



2023 Spring Wheat Field Crop Trials Results

Minnesota Agricultural Experiment Station and the College of Food, Agricultural and Natural Resource Sciences

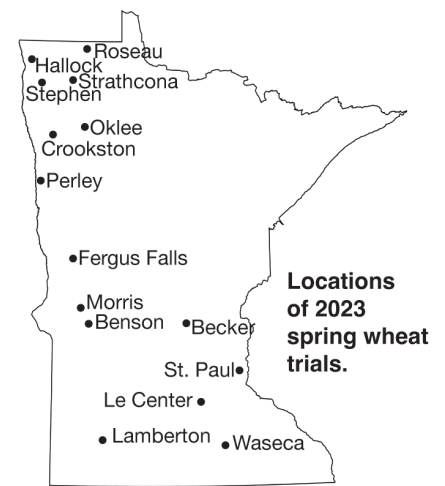
Spring wheat varieties were sown in trial plots at Becker, Crookston, Lamberton, Roseau, St. Paul, and Waseca and on-farm sites near Benson, Fergus Falls, Hallock, Le Center, Oklee, Perley, Stephen, and Strathcona. The Roseau site was abandoned due to hail. These plots are handled so that the factors affecting yield and other characteristics are as nearly the same for all varieties at each location as possible, but seed providers are allowed to choose a preferred seeding rate for each variety. The standard seeding rate is designed to achieve a desired stand of 1.3 million plants/acre, assuming a 10% stand loss and adjusting for the germination percentage and seed weight of each variety. These hard red spring wheat trials are not designed for crop (species) comparisons, because the various crops are grown on different fields or with different manage-

ment. The data should only be used to compare varieties within a table. All locations are set up as randomized complete blocks with 3 replications. Spatial analysis is used to adjust plot yields for each location. Tested hard red spring wheat varieties are listed in alphabetical order in the tables.

Variety Selection Criteria

While grain yield is an important economic trait, return per acre is also affected by grain quality. Because Fusarium Head Blight (FHB), or scab, can reduce grain quality and yield dramatically, it is an important consideration. Disease ratings are on a 1-9 scale where 1 = most resistant and 9 = most susceptible. Rating differences of 2 or more should be considered significant.

Leaf and stripe rust pressure throughout Minnesota has been low the past



six seasons. The majority of varieties are resistant or moderately resistant, but a few are moderately susceptible. Stripe rust can be very damaging when temperatures remain unseasonably cool into early July. Carefully consider a variety's rating for leaf and stripe rust and plan to use a fungicide if a variety is rated 5 or higher and disease

Hard red spring wheat seeding rate calculator.

Calculating and seeding the appropriate amount of seed is an important first step towards maximizing yield. The seeding rate is a function of the number of kernels per pound of seed, the percent germination of the lot, the expected stand loss as a function of the quality of the seedbed and the desired stand. In Minnesota, an average optimum stand for hard red spring wheat when planted early is between 28 to 30 plants per square foot or approximately 1.3 million plants per acre. This number should increase by 1 to 2 plants per square foot for every week planting is delayed past the early, optimum, seeding date. Expected stand loss even under good seedbed conditions is between 10% to 20% and will increase with a poor seedbed or improper seed placement due to poor depth control.

The general formula for calculating a seeding rate is:

$$\text{Seeding Rate (Pounds/Acre)} = \frac{\text{Desired Stand (Plants/Acre)} \div (1 - \text{Expected Stand Loss})}{(\text{Seeds/Pound}) \times \text{Percentage Germination}}$$

Calculate the seeding rate for every single seed lot and calibrate the drill accordingly.

Example: Early variety.

Desired Stand, (Plants/Acre)	Expected Stand Loss	Seeds Per Pound	Percentage Germination	Seeding Rate, (lb/Acre)
1.3 million	0.10	14,000	0.95	109

levels warrant treatment. Varieties with ratings of 4 or better should not experience economic levels of damage in most years. Stem rust ratings are included in the disease tables

because there are differences in variety reaction. However, the levels of this disease have been very low in production fields in recent years, even on susceptible varieties.

Bacterial leaf streak was assessed at only one naturally infected location in 2023, so new varieties don't have a rating assigned yet for this disease. This data, in combination with data

Table 1. Origin and agronomic characteristics of hard red spring wheat varieties in Minnesota in single-year (2023) and multiple-year comparisons.

