	61.3	62.9	62.9	58.7	54.1	62.5	63.7	61.7
LCS Rebel	63.9	62.5	63.1	61.5	62.7	62.4	57.8	55.4	61.5	62.3	61.3
LCS Trigger	63.0	62.8	62.6	61.0	62.5	60.7	58.6	54.0	60.3	61.0	60.7
Linkert	63.4	62.1	61.0	55.0	61.6	61.1	57.2	54.9	61.0	61.3	59.9
Mott	--	--	--	--	--	60.8	56.6	54.1	61.1	--	--
MS Barracuda	63.8	61.7	62.9	59.8	61.3	61.1	55.1	55.0	61.2	61.8	60.4
MS Camaro	62.8	61.7	62.0	58.7	61.9	62.2	57.7	54.0	60.5	62.9	60.4
MS Chevelle	63.4	61.9	62.3	60.0	61.0	61.9	55.8	55.3	61.2	62.3	60.5
ND VitPro	64.2	62.9	63.2	62.0	62.7	61.2	56.9	55.2	61.7	64.5	61.4
Prosper	63.3	62.0	62.7	60.9	62.1	61.0	56.7	54.3	60.4	61.3	60.5
Rollag	63.3	62.6	62.0	61.0	62.5	61.8	57.5	54.6	61.3	63.1	61.0
Shelly	63.9	62.8	62.2	60.1	62.4	62.6	57.6	54.7	61.3	62.7	61.0
Surpass	62.5	61.8	62.2	59.4	61.2	61.2	56.6	54.8	59.9	62.5	60.2
SY Ingmar	63.5	62.6	62.9	61.2	62.6	62.1	57.1	55.2	60.5	62.9	61.1
SY Rockford	--	--	--	--	--	59.5	55.5	54.6	58.5	61.8	--
SY Soren	63.5	61.6	61.5	57.9	61.7	62.1	56.9	54.6	60.6	62.8	60.3
SY Valda	62.7	62.1	62.3	60.6	62.2	60.9	56.8	56.0	60.3	62.2	60.6
TCG-Climax	64.6	63.4	63.8	62.6	63.4	61.4	57.7	54.6	62.0	64.6	61.8
TCG-Glenville	63.4	62.5	61.9	59.8	63.1	62.0	55.7	55.2	61.7	64.5	61.0
TCG-Spitfire	63.1	61.0	61.7	59.7	60.7	60.1	57.0	55.2	58.5	61.6	59.9
WB9479	63.6	62.1	63.0	59.7	61.5	61.8	56.9	55.8	61.1	60.3	60.6
WB9590	63.2	61.7	62.5	59.3	62.8	60.7	56.6	54.1	61.4	61.9	60.4
WB9653	62.5	61.5	61.7	59.5	61.5	60.7	57.1	54.2	58.7	61.7	59.9
WB9719	64.4	63.7	63.8	61.9	63.8	63.4	57.5	54.7	62.5	65.1	62.1
Mean	63.3	62.0	62.2	60.1	62.4	61.3	57.0	54.9	60.5	62.4	60.6
CV%	0.6	1.5	0.7	2.7	1.2	1.6	1.2	2.2	1.0	1.9	1.3
LSD 0.05	0.5	1.2	0.6	2.1	1.2	1.3	0.9	1.7	1.0	1.7	0.7
LSD 0.10	0.4	1.0	0.5	1.7	1.0	1.1	0.8	1.4	0.8	1.5	0.6

Table 6. Quality data from 2017 eastern locations.

