

A574-23 (Revised)

North Dakota Hard Red Spring Wheat

Variety Trial Results for 2023 and Selection Guide

Clair Keene, Andrew Green, Shahidul Islam, Andrew Friskop, Tim Friesen, Zhaohui Liu and Shaobin Zhong (NDSU Main Station); Yue Jin (USDA-ARS St. Paul, MN); John Rickertsen (Hettinger Research Extension Center); Leandro Bortolon, Austin Kraklau and Jayden Hansen (North Central Research Extension Center, Minot); Bryan Hanson (Langdon Research Extension Center); Glenn Martin (Dickinson Research Extension Center); Justin Jacobs (Williston Research Extension Center); Kristin Simons (Carrington Research Extension Center)

Hard red spring (HRS) wheat was planted on 5.6 million acres in 2023, up slightly from 5.3 million acres in 2022. The average yield of HRS wheat was 49 bushels/acre (bu/a), down slightly from 52 bu/a in 2022. 2023 spring wheat yields were highly variable across the state. Most of the state started the season with a deep snowpack and delayed planting due to cold and wet conditions in April. The abundant winter snow provided adequate moisture for the crop during early development. However, most of the region experienced an abnormally hot and dry June, which was then followed by a cooler-than-normal July. Areas of north central and northeast North Dakota experienced periods of severe to extreme drought while southwest North Dakota had one of its highest growing-season rainfall totals in the past five years. This variability in precipitation resulted in some areas having very high wheat yields while other areas had below-average yields. See Figure 1 below for April 1-August 31 rainfall totals at the trial locations as recorded by North Dakota Agricultural Weather Network (NDAWN) stations.

WB9590 was the most popular HRS wheat variety in 2023, reportedly occupying 8.7% of the planted acreage, followed by AP Murdock (8.4%), SY Valda (6.9%), SY Ingmar (6.4%) and MN Torgy (4.5%). WB9590 was released by WestBred/Monsanto. AP Murdock, SY Valda and SY Ingmar are Syngenta/AgriPro varieties. MN Torgy is a University of Minnesota release. NDSU varieties Faller and Glenn were reported on 3.1% and 2.6% of acres, respectively.

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.

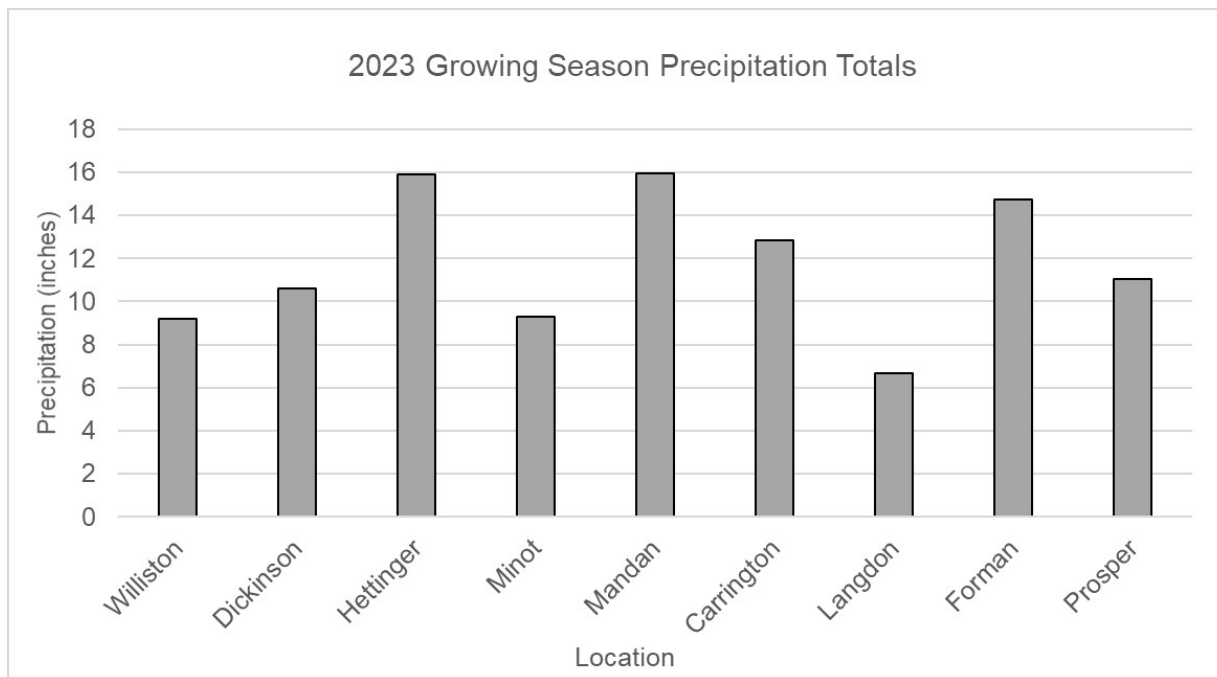


Figure 1. April 1-August 31 rainfall totals at the hard red spring wheat variety trial locations. Note: NDAWN Stirum station used as proxy for Forman location. Langdon had an April blizzard that accounted for approximately 25% of the growing season moisture followed by an extremely dry summer.

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. Growers should balance their variety selection taking into consideration not only yield but also the quality rankings presented in this publication on Table 6.

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% 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 2022. 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 growers 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 least significant difference (LSD) 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% 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% level of confidence. 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 could not be attributed to differences in the varieties. Yield is reported at 13.5% moisture, while protein content is reported at 12% 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 and at <https://vt.ag.ndsu.edu/>.

List of Tables

Table 1. North Dakota hard red spring wheat variety descriptions, agronomic traits, 2023.

Table 2. Yield of hard red spring wheat varieties grown at five locations in eastern North Dakota, 2021-2023.

Table 3. Yield of hard red spring wheat varieties grown at four locations in western North Dakota, 2021-2023.

Table 4. Protein at 12% moisture of hard red spring wheat grown at 10 locations in North Dakota, 2023.

Table 5. Test weight of hard red spring wheat varieties grown at 10 locations in North Dakota, 2023.

Table 6. Quality data 2020-2022.

Table 7. Quality data from 2022 from four locations across North Dakota.