Entry	Origin ¹	Legal Status	Desired Stand (Plants/Acre) ²	Days to Heading ³	Height Inches ³	Straw Strength ⁴
AP Gunsmoke CL2 ⁵	2021 AgriPro/Syngenta	PVP (94)	1.3	50.9	26.6	5
AP Murdock	2020 AgriPro/Syngenta	PVP (94)	1.3	52.2	25.2	5
AP Smith	2021 AgriPro/Syngenta	PVP (94)	1.3	54.3	25.2	2
Ascend-SD	2021 SDSU	PVP (94) pending	1.3	52.8	28.2	5
Brawn-SD	2022 SDSU	PVP (94) (pending)	1.3	51.2	27.1	5
CAG Justify	2021 Champions Alliance Group	PVP (94)	1.2	53.2	27.0	5
CAG Reckless	2021 Champions Alliance Group	PVP (94)	1.3	52.1	28.8	5
CAG Recoil	2022 Champions Alliance Group	PVP (94) pending	1.5	55.9	26.8	3
CP3099A	2020 CROPLAN	PVP (94) pending	1.3	56.4	29.5	4
CP3188	2022 CROPLAN	PVP (94) pending	1.3	52.4	27.4	6
CP3322	2023 CROPLAN	PVP (94) pending	1.3	55.6	26.3	3–4
CP3530	2015 CROPLAN	Patented	1.3	53.1	28.7	6
CP3915	2019 CROPLAN	PVP (94) pending	1.3	52.4	27.4	4
Driver	2020 SDSU	PVP (94)	1.3	51.7	28.6	4
Dyna-Gro Ambush	2016 Dyna-Gro	PVP (94)	1.5	49.8	27.2	5
Dyna-Gro Ballistic	2018 Dyna-Gro	PVP (94)	1.5	52.6	28.4	5
Dyna-Gro Commander	2019 Dyna-Gro	PVP (94)	1.5	50.1	27.4	4
LCS Ascent	2022 Limagrain Cereal Seeds	PVP (94)	1.3	49.6	27.3	5
LCS Boom	2023 Limagrain Cereal Seeds	PVP (94) pending	1.3	48.9	25.5	4
LCS Buster	2020 Limagrain Cereal Seeds	PVP (94)	1.3	55.3	28.3	5
LCS Cannon	2018 Limagrain Cereal Seeds	PVP (94)	1.3	48.4	25.6	4
LCS Dual	2021 Limagrain Cereal Seeds	PVP (94)	1.3	50.3	28.2	3
LCS Trigger	2016 Limagrain Cereal Seeds	PVP (94)	1.3	56.0	28.2	5
Linkert	2013 MN	PVP (94)	1.3	50.6	25.5	2
MN-Rothsay	2022 MN	PVP (94) pending	1.3	53.7	24.9	3
MN-Torgy	2020 MN	PVP (94)	1.3	53.0	26.7	4
MN-Washburn	2019 MN	PVP (94)	1.3	53.6	26.1	3
MS Charger	2023 Meridian Seeds	PVP (94) pending	1.2	50.4	26.1	5
MS Cobra	2022 Meridian Seeds	PVP (94)	1.4	50.4	26.6	4
MS Ranchero	2020 Meridian Seeds	PVP (94)	1.3	55.4	28.7	6
ND Frohberg	2020 NDSU	PVP (94)	1.3	51.9	28.9	5
ND Heron	2021 NDSU	PVP (94)	1.3	49.2	27.0	5
PFS Buns	2021 Peterson Farm Seeds	PVP (94) pending	1.3	57.6	25.4	4
Shelly	2016 MN	PVP (94)	1.3	54.4	25.5	5
SY 611 CL2 ⁵	2019 AgriPro/Syngenta	PVP (94)	1.3	51.0	26.1	4
SY Longmire ⁶	2019 AgriPro/Syngenta	PVP (94)	1.3	52.8	26.4	4
SY Valda	2015 AgriPro/Syngenta	PVP (94)	1.3	52.1	26.7	5
TCG-Heartland	2019 21st Century Genetics	PVP (94), Patent pending	1.6	49.3	24.6	3
TCG-Spitfire	2016 21st Century Genetics	PVP (94)	1.5	54.0	26.6	3
TCG-Teddy	2022 21st Century Genetics	Patented	1.6	52.3	24.0	3–4
TCG-Wildcat	2020 21st Century Genetics	PVP (94), Patent pending	1.5	51.6	27.2	3
WB9479	2017 WestBred	Patented, PVP (94)	1.3	50.2	24.3	3
WB9590	2017 WestBred	Patented, PVP (94)	1.3	50.6	23.7	3
Mean				52.3	26.6	

¹Abbreviations: MN = Minnesota Agricultural Experiment Station; NDSU = North Dakota State University Research Foundation; SDSU = South Dakota Agricultural Experiment Station

²Our standard seeding rate is designed to achieve a desired stand of 1.3 million plants/acre, assuming a 10% stand loss and adjusting for the germination percentage and seed weight of each variety.

³2023 data from Crookston, St. Paul, and Waseca.

⁴1-9 scale in which 1 is the strongest straw and 9 is the weakest. Based on 2014-2022 data. The rating of newer entries may change by as much as one rating point as more data are collected.