Variety	Test Weight ¹ (lb/bu)	Vitreous Kernels ² (%)	1,000 KWT ³ (gram)	Falling Number ⁴ (seconds)	Wheat Protein ⁵ (%)	Flour Extraction ⁶ (%)	Farinograph Absorption ⁷ (%)	Farinograph Stability ⁸ (minutes)	Loaf Volume ⁹ (cubic cm)
Ambush	61.1	68	32.1	368	14.6	68.3	63.3	12.0	1,070
Barlow	60.5	76	29.8	357	14.8	68.8	66.1	10.0	1,040
Bolles	59.8	83	31.7	411	16.1	67.1	65.5	18.7	1,058
Boost	60.0	73	31.9	406	14.6	67.4	65.7	8.3	1,020
Caliber	60.4	71	32.4	285	15.1	66.5	68.2	8.1	983
Elgin-ND	59.7	69	29.4	387	14.6	68.5	66.7	8.7	943
Faller	59.5	57	32.2	396	13.4	68.8	62.8	11.8	1,045
Glenn	62.8	76	29.0	385	15.2	66.9	64.4	15.3	1,065
HRS 3100	59.3	46	28.8	392	13.7	69.3	61.3	12.5	1,000
HRS 3419	59.3	57	26.3	342	13.1	62.7	60.2	15.0	940
HRS 3504	58.3	54	29.0	421	13.3	68.3	61.0	8.6	933
HRS 3530	60.1	59	31.2	391	14.0	68.1	64.7	9.1	1,025
HRS 3616	59.8	44	31.3	417	15.0	65.1	66.3	11.6	1,068
Lang-MN	61.6	90	27.8	398	15.3	67.0	65.4	10.3	1,000
LCS Breakaway	61.8	83	30.5	406	14.1	67.4	64.8	6.1	945
LCS Rebel	61.0	59	30.2	343	14.6	68.8	62.9	11.7	1,003
LCS Trigger	59.7	63	27.2	407	13.0	67.3	64.0	8.1	830
Linkert	59.7	61	31.0	439	15.4	66.5	63.2	38.6	1,043
MS Camaro	60.8	55	29.2	368	14.5	66.3	64.8	8.7	960
MS Chevelle	59.8	38	27.8	353	13.2	67.1	61.9	14.4	970
ND VitPro	61.6	75	29.3	401	15.1	68.4	65.1	10.8	1,023
Prosper	59.8	46	32.4	399	13.6	69.3	63.0	11.6	1,000
Rollag	60.6	61	29.9	491	15.1	65.9	67.8	8.2	913
Shelly	60.4	55	28.9	414	13.8	70.8	61.1	12.3	965
Surpass	58.9	64	25.5	371	14.2	67.9	59.3	12.6	940
SY Ingmar	60.5	69	25.8	400	15.1	69.4	62.4	11.0	1,023
SY Soren	60.8	61	26.1	419	14.9	68.1	63.0	11.3	1,048
SY Valda	60.2	79	28.3	382	14.0	67.6	62.0	9.6	1,035
TCG-Climax	62.9	80	28.5	285	15.9	68.1	64.0	12.7	980
TCG-Spitfire	60.0	60	31.2	303	13.8	66.8	63.4	10.1	1,018
WB 9479	60.8	63	29.0	370	15.0	66.8	61.0	31.8	970
WB 9590	60.3	60	32.0	359	14.5	65.4	61.6	14.7	908
WB 9653	58.2	57	27.8	405	13.4	68.5	60.8	11.5	893
WB 9719	62.5	61	29.4	357	13.9	68.1	61.7	13.3	970

¹Test weight - Expressed in pounds (lbs) per bushel. A high test weight is desirable. A 58 lb test weight is required for a grade of U.S. No. 1.

²Vitreous kernels - Expressed as a percentage of seeds having a vitreous colored endosperm. A high percentage is desirable. US No. 1 DNS requires greater than 75 percent vitreous kernels.

³1,000 KWT- estimate of weight of 1,000 seeds based on a clean 10g sample. Expressed in grams and used to approximate seed size.

⁴Falling Number- Expressed in seconds at a 14 percent moisture basis. It is used as an indicator of sprouting based on elevated enzyme activity. A high falling number is desirable, preferably greater than 400 seconds.

⁵Wheat Protein- measured by NIR at a 12 percent moisture basis. A high protein is desirable for baking quality.

⁶Flour Extraction- Percentage of milled flour recovered from cleaned and tempered wheat. A high flour extraction percentage is desirable.

⁷Farinograph Absorption- measured by NIR at a 14 percent moisture basis. A measure of dough water absorption, expressed as percent. A high absorption is desirable.

⁸Farinograph Stability- A measure of dough strength. It is expressed in minutes above the 500 Brabender unit line during mixing. A high stability is desirable.

⁹Loaf volume- The volume of the pup loaf of bread, expressed in cubic centimeters. A high volume is desirable.

Table 7. Quality data from 2017 western locations.