Table 1. North Dakota hard red spring wheat variety descriptions, agronomic traits, 2023.

Variety	Agent or Origin ¹	Year Released	Height (inches) ²	Straw Strength ³	Days to Head ⁴	Reaction to Disease ⁵				
						Stem Rust ⁶	Leaf Rust	Tan Spot	Bact. Leaf Streak	Head Scab
AAC Starbuck	Canada	2018	30	4	47	1	6	NA	6	5
AP Gunsmoke CL2	Syngenta/AgriPro	2021	27	6	47	2	3	4	8	5
AP Murdock	Syngenta/AgriPro	2019	26	4	47	2	5	4	6	6
AP Smith	Syngenta/AgriPro	2021	26	2	49	1	3	3	5	6
AR3530	Armor Brand/ Croplan	2015	31	7	49	2	5	NA	5	4
AR3915	Armor Brand/ Croplan	2019	27	4	48	NA	2	NA	5	4
Ascend-SD	SD	2022	31	5	48	2	4	NA	5	4
Bolles	MN	2015	30	4	50	2	2	4	6	6
Brawn-SD	SD	2022	29	4	48	NA	2	NA	4	4
CAG-Justify	Champions Alliance Grp	2021	29	6	49	2	2	5	6	5
CAG-Reckless	Champions Alliance Grp	2021	30	5	48	2	2	6	6	5
CDCLandmarkVB	ND CISA	2018	30	4	48	NA	5	NA	6	6
CP3099A	Croplan	2020	31	5	51	6	3	4	7	6
CP3188	Croplan	2020	29	8	48	6	2	6	7	5
CP3322	Croplan	2023	29	3	53	NA	3	NA	4	6
Driver	SD	2019	30	4	48	2	1	7	7	4
Elgin ND	ND	2012	32	5	46	2	6	NA	7	5
Glenn	ND	2005	31	4	46	2	6	6	5	4
Lang MN	MN	2017	31	4	50	2	2	NA	5	3
Lanning	MT	2017	29	3	50	2	7	4	5	6
LCS Ascent	Limagrain	2022	28	4	45	2	6	NA	7	4
LCS Boom	Limagrain	2023	26	4	45	NA	6	NA	6	7
LCS Buster	Limagrain	2020	30	4	51	1	4	4	4	4
LCS Cannon	Limagrain	2018	26	4	44	1	7	5	7	6
LCS Dual	Limagrain	2020	28	4	46	2	6	NA	7	6
LCS Hammer AX	Limagrain	2022	26	4	47	2	6	NA	7	6
LCS Trigger	Limagrain	2016	31	5	53	6	1	4	4	3
MN- Rothsay	MN	2022	26	3	50	2	6	NA	5	5
MN-Torgy	MN	2020	29	4	49	2	3	3	5	4
MS Charger	Meridian Seeds	2022	27	7	46	2	2	NA	7	5
MS Cobra	Meridian Seeds	2022	27	4	47	1	2	4	7	5
MS Rancho	Meridian Seeds	2020	34	5	54	2	4	5	5	6
ND Frohberg	ND	2020	30	4	47	2	5	8	5	5
ND Heron	ND	2021	28	6	45	1	7	NA	7	4
ND Thresher	ND	2023	27	4	50	2	4	NA	4	4
ND VitPro	ND	2016	28	4	46	2	4	6	6	4
PFS Buns	Peterson Farm Seeds	2021	28	4	57	1	2	NA	4	6
Shelly	MN	2016	27	4	49	2	6	3	7	5
SY 611CL2	Syngenta/AgriPro	2019	26	3	48	2	6	4	6	5
SY Ingmar	Syngenta/AgriPro	2014	27	2	48	2	3	6	6	6
SY Longmire ⁷	Syngenta/AgriPro	2019	27	5	48	2	6	4	6	6
SY McCloud	Syngenta/AgriPro	2019	28	4	47	2	5	7	7	6
SY Valda	Syngenta/AgriPro	2015	27	4	48	2	2	7	6	5
TCG-Heartland	21st Century Genetics	2019	26	3	46	2	3	4	7	6
TCG-Spitfire	21st Century Genetics	2015	28	3	50	2	5	6	5	6
TCG-Teddy	21st Century Genetics	2023	25	3	48	NA	4	NA	5	6
TCG-Wildcat	21st Century Genetics	2020	27	3	48	2	5	6	7	6
WB9590	WestBred	2017	25	3	47	2	3	8	8	7
WB9606	WestBred	2020	29	4	49	NA	4	NA	6	6
WB9719	WestBred	2018	27	4	49	NA	5	NA	5	6

¹Refers to agent or developer: MN = Univ of Minnesota; MT = Montana State Univ; ND = North Dakota State Univ; SD = South Dakota State Univ
Canada = Agri-Food Canada. NDCISA = ND Crop & Seed Improvement Assoc. Bold varieties are recently released, so data are limited and rating values may change.

²Height data averaged from multiple locations in 2023.

³Straw 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.

⁴Days to Head = the number of days from planting to head emergence from the boot, averaged based on data from several locations in 2023.

⁵Disease reaction scores from 1 to 9, with 1 = resistant and 9 = very susceptible, NA = not available.

⁶Stem rust scores determined from field severity ratings and *Puccinia graminis* f. sp. *tritici* race QFCQ

⁷Solid 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, 2021-2023.