⁵AP Gunsmoke CL2 and SY 611 CL2 have tolerance to Beyond® herbicide.

⁶SY Longmire has solid stems.

from past years was used to assign a rating to varieties that have been tested for two or more years. This disease cannot be controlled with fungicides. Selection of more resistant varieties is the only recommended practice at this time to reduce losses caused by this disease. The rating of newer varieties may change by as much as one rating point once more data is collected.

The “Other Leaf Diseases” rating represents a combined reaction to two different Septoria leaf blotches and tan spot. Although varieties may differ for their response to each of those diseases, the rating does not differentiate among them. Consequently, the rating should be used as a general indication and only for varietal selection in areas where these diseases have been a problem or if the previous crop was wheat or barley. Control of fungal leaf diseases with fungicides may be warranted, even for varieties with an above-average rating.

WB9590 was the no. 1 variety grown in Minnesota in 2023, seeded on 23.7% of the 1.14 million acres. The next most seeded varieties were MN-Torgy (18.6%), SY Valda (9.1%), WB9479 (7.1%), MN-Rothsay (6.3%), and Linkert (6.0%).

Varieties tested for the first time in 2023 were CP3322, LCS Boom, and TCG-Teddy. PFS Buns was first tested in 2021 but not 2022. Brawn-SD (released in 2022) was tested in 2022 under its experimental designation and 2-year averages are reported. WestBred did not submit any HRSW varieties for testing, but WB9479 and WB9590 were both tested in 2023 because each occupied more than 5% of the state’s acreage in 2022.

Since 2004 we have been conducting an “intensive” management trial in which fungicides are applied at the time of herbicide application (Feekes 5), flag leaf emergence (Feekes 9), and at the onset of flowering (Feekes 10.51). The practice of three fungi-

Table 2. Grain quality of hard red spring wheat varieties in Minnesota in single-year (2023) and multiple-year comparisons.

Entry	Test Weight (lb/Bu)		Protein (%) ¹		Baking Quality ²	Pre-Harvest Sprouting ³
	2023	2 Yr	2023	2 Yr		
AP Gunsmoke CL2	61.0	59.9	14.7	15.2	5	2
AP Murdock	60.0	59.7	14.1	14.2	5	1
AP Smith	61.2	60.0	14.5	15.0	3	3
Ascend-SD	61.5	60.3	14.0	14.6	5	4
Brawn-SD	62.4	61.4	12.9	13.5	–	1
CAG Justify	58.8	58.5	13.0	13.4	7	3
CAG Reckless	61.7	60.8	14.1	14.6	3	4
CAG Recoil	59.8	59.5	13.9	14.2	–	1
CP3099A	59.2	58.1	11.7	12.4	6	1
CP3188	59.6	58.4	12.6	13.2	6	1
CP3322	59.7	–	12.9	–	–	2
CP3530	60.9	60.2	14.2	14.7	3	1
CP3915	61.4	60.2	14.2	14.7	4	1
Driver	61.7	61.1	14.0	14.4	6	2
Dyna-Gro Ambush	62.0	60.3	14.4	14.4	2	3
Dyna-Gro Ballistic	60.4	60.3	13.2	14.1	5	3
Dyna-Gro Commander	61.4	60.2	14.2	14.7	6	1
LCS Ascent	61.6	60.7	13.7	14.2	–	3
LCS Boom	62.7	–	14.2	–	–	3
LCS Buster	59.3	58.0	11.9	12.2	7	5
LCS Cannon	62.7	61.7	14.2	14.5	4	3
LCS Dual	61.4	60.3	13.6	14.1	–	2
LCS Trigger	60.9	60.2	12.2	12.6	7	1
Linkert	61.8	60.9	15.2	15.4	1	1
MN-Rothsay	61.5	60.5	14.0	14.4	5	2
MN-Torgy	61.7	60.6	14.4	14.7	4	1
MN-Washburn	61.3	60.1	13.9	14.3	3	1
MS Charger	61.0	60.0	12.8	13.2	–	1
MS Cobra	61.7	60.3	14.2	14.6	3	4
MS Ranchero	59.3	58.1	13.5	14.2	6	4
ND Frohberg	61.3	60.6	14.1	14.6	3	4
ND Heron	62.3	61.4	14.8	15.1	–	2
PFS Buns	58.7	–	13.0	–	–	4
Shelly	61.3	60.1	13.4	14.0	5	1
SY 611 CL2	61.8	60.4	14.3	14.7	6	2
SY Longmire	61.1	59.6	14.2	15.0	3	3
SY Valda	61.2	60.1	13.8	14.2	6	2
TCG-Heartland	61.6	60.4	15.2	15.4	2	1
TCG-Spitfire	60.4	59.3	13.9	14.1	3	4
TCG-Teddy	60.8	–	14.1	–	–	1
TCG-Wildcat	61.6	60.8	14.4	14.8	4	1
WB9479	61.5	60.1	15.3	15.7	1	1
WB9590	61.2	60.0	14.9	15.3	4	1
Mean	61.1	60.1	14.0	14.4		
No. of Environments	10	16	11	17		

¹12% moisture basis.