Variety	Test Weight ¹	Vitreous Kernels ²	1,000 KWT ³	Falling Number ⁴	Wheat Protein ⁵	Flour Extraction ⁶	Farinograph Absorption ⁷	Farinograph Stability ⁸	Loaf Volume ⁹
	(lb/bu)	(%)	(gram)	(seconds)	(%)	(%)	(%)	(minutes)	(cubic cm)
Ambush	60.6	81	31.2	459	15.0	65.2	61.3	41.0	965
Barlow	61.5	98	29.9	458	15.6	67.8	67.2	16.0	995
Bolles	58.8	77	30.3	453	16.2	65.1	62.2	42.1	983
Boost	59.5	92	30.4	489	15.9	66.3	64.8	15.1	1,003
Caliber	61.2	86	31.6	487	15.4	64.2	66.8	18.9	890
Elgin-ND	59.1	96	28.5	460	15.0	65.3	65.2	22.0	1,003
Faller	57.5	86	27.4	432	15.3	67.5	63.9	17.1	990
Glenn	61.6	91	30.3	427	15.1	67.2	64.8	35.8	980
HRS 3100	58.7	85	28.8	436	15.1	68.2	61.7	43.1	923
HRS 3419	56.6	76	22.5	476	15.1	64.3	62.2	29.8	990
HRS 3504	59.9	86	29.9	489	14.5	68.7	61.1	21.2	920
HRS 3530	58.6	93	29.2	433	15.2	64.7	63.9	17.9	965
HRS 3616	59.0	83	27.8	454	15.1	64.9	63.3	29.6	913
Lang-MN	60.0	89	30.3	460	14.9	66.7	63.9	33.8	898
LCS Breakaway	61.1	91	28.6	452	15.2	66.8	64.5	9.5	885
LCS Rebel	61.2	90	33.0	450	15.0	70.1	64.3	25.2	908
LCS Trigger	56.4	91	23.5	484	14.9	66.3	63.4	18.0	838
Linkert	60.9	86	34.1	481	16.1	66.6	65.6	38.3	928
MS Camaro	60.4	75	29.9	463	15.2	65.3	65.5	9.6	910
MS Chevelle	60.6	67	29.3	416	14.1	66.3	63.4	31.8	918
ND VitPro	61.8	96	32.1	450	15.8	67.5	65.6	12.9	945
Prosper	58.5	78	29.0	430	14.5	68.4	62.5	13.6	968
Rollag	59.8	68	30.9	530	15.7	67.1	68.0	9.7	893
Shelly	59.3	59	27.9	466	14.3	67.8	58.9	42.6	875
Surpass	60.3	56	27.0	434	14.3	67.6	59.4	29.2	880
SY Ingmar	59.7	85	27.1	471	15.0	67.7	61.2	15.7	945
SY Rockford	57.5	67	30.5	448	15.1	66.2	64.3	13.9	958
SY Soren	59.9	71	27.2	488	15.2	66.5	62.1	15.1	983
SY Valda	59.7	83	28.8	450	14.5	66.8	61.3	13.1	880
TCG-Climax	59.8	75	23.0	392	16.2	64.3	63.3	12.8	930
TCG-Spitfire	59.5	78	29.7	475	14.1	65.2	62.7	39.9	945
WB 9479	60.5	74	33.3	460	15.6	66.3	63.9	30.3	895
WB 9590	60.2	69	34.7	446	15.0	65.8	64.3	27.1	873
WB 9653	59.3	69	30.3	505	14.7	68.9	62.2	28.6	885
WB 9719	62.5	94	32.8	457	14.2	65.9	64.4	20.5	863

¹Test weight - Expressed in pounds (lbs) per bushel. A high test weight is desirable. A 58 lb test weight is required for a grade of U.S. No. 1.

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³1,000 KWT- estimate of weight of 1,000 seeds based on a clean 10g sample. Expressed in grams and used to approximate seed size.

⁴Falling Number- Expressed in seconds at a 14 percent moisture basis. It is used as an indicator of sprouting based on elevated enzyme activity. A high falling number is desirable, preferably greater than 400 seconds.

⁵Wheat Protein- measured by NIR at a 12 percent moisture basis. A high protein is desirable for baking quality.

⁶Flour Extraction- Percentage of milled flour recovered from cleaned and tempered wheat. A high flour extraction percentage is desirable.

⁷Farinograph Absorption- measured by NIR at a 14 percent moisture basis. A measure of dough water absorption, expressed as percent. A high absorption is desirable.

⁸Farinograph Stability- A measure of dough strength. It is expressed in minutes above the 500 Brabender unit line during mixing. A high stability is desirable.

⁹Loaf volume- The volume of the pup loaf of bread, expressed in cubic centimeters. A high volume is desirable.

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