Variety	<u>Carrington</u>		<u>Casselton</u>		<u>Forman</u>	<u>Langdon</u>		<u>Prosper</u>		<u>Average</u>	
	2023	3 Yr.	2023	3 Yr.	2023	2023	3 Yr. ¹	2023	3 Yr.	2023	3 Yr.
	------(bu/a)-----										
AAC Starbuck	73.7	63.9	80.9	--	70.6	84.9	--	90.6	--	80.1	--
AP Gunsmoke CL2	72.1	62.5	84.4	86.8	71.8	76.7	78.0	87.6	78.2	78.5	76.4
AP Murdock	65.5	58.0	90.4	87.8	68.5	72.9	84.3	88.4	79.7	77.1	77.4
AP Smith	64.5	57.7	82.5	81.1	67.4	75.1	76.8	84.7	75.6	74.8	72.8
AR3530	70.7	63.0	79.4	82.9	60.9	80.0	83.3	93.2	77.9	76.9	76.8
AR3915	67.5	--	84.1	--	68.7	75.3	79.9	93.7	--	77.9	--
Ascend-SD	83.4	--	86.6	--	68.9	81.2	--	101.3	--	84.3	--
Bolles	68.5	57.4	75.7	79.8	65.0	73.5	70.8	88.1	--	74.2	69.3
Brawn-SD	73.8	--	90.4	--	74.5	83.5	--	108.9	--	86.2	--
CAG-Justify	69.9	63.7	89.8	92.0	70.9	80.7	--	96.7	79.5	81.6	78.4
CAG-Reckless	71.3	59.7	88.1	89.9	70.1	84.5	--	99.4	85.2	82.7	78.2
CDCLandmarkVB	68.1	--	84.0	--	71.0	81.3	--	82.1	--	77.3	--
CP3099A	62.8	60.0	78.2	89.5	72.3	77.4	--	102.6	86.3	78.7	78.6
CP3188	53.3	59.1	87.9	86.4	68.4	70.7	--	90.8	76.9	74.2	74.1
CP3322	72.3	--	81.5	--	63.5	80.2	--	90.8	--	77.7	--
Driver	73.6	64.7	80.4	86.9	67.5	84.1	79.6	91.4	79.5	79.4	77.7
Elgin ND	67.8	--	79.6	--	66.3	72.9	--	91.8	--	75.7	--
Glenn	64.4	55.4	73.0	71.5	68.7	68.7	70.0	83.6	72.6	71.7	67.4
Lang MN	71.6	--	82.1	--	67.8	77.7	--	93.1	--	78.5	--
Lanning	70.1	58.6	80.9	83.7	67.6	75.2	64.3	91.2	77.8	77.0	71.1
LCS Ascent	59.2	--	88.0	--	66.4	84.0	--	89.8	--	77.5	--
LCS Boom	54.1	--	85.1	--	57.6	80.9	--	89.0	--	73.3	--
LCS Buster	71.3	59.2	85.0	92.3	71.6	80.1	80.0	105.2	86.0	82.6	79.4
LCS Cannon	57.7	55.2	77.9	88.1	66.9	87.3	78.8	82.3	--	74.4	74.0
LCS Dual	60.2	--	84.1	--	69.7	79.7	--	94.5	--	77.6	--
LCS Hammer AX	64.0	--	83.8	--	61.4	79.4	--	93.5	--	76.4	--
LCS Trigger	72.7	63.3	91.7	93.6	70.6	79.9	84.7	103.9	92.9	83.7	83.6
MN- Rothsay	72.8	--	82.3	--	67.9	80.0	73.4	88.7	--	78.4	--
MN-Torgy	58.4	61.3	75.8	82.0	70.9	75.4	75.9	98.7	83.5	75.8	75.7
MS Charger	63.8	--	92.5	--	66.1	85.2	--	96.4	--	80.8	--
MS Cobra	62.3	59.9	82.0	85.3	65.7	78.4	--	89.1	74.2	75.5	73.1
MS Rancho	81.2	65.6	42.6	70.5	52.2	78.3	72.1	81.2	68.6	67.1	69.2
ND Frohberg	69.1	63.7	85.2	86.1	66.2	75.4	75.4	89.4	79.0	77.0	76.0
ND Heron	57.5	56.6	79.4	73.0	61.8	80.9	71.3	84.2	74.8	72.8	68.9
ND Thresher	69.5	56.0	82.5	77.6	58.5	73.4	--	99.6	82.0	76.7	71.9
ND VitPro	57.3	52.8	77.2	73.3	64.6	69.9	72.4	87.1	75.2	71.2	68.4
PFS Buns	80.2	--	82.2	--	62.1	79.7	--	103.8	--	81.6	--
Shelly	65.5	63.1	83.9	--	72.8	85.6	73.1	92.0	--	80.0	--
SY 611CL2	72.8	63.2	80.2	81.0	63.3	86.3	81.9	97.7	83.4	80.1	77.4
SY Ingmar	60.7	55.1	80.9	80.4	64.7	71.3	74.6	88.8	74.6	73.3	71.2
SY Longmire	71.0	60.7	78.0	80.2	69.5	71.7	73.3	97.5	79.1	77.6	73.3
SY McCloud	66.9	60.6	84.6	83.7	67.2	82.2	77.8	89.6	77.3	78.1	74.9
SY Valda	72.4	61.8	84.5	86.1	69.1	79.4	81.4	98.8	84.4	80.8	78.4
TCG-Heartland	65.1	53.5	80.1	79.6	67.0	75.2	70.0	88.3	72.8	75.1	69.0
TCG-Spitfire	81.1	66.3	81.4	83.9	68.5	78.9	80.4	104.0	91.8	82.8	80.6
TCG-Teddy	73.4	--	82.3	--	67.4	75.0	--	88.8	--	77.4	--
TCG-Wildcat	71.6	59.1	87.1	87.7	61.8	80.6	77.6	95.0	81.5	79.2	76.5
WB9590	68.8	60.6	89.2	86.6	64.7	79.1	--	95.5	77.5	79.5	74.9
WB9606	70.2	--	82.3	--	73.2	81.4	--	94.1	--	80.2	--
WB9719	71.3	--	80.3	--	66.9	79.3	--	109.1	--	81.4	--
Mean	68.8	60.0	82.2	83.5	66.9	78.7	76.3	93.4	79.6	77.8	74.7
CV%	10.9	--	4.4	--	4.7	8.2	--	5.8	--	6.9	--
LSD 0.05	10.4	--	6.5	--	5.9	9.0	--	8.5	--	6.7	--
LSD 0.10	8.7	--	5.0	--	4.6	7.5	--	7.1	--	5.6	--

¹Three-year average includes 2020 data.

Table 3. Yield of hard red spring wheat varieties grown at four locations in western North Dakota, 2021-2023.