²2014-2022 crop years, where applicable.

³1-9 scale in which 1 = best and 9 = worst. Values of 1-2 should be considered as resistant.

cide applications during the growing season is not recommended. This fungicide regime was implemented to measure the varieties’ performance when fungal diseases were controlled to the maximum extent possible. Decisions regarding fungicide applications should be based on the available decision support systems and used only if

and when disease levels are forecasted to reach economically damaging levels. The additional performance evaluations were carried out adjacent to the conventional (no fungicides applied) trials, so results can be compared directly. Due to operational changes, trials were not seeded at Morris this year and the intensive trial treatments

were not applied at the other southern location, Lamberton. The Roseau trial was hailed out, leaving Crookston as the only 2023 location with conventional and intensive treatments. The Crookston site had a higher than normal field variability and LSD (Least Significant Difference); therefore no conventional vs intensive data table is presented this year.

Project Leaders

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Test Plot Managers

Test plot establishment and management were supervised by Matt Bickell, Dave Grafstrom, Fernando de Paula Alberto, Danielle Fiebelkorn-Wrucke, Tom Hoverstad, Mike Leiseth, Susan Reynolds, Nathan Stuart, Donn Vellekson, and Travis Vollmer.

Table 3. Disease reactions¹ of hard red spring wheat varieties in Minnesota in multiple-year comparisons.

Entry	Leaf Rust	Stripe Rust ²	Stem Rust ³	Bacterial Leaf Streak ⁴	Other Leaf Diseases ⁵	Scab
AP Gunsmoke CL2	3	–	1	8	7	5
AP Murdock	3	–	1	4	5	7
AP Smith	6	–	2	4	4	6
Ascend-SD	3	–	1	2–3	6	3
Brawn-SD	1	–	2	3	6	5–6
CAG Justify	3	–	2	4–5	4	4
CAG Reckless	1	–	1	3	5	4
CAG Recoil	2	–	1	2–3	5	7
CP3099A	7	–	8	6–7	4	7
CP3188	3	–	6	6–7	6	5
CP3322	7	–	2	–	3	6–7
CP3530	7	3	1	3	6	4
CP3915	1	–	1	2	4	4
Driver	2	–	1	3	4	4
Dyna-Gro Ambush	4	–	1	4	4	4
Dyna-Gro Ballistic	4	–	3	3	4	5
Dyna-Gro Commander	4	–	1	4	7	5
LCS Ascent	5	–	1	6–7	5	5–6
LCS Boom	3	–	1	–	6	3
LCS Buster	4	–	2	4	3	3
LCS Cannon	4	–	1	5	7	4
LCS Dual	3	–	2	5	5	5
LCS Trigger	1	–	1	2	3	3
Linkert	3	1	1	4	5	5
MN-Rothsay	4	–	1	4	3	4
MN-Torgy	3	–	1	3	4	3
MN-Washburn	1	2	1	3	4	4
MS Charger	4	–	2	5–6	6	5–6
MS Cobra	1	–	1	4–5	4	5
MS Rancho	4	–	1	6	3	4
ND Frohberg	2	–	1	3	5	5
ND Heron	5	–	1	6	4	3–4
PFS Buns	5	–	1	2–3	3	6
Shelly	5	1	1	6	4	4
SY 611 CL2	5	–	5	4	4	3
SY Longmire	5	–	1	3	5	7
SY Valda	4	2	1	4	5	4
TCG-Heartland	3	–	2	5	6	7
TCG-Spitfire	4	–	1	3	4	6
TCG-Teddy	2	–	1	–	7	5–6
TCG-Wildcat	4	–	3	6	7	7
WB9479	5	–	1	6	5	7
WB9590	5	–	2	6	6	7

¹ 1-9 scale where 1 = most resistant, 9 = most susceptible.

² Based on natural infections in 2015 at Kimball, Lamberton, and Waseca.

³ Stem rust levels have been very low in production fields in recent years, even on susceptible varieties.

⁴ Bacterial leaf streak symptoms are highly variable from one environment to the next. The rating of entries may change as more data is collected.

⁵ Combined rating of tan spot and septoria.

Table 4. Relative grain yield of hard red spring wheat varieties in northern Minnesota locations in single-year (2023) and multiple-year comparisons (2021-2023).

Entry	Crookston			Fergus Falls			Hallock			Oklee			Perley			Roseau ¹	Stephen			Strathcona		
	2023	2 Yr	3 Yr	2023	2 Yr	3 Yr	2023	2 Yr	3 Yr	2023	2 Yr	3 Yr	2023	2 Yr	3 Yr	2 Yr	2023	2 Yr	3 Yr	2023	2 Yr	3 Yr
AP Gunsmoke CL2	87	90	95	98	101	100	103	101	101	93	97	100	97	89	95	100	109	101	102	106	103	104
AP Murdock	91	99	98	94	92	91	93	92	91	94	98	94	102	109	105	98	86	97	95	90	101	99
AP Smith	106	103	102	102	97	100	93	93	94	94	104	104	95	99	99	92	95	96	98	93	92	95
Ascend-SD	94	97	96	100	107	106	101	101	101	104	99	102	105	103	101	107	99	107	106	101	110	105
Brawn-SD	96	101	-	108	109	-	96	100	-	97	103	-	110	110	-	-	99	103	-	101	97	-
CAG Justify	98	97	95	103	102	105	112	113	112	119	110	109	107	104	105	109	114	109	108	120	117	111
CAG Reckless	96	93	98	104	100	102	107	105	104	104	100	101	93	95	97	105	92	97	100	107	105	104
CAG Recoil	99	102	-	100	101	-	93	95	-	95	94	-	96	104	-	-	95	96	-	81	88	-
CP3099A	117	117	110	116	116	118	98	105	107	118	120	126	124	114	110	114	123	114	116	118	116	110
CP3188	104	104	106	106	98	101	105	99	100	105	102	103	108	101	103	106	105	101	104	117	110	108
CP3322	103	-	-	119	-	-	113	-	-	105	-	-	114	-	-	-	105	-	-	99	-	-
CP3530	84	90	87	98	96	97	103	106	102	111	105	101	102	102	100	110	106	106	106	100	105	103
CP3915	107	101	98	98	98	97	100	99	101	91	95	94	88	96	97	95	96	99	96	94	105	103
Driver	96	100	100	102	105	106	108	106	104	96	101	106	91	98	101	107	94	96	98	105	103	102
Dyna-Gro Ambush	100	96	101	101	103	104	96	102	100	96	103	99	98	96	98	102	105	108	103	103	104	104
Dyna-Gro Ballistic	120	108	106	115	110	109	112	107	105	101	99	103	103	95	96	98	115	110	109	108	105	103
Dyna-Gro Commander	116	108	107	96	92	94	96	97	96	99	99	98	94	100	100	101	96	97	97	115	107	108
LCS Ascent	105	101	-	107	101	-	97	101	-	96	99	-	103	97	-	-	101	102	-	98	101	-
LCS Boom	80	-	-	96	-	-	98	-	-	103	-	-	97	-	-	-	89	-	-	107	-	-
LCS Buster	118	115	109	109	110	109	115	114	111	112	110	110	116	111	110	100	113	110	109	109	104	102
LCS Cannon	98	97	95	97	97	95	99	94	96	102	101	101	95	99	101	109	96	99	102	104	103	104
LCS Dual	98	100	-	100	102	-	88	95	-	101	94	-	106	104	-	-	99	99	-	109	103	-
LCS Trigger	109	110	107	109	109	105	111	113	110	121	120	115	111	117	113	104	103	106	107	108	111	107
Linkert	85	92	97	86	86	88	91	90	93	94	92	88	90	90	89	89	91	91	94	93	91	92
MN-Rothsay	113	109	112	103	101	101	105	109	106	89	96	99	100	103	105	103	110	109	107	98	99	99
MN-Torgy	99	102	103	105	103	101	99	102	101	100	93	93	100	101	102	97	96	105	104	100	96	97
MN-Washburn	102	101	99	98	107	101	100	100	100	95	89	91	102	102	101	98	100	102	99	98	99	97
MS Charger	113	114	-	104	107	-	105	106	-	103	106	-	101	101	-	-	109	103	-	108	108	-
MS Cobra	97	99	99	93	92	98	96	97	98	102	101	97	96	95	97	100	103	99	98	107	99	100
MS Rancho	102	93	101	117	114	108	101	105	104	99	97	98	106	98	99	100	95	91	91	75	91	93
ND Frohberg	92	90	97	97	96	96	91	94	92	98	93	96	103	96	96	101	86	84	87	104	96	97
ND Heron	85	89	-	90	94	-	92	93	-	100	100	-	95	91	-	-	98	96	-	111	101	-
PFS Buns	118	-	-	111	-	-	111	-	-	101	-	-	113	-	-	-	97	-	-	93	-	-
Shelly	101	101	100	108	108	108	110	109	107	97	97	99	100	101	98	106	107	105	105	97	101	101
SY 611 CL2	103	100	98	93	101	105	103	99	100	102	104	104	102	107	104	103	97	99	98	94	95	97
SY Longmire	98	96	95	96	95	97	97	97	97	97	95	96	96	97	97	89	96	95	98	103	102	101
SY Valda	100	95	95	99	103	101	107	108	107	111	109	109	105	109	105	104	104	105	106	97	96	97
TCG-Heartland	94	94	96	92	93	92	89	89	90	95	94	94	95	95	90	89	93	92	91	94	86	89
TCG-Spitfire	106	106	104	106	104	108	102	99	101	111	107	103	104	107	110	94	104	104	105	94	92	95
TCG-Teddy	106	-	-	98	-	-	99	-	-	98	-	-	105	-	-	-	95	-	-	97	-	-
TCG-Wildcat	104	106	102	94	92	96	96	97	98	105	102	102	101	101	103	104	92	98	96	104	104	105
WB9479	105	102	101	86	88	89	94	95	94	104	100	99	92	94	96	91	89	92	91	89	97	98
WB9590	108	103	103	89	98	99	103	103	100	102	104	100	98	96	97	101	103	100	97	101	102	101
Mean (Bu/Acre)	96.1	76.9	74.6	83.9	79.1	80.1	82.3	77.3	72.8	71.8	70.8	73.5	96.9	91.1	83.1	86.0	89.5	79.8	77.1	83.8	72.3	71.3
LSD (0.10)	9.0	9.5	6.2	14.6	6.4	4.3	20.0	6.0	5.1	18.9	7.5	5.7	7.9	7.4	5.9	7.2	11.4	7.0	5.6	19.3	9.1	7.1