Variety	Dickinson		Hettinger		Mandan		Minot		Average	
	2023	3 Yr.	2023	3 Yr.	2023	3 Yr.	2023	2 Yr.	2023	2/3 Yr.
	------(bu/a)-----									
AAC Starbuck	51.3	--	82.6	68.4	54.2	42.0	65.0	58.7	63.3	56.4
AP Gunsmoke CL2	53.0	40.5	84.9	70.7	49.4	45.2	68.4	63.1	63.9	59.7
AP Murdock	41.6	33.2	75.2	62.8	52.6	44.8	63.8	61.0	58.3	56.2
AP Smith	53.1	38.8	80.8	65.1	48.8	43.6	67.6	63.1	62.6	57.3
AR3530	52.5	38.9	86.5	67.6	54.4	44.0	62.7	59.1	64.0	56.9
AR3915	46.3	37.5	76.6	--	53.0	--	59.5	57.9	58.9	--
Ascend-SD	48.6	--	83.4	66.2	56.3	47.2	70.3	66.1	64.6	59.8
Bolles	45.7	32.9	75.8	63.0	51.3	42.1	70.4	66.0	60.8	57.0
Brawn-SD	50.1	--	89.1	--	50.3	--	69.9	--	64.8	--
CAG-Justify	61.2	--	93.6	74.7	50.3	46.1	63.2	65.0	67.1	61.9
CAG-Reckless	45.5	--	83.8	69.6	52.4	43.1	70.7	63.5	63.1	58.7
CDC LandmarkVB	47.2	--	81.8	--	55.7	--	60.3	--	61.2	--
CP3099A	54.7	--	91.7	70.1	54.4	44.1	62.9	65.8	65.9	60.0
CP3188	54.3	--	80.8	67.2	56.4	46.5	62.0	60.7	63.4	58.1
CP3322	62.5	--	84.0	--	53.6	--	59.6	--	64.9	--
Driver	46.5	--	86.8	69.9	56.9	45.7	57.4	60.2	61.9	58.6
Elgin ND	50.4	--	78.9	--	41.8	--	68.9	--	60.0	--
Glenn	45.6	34.2	73.3	62.0	45.9	39.9	61.9	59.3	56.7	53.7
Lang MN	51.0	37.3	76.9	--	56.8	--	61.1	--	61.4	--
Lanning	47.4	37.1	78.5	68.1	52.3	43.5	62.3	62.9	60.1	58.2
LCS Ascent	54.3	--	80.0	--	45.6	--	68.0	66.6	62.0	--
LCS Boom	46.5	--	76.2	--	47.0	--	68.5	--	59.5	--
LCS Buster	59.6	41.3	90.6	71.8	59.0	50.2	71.8	69.3	70.2	63.8
LCS Cannon	54.3	39.9	76.3	68.1	45.1	39.9	65.7	62.5	60.4	56.8
LCS Dual	48.9	--	85.2	--	45.2	--	60.3	66.5	59.9	--
LCS Hammer AX	49.8	--	73.3	--	51.7	--	61.4	60.9	59.0	--
LCS Trigger	54.1	40.1	93.2	71.1	60.3	51.0	70.6	68.7	69.6	63.6
MN- Rothsay	51.4	38.4	85.1	67.5	56.8	46.9	64.4	67.3	64.4	60.5
MN-Torgy	53.4	38.7	85.4	69.2	60.7	49.2	63.4	64.4	65.7	60.9
MS Charger	52.7	--	88.9	--	46.9	--	60.1	59.6	62.2	--
MS Cobra	45.7	--	76.7	65.5	50.7	43.3	61.7	58.5	58.7	55.8
MS Rancho	59.4	42.1	91.4	73.0	66.6	52.6	53.5	52.8	67.7	59.5
ND Frohberg	44.2	34.1	78.4	66.0	47.9	41.5	66.0	62.0	59.1	56.5
ND Heron	45.2	35.8	75.7	65.9	44.2	38.0	56.5	56.2	55.4	53.4
ND Thresher	46.3	--	82.0	64.5	53.2	41.5	59.4	--	60.2	--
ND VitPro	42.9	33.7	74.3	61.8	47.5	38.4	58.0	56.1	55.7	52.1
PFS Buns	57.4	--	91.9	--	63.9	--	67.6	--	70.2	--
Shelly	51.6	--	86.4	--	51.5	--	64.1	64.0	63.4	--
SY 611CL2	49.4	38.1	82.9	69.6	57.4	46.1	67.0	61.8	64.2	59.2
SY Ingmar	49.8	36.4	70.8	59.5	49.9	41.9	59.0	56.3	57.4	52.6
SY Longmire	45.1	34.4	76.6	62.5	52.5	42.4	66.3	59.9	60.1	54.9
SY McCloud	41.5	32.8	73.3	65.5	48.6	42.0	54.6	60.7	54.5	56.0
SY Valda	55.6	39.2	86.7	68.3	60.3	47.5	61.4	59.4	66.0	58.4
TCG-Heartland	43.8	33.5	72.5	63.8	45.4	37.3	60.1	59.4	55.5	53.5
TCG-Spitfire	53.1	37.9	84.2	68.1	62.6	50.5	61.7	62.2	65.4	60.2
TCG-Teddy	50.6	--	78.5	--	40.6	--	58.8	--	57.1	--
TCG-Wildcat	50.5	38.9	78.6	66.3	55.5	47.0	74.5	67.9	64.8	60.4
WB9590	44.1	--	79.1	66.6	45.7	40.1	66.9	63.0	59.0	56.6
WB9606	45.1	--	86.0	--	51.5	--	63.9	--	61.6	--
WB9719	52.9	--	81.6	--	53.0	--	65.1	--	63.1	--
Mean	49.8	37.1	81.5	67.1	52.4	44.3	62.5	62.0	62.0	57.8
CV%	10.3	--	5.5	--	9.2	--	11.0	--	6.9	--
LSD 0.05	6.0	--	5.2	--	5.6	--	11.0	--	5.9	--
LSD 0.10	4.7	--	4.1	--	4.4	--	9.2	--	4.9	--

Williston 2023 data was not suitable to publish due to hail loss. Dickinson 2022 trial lost to hail.

Table 4. Protein at 12% moisture of hard red spring wheat varieties grown at ten locations in North Dakota, 2023.