¹2023 Roseau was abandoned due to hail. 2 yr data is 2021 & 2022.

Table 5. Relative grain yield of hard red spring wheat varieties in southern Minnesota locations in single-year (2023) and multiple-year comparisons (2021-2023).

Entry	Becker			Benson ¹		Le Center			Lamberton			Morris ²	St Paul			Waseca ³	
	2023	2 Yr	3 Yr	2023	2 Yr	2023	2 Yr	3 Yr	2023	2 Yr	3 Yr	2 Yr	2023	2 Yr	3 Yr	2023	2 Yr
AP Gunsmoke CL2	109	106	106	93	94	101	100	103	82	96	99	110	106	105	100	99	99
AP Murdock	82	87	92	92	91	98	101	98	102	101	100	102	84	81	90	85	93
AP Smith	102	101	99	97	100	98	99	100	100	99	100	98	94	93	97	102	102
Ascend-SD	106	112	111	98	102	118	113	109	110	110	109	123	103	99	100	105	111
Brawn-SD	110	111	–	103	–	113	113	–	105	107	–	–	128	121	–	115	115
CAG Justify	103	102	99	108	110	108	107	101	88	100	99	129	99	103	104	108	110
CAG Reckless	99	104	110	102	101	104	101	99	118	114	109	109	120	115	113	98	98
CAG Recoil	98	86	–	98	–	101	105	–	104	99	–	–	87	86	–	102	102
CP3099A	107	100	101	109	111	115	114	106	122	119	119	114	111	101	98	134	127
CP3188	109	103	105	109	110	118	111	111	81	85	96	118	84	89	94	101	100
CP3322	108	–	–	102	–	106	–	–	108	–	–	–	98	–	–	105	–
CP3530	104	99	99	101	101	96	102	104	98	99	99	100	96	100	101	89	95
CP3915	94	96	100	96	97	93	94	94	106	106	104	92	118	115	104	94	91
Driver	94	99	101	101	104	103	104	102	77	90	99	107	105	112	109	104	101
Dyna-Gro Ambush	105	105	103	96	99	96	102	104	104	107	103	87	105	103	107	92	98
Dyna-Gro Ballistic	114	102	106	109	104	103	102	102	101	103	101	105	120	115	106	115	111
Dyna-Gro Commander	104	99	103	98	103	98	98	100	99	95	95	103	100	103	108	105	107
LCS Ascent	105	108	–	100	–	96	100	–	92	95	–	–	119	116	–	102	100
LCS Boom	100	–	–	94	–	96	–	–	98	–	–	–	112	–	–	83	–
LCS Buster	108	106	112	105	105	101	105	103	109	107	105	96	112	105	106	122	118
LCS Cannon	99	109	108	95	102	93	96	100	77	90	93	92	91	112	112	94	99
LCS Dual	95	105	–	99	–	105	102	–	100	103	–	–	104	100	–	97	104
LCS Trigger	90	93	99	104	105	101	106	109	121	116	116	117	114	106	110	121	119
Linkert	94	97	98	94	94	88	90	93	91	93	93	92	90	98	99	87	88
MN-Rothsay	95	97	101	103	104	103	99	99	93	90	90	97	99	93	97	101	104
MN-Torgy	103	104	105	101	102	106	105	105	95	100	98	97	106	85	93	102	102
MN-Washburn	104	99	98	94	95	99	100	100	114	109	105	104	109	103	103	96	92
MS Charger	107	114	–	108	–	105	107	–	99	105	–	–	94	106	–	103	107
MS Cobra	98	103	102	105	101	98	99	100	95	98	99	93	109	111	112	98	99
MS Rancho	96	89	90	105	108	105	99	100	99	91	92	78	79	77	85	94	89
ND Frohberg	96	98	100	98	103	91	91	94	105	101	100	102	110	109	107	91	95
ND Heron	103	104	–	91	–	92	92	–	81	86	–	–	103	110	–	89	92
PFS Buns	83	–	–	112	–	113	–	–	112	–	–	–	77	–	–	127	–
Shelly	101	95	96	101	102	101	100	101	96	102	102	102	106	105	109	111	106
SY 611 CL2	94	103	104	102	104	93	95	95	109	103	103	95	90	95	93	98	100
SY Longmire	101	88	94	98	99	102	100	98	112	101	103	100	98	97	86	103	95
SY Valda	96	97	97	104	101	98	105	105	104	102	103	99	89	100	100	99	101
TCG-Heartland	105	102	100	92	91	96	98	98	96	92	93	86	99	101	98	89	94
TCG-Spitfire	102	106	107	105	107	109	112	110	112	111	113	105	108	107	103	111	110
TCG-Teddy	105	–	–	106	–	101	–	–	102	–	–	–	94	–	–	96	–
TCG-Wildcat	106	109	109	99	98	97	101	101	121	114	113	113	106	98	101	97	99
WB9479	87	92	92	88	91	90	93	96	98	98	94	89	94	98	96	82	89
WB9590	99	101	98	94	95	89	94	96	98	93	97	91	104	106	103	90	93
Mean (Bu/Acre)	62.0	61.2	54.5	96.8	78.7	89.7	85.4	80.7	74.3	67.4	65.1	56.4	56.7	55.3	53.0	80.6	59.5
LSD (0.10)	13.4	13.1	11.4	6.3	7.6	10.7	8.9	8.7	10.9	15.3	12.4	20.4	17.5	16.8	15.7	9.8	17.0

¹2022 Benson was abandoned due to early season flooding. 2 year data is 2021 and 2023.²2023 Morris was not seeded. 2 year data is 2021 and 2022³2021 Waseca was discarded due to excessive within trial variation. 2 year data is 2022 and 2023.

Table 6. Relative grain yield of hard red spring wheat varieties in Minnesota in single-year (2023) and multiple-year comparisons (2021-2023).

Entry	State			North			South		
	2023	2 Yr	3 Yr	2023	2 Yr	3 Yr	2023	2 Yr	3 Yr
AP Gunsmoke CL2	98	99	100	99	98	99	93	101	101
AP Murdock	92	97	96	93	99	96	93	95	95
AP Smith	98	98	99	97	97	98	99	98	99
Ascend-SD	103	106	105	101	104	103	104	110	109
Brawn-SD	105	107	–	101	103	–	105	112	–
CAG Justify	108	108	106	111	108	107	100	107	106
CAG Reckless	103	102	103	100	99	101	106	106	105
CAG Recoil	96	97	–	94	97	–	100	97	–
CP3099A	116	113	112	116	115	114	112	111	110
CP3188	105	102	104	107	103	104	100	101	105
CP3322	107	–	–	108	–	–	106	–	–
CP3530	99	101	100	101	102	100	101	100	100
CP3915	97	99	98	96	99	98	99	99	98
Driver	98	102	103	99	102	103	91	102	103
Dyna-Gro Ambush	99	102	101	100	101	101	101	102	101
Dyna-Gro Ballistic	110	105	104	110	104	104	108	106	104
Dyna-Gro Commander	101	100	101	101	100	100	100	100	102
LCS Ascent	101	102	–	101	101	–	99	103	–
LCS Boom	96	–	–	96	–	–	97	–	–
LCS Buster	112	109	107	113	110	108	107	107	106
LCS Cannon	96	100	100	99	99	100	91	101	101
LCS Dual	100	100	–	100	99	–	98	103	–
LCS Trigger	110	111	109	111	112	109	106	108	110
Linkert	90	91	92	90	90	91	93	93	94
MN-Rothsay	101	101	102	103	104	104	98	97	99
MN-Torgy	101	100	100	100	100	100	100	99	101
MN-Washburn	100	100	99	99	99	98	103	100	100
MS Charger	105	107	–	106	106	–	105	108	–
MS Cobra	100	99	99	99	97	98	100	101	101
MS Ranchero	99	95	97	99	98	99	101	90	93
ND Frohberg	96	95	97	96	93	95	100	99	100
ND Heron	94	95	–	96	95	–	91	95	–
PFS Buns	107	–	–	106	–	–	104	–	–
Shelly	103	103	103	103	104	103	99	101	102
SY 611 CL2	99	101	100	100	101	101	102	100	99
SY Longmire	99	96	97	97	96	97	103	96	97
SY Valda	102	103	102	104	103	103	102	102	101
TCG-Heartland	94	93	93	93	91	91	97	96	95
TCG-Spitfire	105	105	105	104	102	103	106	109	108
TCG-Teddy	100	–	–	100	–	–	105	–	–
TCG-Wildcat	101	102	102	100	100	101	108	105	105
WB9479	93	94	94	95	95	95	91	93	93
WB9590	98	99	98	101	101	99	98	97	97
Mean (Bu/Acre)	86.5	80.2	75.2	94.9	90.2	84.1	77.7	67.7	63.8
LSD (0.10)	3.4	3.3	2.8	4.3	4.1	3.4	5.4	5.5	4.7
No. of Environments	13	26	41	7	14	23	6	12	18