Variety	Carrington	Casselton	Forman	Langdon	Prosper	Dickinson	Hettinger	Mandan	Minot	Williston	State Avg.
------(%)-----											
AAC Starbuck	15.7	15.6	15.6	12.7	15.6	13.8	14.7	13.7	15.6	15.0	14.8
AP Gunsmoke CL2	15.6	15.3	15.3	13.7	15.5	13.7	13.7	12.5	14.7	15.1	14.5
AP Murdock	15.4	14.9	14.9	12.8	14.8	14.8	13.3	12.1	14.4	14.3	14.2
AP Smith	15.3	14.6	14.7	13.1	14.8	13.9	13.9	13.4	14.2	15.0	14.3
AR3530	14.8	15.4	14.8	12.8	15.4	12.9	14.1	12.7	14.6	14.7	14.2
AR3915	15.0	15.1	14.8	13.5	14.9	14.7	13.4	12.0	14.3	15.8	14.4
Ascend-SD	15.3	15.0	14.3	12.2	15.7	13.4	13.2	12.4	14.8	15.0	14.1
Bolles	17.5	16.9	16.6	14.4	16.2	14.9	15.5	13.9	15.7	16.1	15.8
Brawn-SD	14.5	13.8	14.0	12.2	14.2	12.8	13.4	12.1	13.3	13.9	--
CAG-Justify	14.1	13.6	13.8	12.4	13.9	11.9	12.3	11.0	13.4	13.4	13.0
CAG-Reckless	14.8	14.9	14.6	12.4	14.7	14.7	14.2	12.6	14.5	13.3	14.1
CDCLandmarkVB	15.9	15.4	15.3	13.0	15.6	15.1	14.7	13.6	15.4	15.5	--
CP3099A	12.0	11.4	13.3	11.0	13.3	12.0	10.6	10.6	11.3	12.9	11.8
CP3188	13.5	13.7	13.7	11.8	13.8	11.9	12.0	11.6	12.9	13.1	12.8
CP3322	13.6	13.4	14.3	12.5	13.7	11.4	11.3	11.5	13.1	12.7	--
Driver	14.3	14.7	14.1	12.9	14.5	13.5	13.4	12.0	14.4	13.8	13.8
Elgin ND	14.5	14.5	14.4	12.5	14.1	14.2	13.7	12.6	13.8	13.9	--
Glenn	15.5	15.2	15.0	13.3	15.3	14.6	14.6	13.0	15.4	15.1	14.7
Lang MN	15.0	15.5	14.8	13.4	15.6	13.8	13.8	13.0	15.2	14.8	--
Lanning	15.7	15.5	15.4	13.9	15.4	14.4	13.9	13.2	15.3	14.1	14.7
LCS Ascent	14.8	14.0	14.5	12.6	13.7	13.4	13.1	11.9	13.7	13.7	13.5
LCS Boom	16.0	14.9	15.5	13.0	14.6	14.5	14.2	12.7	14.6	14.6	--
LCS Buster	12.7	13.0	13.4	11.5	12.7	11.0	11.6	10.8	12.1	12.7	12.2
LCS Cannon	14.8	14.8	15.0	12.8	14.7	12.2	14.3	12.2	14.9	14.2	14.0
LCS Dual	14.8	14.2	13.8	12.2	14.7	13.3	13.1	12.3	13.8	13.7	13.6
LCS Hammer AX	15.1	14.8	14.6	12.8	14.8	13.9	13.6	12.4	14.4	13.9	14.0
LCS Trigger	12.8	12.8	13.9	11.6	12.5	12.0	11.4	10.5	11.7	13.7	12.3
MN- Rothsay	15.2	15.0	14.5	13.6	14.4	13.7	13.9	12.9	13.8	14.3	14.1
MN-Torgy	15.7	15.5	15.2	13.9	15.2	13.7	14.4	12.7	14.2	14.5	14.5
MS Charger	14.2	13.4	13.4	12.1	13.6	12.5	12.2	11.7	12.7	12.7	12.8
MS Cobra	15.8	15.1	15.1	13.1	15.7	14.9	14.3	13.1	14.6	15.1	14.7
MS Rancho	14.7	14.9	15.5	13.1	13.9	12.1	12.5	11.8	14.2	12.8	13.6
ND Frohberg	15.6	14.4	14.8	13.2	15.1	14.9	14.4	13.2	14.6	14.8	14.5
ND Heron	15.7	15.1	15.5	12.7	15.5	15.3	14.7	12.8	15.2	14.9	14.8
ND Thresher	14.5	15.2	15.3	13.6	14.8	13.8	14.0	12.3	14.2	15.0	--
ND VitPro	16.0	15.3	15.3	13.8	15.4	15.0	14.7	13.2	15.1	15.1	14.9
PFS Buns	13.6	13.4	15.4	12.8	12.8	11.6	11.9	11.3	11.9	13.5	--
Shelly	14.6	14.3	13.9	12.9	14.6	13.7	13.1	12.4	13.4	14.0	13.7
SY 611CL2	15.7	14.9	15.0	13.3	15.4	14.0	14.1	12.5	14.0	14.4	14.3
SY Ingmar	15.8	15.2	14.9	13.3	15.3	14.3	14.8	13.3	14.6	15.0	14.7
SY Longmire	15.5	14.6	14.9	13.2	14.6	15.4	14.2	12.8	14.3	15.0	14.4
SY McCloud	16.1	15.5	15.4	13.0	15.4	14.6	14.6	13.9	14.9	15.0	14.8
SY Valda	15.1	14.4	14.6	12.5	14.8	13.3	14.5	12.0	14.1	15.0	14.0
TCG-Heartland	16.2	15.5	15.8	14.0	15.4	14.5	14.9	13.6	15.1	14.5	14.9
TCG-Spitfire	14.5	14.2	14.5	12.9	14.0	13.3	13.4	12.1	13.9	14.2	13.7
TCG-Teddy	15.6	15.1	15.0	13.6	15.4	13.9	13.7	13.1	14.0	15.1	--
TCG-Wildcat	16.1	14.6	15.2	13.2	15.0	14.1	14.6	13.4	14.4	14.4	14.5
WB9590	15.3	14.9	15.7	13.8	15.0	14.6	14.3	12.6	14.8	14.2	14.5
WB9606	13.8	14.2	13.6	12.2	13.3	13.2	12.8	11.6	13.9	14.3	--
WB9719	14.5	14.4	14.4	12.6	14.4	13.3	13.2	12.0	14.1	14.3	--
Mean	15.0	14.7	14.8	13.0	14.7	13.8	13.6	12.5	14.2	14.4	14.1
CV%	3.2	1.1	0.9	4.9	2.5	6.0	4.1	4.4	3.1	4.3	--
LSD 0.05	0.7	0.3	0.3	0.9	NS	1.0	0.7	0.6	0.7	1.0	--
LSD 0.10	0.6	0.2	0.2	0.8	0.5	0.8	0.5	0.5	0.6	0.8	--

Table 5. Test weight of hard red spring wheat varieties grown at ten locations in North Dakota, 2023.

Variety	Carrington	Casselton	Forman	Langdon	Prosper	Dickinson	Hettinger	Mandan	Minot	Williston	State Avg.
	------(%)-----										
AAC Starbuck	61.3	62.7	60.5	61.4	62.4	61.2	58.8	56.8	60.5	60.4	60.6
AP Gunsmoke CL2	60.0	61.2	58.7	59.0	59.8	60.2	59.8	55.8	60.2	58.6	59.3
AP Murdock	60.2	61.0	59.2	58.4	61.4	58.5	58.1	57.0	59.7	58.0	59.2
AP Smith	60.5	60.2	59.7	59.6	60.5	60.9	59.8	57.1	59.6	59.0	59.7
AR3530	60.0	61.1	58.7	59.4	61.6	59.8	59.7	57.3	59.5	59.1	59.6
AR3915	60.7	62.3	61.2	59.5	62.2	62.0	60.3	57.1	60.4	59.9	60.5
Ascend-SD	60.9	61.7	60.3	59.4	61.7	60.6	60.0	57.6	59.7	59.7	60.2
Bolles	59.8	60.4	58.4	59.3	59.8	60.2	58.6	56.6	59.4	60.0	59.2
Brawn-SD	61.9	63.3	61.8	61.2	63.0	61.6	59.9	57.4	61.9	60.7	--
CAG-Justify	58.0	59.8	56.8	55.7	58.4	58.6	58.7	55.3	57.3	57.6	57.6
CAG-Reckless	61.9	62.2	60.8	60.6	62.5	61.2	59.5	58.0	60.7	57.1	60.4
CDCLandmarkVB	61.2	62.1	60.7	61.3	61.7	61.0	59.6	58.0	60.5	60.3	--
CP3099A	56.0	56.7	56.5	53.8	57.1	59.3	58.4	52.7	55.6	57.8	56.4
CP3188	58.0	60.9	57.2	57.6	59.3	58.9	58.7	56.2	58.3	58.3	58.3
CP3322	59.2	60.5	57.4	58.1	58.8	60.7	59.3	55.6	58.2	60.1	--
Driver	61.2	62.1	60.6	60.3	61.5	61.1	60.0	57.9	60.5	61.0	60.6
Elgin ND	60.0	61.4	60.6	60.0	61.6	60.2	58.8	55.4	60.2	60.0	--
Glenn	62.5	63.4	62.6	62.1	63.0	62.3	60.6	58.5	61.3	61.5	61.8
Lang MN	61.3	62.0	60.9	61.2	61.8	60.4	59.7	58.5	61.3	60.2	--
Lanning	58.4	60.3	58.0	59.2	58.7	59.2	58.1	56.0	59.6	59.7	58.7
LCS Ascent	60.6	62.5	60.8	60.5	62.5	60.9	59.6	56.4	60.2	61.2	60.5
LCS Boom	61.5	63.5	60.9	60.1	62.7	61.2	60.0	57.7	60.9	60.6	--
LCS Buster	58.3	60.3	57.3	56.6	58.6	59.3	58.7	56.8	59.3	58.6	58.4
LCS Cannon	60.2	63.5	61.5	60.8	62.7	60.4	60.2	55.9	61.1	61.2	60.7
LCS Dual	60.2	62.2	60.2	60.2	61.6	60.8	59.8	55.0	60.0	60.1	60.0
LCS Hammer AX	60.1	61.4	59.6	59.5	61.5	59.5	58.2	56.0	59.5	59.1	59.4
LCS Trigger	60.2	62.2	59.2	59.0	61.3	60.6	60.0	58.9	61.1	58.8	60.1
MN- Rothsay	60.1	61.2	59.9	59.4	61.6	60.9	58.9	57.5	60.3	59.3	59.9
MN-Torgy	59.3	61.6	60.4	60.6	62.0	60.6	58.8	59.0	60.9	60.3	60.4
MS Charger	60.4	61.6	60.6	59.4	60.7	60.1	59.8	55.5	59.5	59.9	59.7
MS Cobra	61.2	61.9	60.5	60.7	61.6	60.5	59.1	55.7	60.4	60.0	60.1
MS Ranchero	60.0	57.1	58.2	59.1	55.2	60.0	58.7	57.3	59.2	60.7	58.5
ND Frohberg	61.3	62.0	60.1	60.0	61.7	60.1	59.7	58.0	61.2	60.2	60.4
ND Heron	60.9	63.1	60.7	61.1	61.0	60.2	59.4	55.8	60.5	60.7	60.3
ND Thresher	59.5	60.4	57.5	58.3	61.1	59.0	58.6	56.8	58.3	58.7	--
ND VitPro	61.8	63.3	61.7	61.5	63.2	61.5	60.2	56.9	61.0	58.0	60.9
PFS Buns	58.5	59.3	55.5	57.0	59.1	59.4	57.3	56.3	58.5	58.7	--
Shelly	58.7	62.2	60.5	59.9	61.3	60.8	58.9	55.8	60.7	59.9	59.9
SY 611CL2	62.4	61.9	61.1	61.4	61.1	62.3	60.3	57.5	60.9	61.4	61.0
SY Ingmar	61.4	62.0	61.2	59.8	61.4	62.0	60.0	58.0	60.1	60.3	60.6
SY Longmire	61.4	61.6	60.5	59.8	61.3	61.1	59.6	58.6	60.0	60.2	60.4
SY McCloud	60.8	62.6	61.4	61.0	62.3	60.7	59.4	57.0	60.8	61.0	60.7
SY Valda	61.6	61.6	60.2	59.5	61.1	60.2	59.6	57.2	60.4	58.5	60.0
TCG-Heartland	61.8	62.7	61.0	60.4	61.9	61.7	59.6	56.7	60.1	61.0	60.7
TCG-Spitfire	60.4	60.7	58.8	59.0	60.2	61.1	58.8	57.7	59.8	60.2	59.7
TCG-Teddy	59.0	60.7	60.1	57.9	60.3	61.1	58.9	55.3	59.2	59.2	--
TCG-Wildcat	61.5	61.5	60.6	59.9	61.5	61.2	59.8	57.2	60.7	60.3	60.4
WB9590	59.5	61.8	59.9	60.1	61.5	59.7	58.4	53.9	59.9	59.7	59.4
WB9606	61.4	62.0	60.0	59.9	61.3	61.3	59.8	56.5	61.2	60.9	--
WB9719	63.0	63.8	61.5	61.2	62.8	63.0	61.0	58.4	61.6	62.7	--
Mean	59.3	61.5	59.8	59.6	61.0	60.5	59.3	56.6	59.9	59.7	59.9
CV%	1.4	0.4	0.4	1.3	1.3	0.8	0.7	1.6	1.1	1.2	--
LSD 0.05	1.1	0.5	0.4	1.1	1.2	0.5	0.5	1.1	1.0	1.2	--
LSD 0.10	1.0	0.4	0.3	0.9	1.0	0.4	0.4	0.8	0.9	1.0	--

Table 6. Quality data from 2020-2022. The Wheat Quality Index is a weighted average developed to summarize the relative milling and baking quality of lines in the trial. Data from across years are from 2019-2022 for all varieties which were tested in a minimum of two years (four locations per year) across North Dakota.

Variety	Test Weight ¹	Vitreous Kernels ²	Wheat Protein ³	Farinograph Absorption ⁴	Flour Extraction ⁵	Farinograph Stability ⁶	Loaf Volume ⁷	WQI RANK ⁸
	lb/bu	%	12% m.b.	%	%	min	cm ³	
MS Cobra	61.7	82.9	15.1	65.7	67.6	11.8	1039.1	1
AR3915	62.3	74.6	15.1	64.1	68.7	14.5	981.0	2
SY McCloud	62.5	77.5	15.5	66.2	66.4	11.9	962.8	3
Bolles	60.7	83.4	16.9	64.6	64.1	21.8	940.0	4
Glenn	63.5	86.4	15.5	64.7	65.5	15.1	957.1	5
CAG-Reckless	61.9	79.7	15.2	65.1	65.1	15.3	966.0	6
AR3530	61.3	72.4	14.9	64.6	67.9	11.9	976.2	7
ND VitPro	62.9	84.1	15.6	65.2	66.7	10.4	951.8	8
ND Frohberg	62.1	74.6	14.9	66.3	65.8	14.1	922.4	9
TCG-Heartland	62.3	76.7	15.7	63.7	66.9	14.7	941.5	10
SY Longmire	61.5	77.6	15.1	64.4	66.8	13.0	965.0	11
Lanning	60.3	82.2	15.7	63.5	66.1	12.1	991.0	12
AP Smith	61.0	76.5	15.1	62.9	66.0	16.3	978.7	13
SY Invmar	62.0	80.9	15.4	63.1	67.1	14.1	954.6	14
Lang-MN	61.8	86.6	15.4	63.9	66.8	12.3	943.0	15
Elgin ND	60.4	74.0	15.3	64.2	67.2	12.7	945.1	16
WB9590	61.8	77.6	15.4	63.7	66.1	14.4	924.9	17
ND Heron	62.9	82.9	15.6	71.7	64.0	8.3	922.4	18
SY 611CL2	62.1	77.6	15.1	68.1	65.2	9.3	920.2	19
LCS Cannon	62.7	66.2	14.6	62.6	68.2	14.6	933.9	20
MS Ranchero	59.9	79.9	14.7	65.7	64.7	13.2	927.8	21
MN Rothsay	61.5	72.5	15.1	61.8	67.3	15.1	955.6	22
ND Thresher	59.8	78.6	15.5	65.2	65.9	10.3	919.5	23
TCG-Spitfire	60.8	71.4	14.5	64.5	65.0	12.5	950.9	24
AP Murdock	60.9	63.3	14.5	63.8	67.1	14.0	924.6	25
TCG-Wildcat	62.2	76.6	15.1	63.9	66.8	9.7	928.9	26
Faller	60.9	70.2	14.5	64.3	68.2	10.6	911.2	27
MN Torgy	62.0	70.7	15.1	62.1	65.8	14.3	923.5	28
AP Gunsmoke CL2	60.8	74.9	15.5	61.4	65.9	13.5	915.8	29
Shelly	60.8	74.3	14.7	61.3	67.2	13.3	907.7	30
CP3188	60.1	67.4	13.7	60.2	67.7	17.6	897.5	31
Driver	62.2	75.7	14.8	60.9	66.7	11.5	897.8	32
SY Valda	61.7	84.2	14.7	63.2	65.6	7.7	882.9	33
LCS Trigger	61.4	82.0	13.2	64.6	67.1	9.9	819.2	34
CP3099A	58.9	78.8	13.2	61.4	65.8	14.0	893.0	35
CAG-Justify	59.1	77.2	14.3	62.6	67.0	9.1	866.1	36
LCS Buster	59.1	64.1	13.1	58.2	68.2	15.1	849.1	37
Mean								

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 US 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% vitreous kernels.

³Wheat Protein - Measured by NIR at a 12% moisture basis. A high protein is desirable for baking quality.

⁴Farinograph Absorption - Measured by NIR at a 14% moisture basis. A measure of dough water absorption, expressed as percent. A high absorption is desirable.

⁵Flour Extraction - Percentage of milled flour recovered from cleaned and tempered wheat. A high flour extraction percentage is desirable.

⁶Farinograph Stability - A measure of dough strength expressed in minutes above the 500 Brabender unit line during mixing. A high stability is desirable.

⁷Loaf Volume - The volume of the pup loaf of bread, expressed in cubic centimeters. A high volume is desirable.

⁸Standardized means were used to calculate the Wheat Quality Index (WQI). The WQI is a weighted index calculated as: Test Weight (5%); Vitreous kernel (5%); Wheat Protein (10%); Flour Extraction (10%); Farinograph Absorption (23.3%); Farinograph Stability (23.3%) and Loaf Volume (23.3%). Adjusted means across locations were calculated for each trait using a mixed model. These means were standardized (mean=0 and standard deviation=1) to remove the effect of scale, which vary between traits.

Table 7. Quality data from 2022 from four locations across North Dakota. The Wheat Quality Index is a weighted average developed to summarize the relative milling and baking quality of lines in the trial. Data from 2022 are for all varieties which were tested in the 2023 trial. Data were collected from Carrington, Thompson, Hettinger, and Prosper, North Dakota.

Variety	Test Weight ¹	Vitreous Kernels ²	Wheat Protein ³	Farinograph Absorption ⁴	Flour Extraction ⁵	Farinograph Stability ⁶	Loaf Volume ⁷	WQI RANK ⁸
	lb/bu	%	12% m.b.	%	%	min	cm ³	
Bolles	60.6	80.1	16.4	64.8	66.0	17.1	996.4	1
Glenn	62.9	80.5	15.6	65.1	66.7	11.7	1040.6	2
MS Cobra	61.4	79.3	15.0	65.9	68.2	10.0	1052.2	3
ND Thresher	60.1	71.5	15.1	65.7	67.7	11.3	1014.3	4
ND Frohberg	61.7	71.1	14.9	66.5	66.7	11.2	981.7	5
ND VitPro	62.5	79.9	15.6	65.4	66.9	10.3	989.1	6
SY McCloud	61.9	74.0	15.6	66.4	66.1	9.8	985.9	7
CAG-Reckless	61.5	78.3	15.2	65.7	65.8	12.7	965.9	8
TCG-Heartland	61.7	74.1	15.5	64.0	66.9	11.6	980.7	9
SY Ingmar	61.1	78.6	15.5	62.9	67.9	10.5	1017.5	10
ND Heron	62.5	72.4	15.6	72.4	65.6	8.6	972.3	11
AAC Starbuck	61.1	75.3	15.9	64.9	67.9	10.4	947.0	12
LCS Ascent	61.9	64.3	14.3	63.8	67.3	13.0	972.3	13
MS Ranchero	59.1	78.4	14.6	66.9	65.6	11.1	960.7	14
WB9590	61.3	76.2	15.4	64.1	66.4	11.7	955.4	15
SY 611CL2	61.3	75.9	15.2	69.1	66.0	8.4	951.2	16
AP Smith	60.6	75.7	15.0	63.4	66.7	11.2	985.9	17
LCS Cannon	62.2	65.6	14.7	63.3	68.7	10.8	954.4	18
AR3530	60.8	73.3	15.0	64.6	67.4	9.5	961.7	19
TCG-Wildfire	61.6	72.0	15.1	64.5	67.5	9.3	953.3	20
SY Longmire	60.7	71.6	15.1	64.8	66.8	9.7	949.1	21
TCG-Spitfire	60.2	69.5	14.2	64.5	66.1	9.7	977.5	22
Ascend-SD	61.2	78.9	14.6	64.3	66.6	10.1	944.9	23
Boost	60.3	68.5	14.8	65.4	67.2	8.8	928.5	24
LCS Hammer AX	61.3	72.4	14.6	63.2	67.2	10.4	949.1	25
MN-Rothsay	60.9	73.2	14.8	61.9	68.0	11.9	938.6	26
MS Charger	61.3	68.5	13.6	65.0	66.7	9.7	942.8	27
Lanning	59.6	78.2	15.7	63.5	66.3	9.4	947.0	28
SY Valda	61.0	79.0	14.7	63.8	67.2	8.4	949.1	29
AP Murdock	60.4	66.3	14.0	63.1	66.7	11.9	943.9	30
Brawn-SD	62.0	69.3	14.1	62.0	67.9	11.4	937.6	31
MN-Torgy	61.5	72.4	15.1	63.0	67.2	9.9	915.5	32
Shelly	61.5	75.5	14.5	61.9	68.7	11.0	909.2	33
CP3188	59.8	69.1	13.5	61.0	68.3	12.0	912.3	34
AP Gunsmoke CL2	60.5	70.9	15.4	61.3	65.8	10.5	912.3	35
Driver	61.7	71.1	14.7	60.9	66.9	10.8	900.8	36
LCS Trigger	60.9	76.1	12.8	65.2	67.9	8.7	821.9	37
CP3099A	59.1	79.0	13.0	62.4	65.9	12.3	873.4	38
CAG-Justify	59.3	72.1	14.2	63.2	66.9	8.8	845.0	39
LCS Buster	58.5	64.9	13.0	59.1	68.5	11.2	883.9	40
Mean	61.1	73.8	14.8	64.4	67.0	10.7	952.2	

See footnotes below Table 6.

NDSU does not endorse commercial products or companies even though reference may be made to tradenames, trademarks or service names.

For more information on this and other topics, see www.ag.ndsu.edu

NDSU encourages you to use and share this content, but please do so under the conditions of our Creative Commons license. You may copy, distribute, transmit and adapt this work as long as you give full attribution, don't use the work for commercial purposes and share your resulting work similarly. For more information, visit www.ag.ndsu.edu/agcomm/creative-commons.

County commissions, North Dakota State University and U.S. Department of Agriculture cooperating. NDSU does not discriminate in its programs and activities on the basis of age, color, gender expression/identity, genetic information, marital status, national origin, participation in lawful off-campus activity, physical or mental disability, pregnancy, public assistance status, race, religion, sex, sexual orientation, spousal relationship to current employee, or veteran status, as applicable. Direct inquiries to Vice Provost for Title IX/ADA Coordinator, Old Main 201, NDSU Main Campus, 701-231-7708, ndsuoaa.ndsu.edu. This publication will be made available in alternative formats for people with disabilities upon request, 701-231-7881.