Table 7. Grain yield (bushels per acre) of hard red spring wheat varieties grown under conventional and intensive management.

Entry	North						South						State					
	2022		2 Yr		3 Yr		2022		2 Yr		3 Yr		2022		2 Yr		3 Yr	
	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int
AP Gunsmoke CL2	86.6	103.3	81.6	93.4	81.4	90.4	68.0	71.9	64.2	71.2	58.8	64.8	77.3	87.6	72.9	82.3	70.1	77.6
AP Murdock	93.4	108.4	81.6	89.8	82.6	90.4	62.8	65.3	58.7	63.4	58.1	60.6	78.1	86.8	70.1	76.6	70.3	75.5
AP Smith	85.2	97.7	78.4	85.7	78.9	82.8	56.5	65.0	58.1	66.5	57.8	61.4	70.8	81.3	68.2	76.1	68.4	72.1
Ascend-SD	94.4	104.2	83.5	95.5	–	–	71.4	75.3	67.3	72.9	–	–	82.9	89.7	75.4	84.2	–	–
Bolles	82.7	95.5	76.8	85.2	76.0	81.1	53.8	60.1	54.1	60.7	54.4	59.2	68.2	77.8	65.4	72.9	65.2	70.1
CAG Justify	94.8	108.5	83.3	98.6	–	–	72.2	68.4	68.5	69.3	–	–	83.5	88.4	75.9	84.0	–	–
CAG Reckless	86.4	94.1	83.5	88.0	–	–	66.4	68.1	62.2	64.6	–	–	76.4	81.1	72.8	76.3	–	–
CAG Recoil	86.0	95.3	–	–	–	–	58.3	61.2	–	–	–	–	72.2	78.2	–	–	–	–
CP3099A	106.1	116.2	90.5	102.2	–	–	62.3	68.7	67.4	78.1	–	–	84.2	92.4	79.0	90.2	–	–
CP3119A	85.6	104.2	86.4	102.6	–	–	49.0	58.4	58.1	68.0	–	–	67.3	81.3	72.3	85.3	–	–
CP3188	93.7	106.6	87.1	97.9	–	–	59.7	66.3	65.2	70.0	–	–	76.7	86.5	76.1	84.0	–	–
CP3530	93.7	103.3	81.5	89.6	78.9	88.3	60.9	59.9	58.4	62.2	56.7	60.4	77.3	81.6	70.0	75.9	67.8	74.4
CP3915	86.6	103.1	76.7	92.2	80.4	90.3	57.2	64.9	56.9	66.3	57.2	62.8	71.9	84.0	66.8	79.3	68.8	76.6
CPX39120	61.2	92.4	–	–	–	–	55.8	62.7	–	–	–	–	58.5	77.6	–	–	–	–
Driver	97.1	103.1	85.8	95.6	83.1	88.1	63.8	68.1	64.1	66.9	62.4	62.8	80.5	85.6	75.0	81.2	72.8	75.5
Dyna-Gro Ambush	85.6	101.0	83.3	89.7	81.4	85.3	64.6	72.9	55.4	68.6	55.8	64.0	75.1	86.9	69.3	79.2	68.6	74.6
Dyna-Gro Ballistic	85.9	99.5	79.8	93.4	83.0	89.3	61.4	67.5	59.9	67.2	59.7	66.0	73.7	83.5	69.8	80.3	71.4	77.6
Dyna-Gro Com-mander	88.8	101.0	83.0	92.0	80.8	87.1	57.9	63.3	57.2	64.1	58.0	61.8	73.3	82.2	70.1	78.1	69.4	74.5
Lang-MN	90.3	98.5	80.0	85.9	79.9	83.9	55.9	62.8	55.7	63.9	55.0	61.3	73.1	80.6	67.9	74.9	67.5	72.6
LCS Ascent	91.3	104.8	–	–	–	–	61.7	71.9	–	–	–	–	76.5	88.3	–	–	–	–
LCS Buster	94.2	107.6	83.3	97.7	85.5	94.0	59.6	69.0	58.2	73.8	60.4	70.2	76.9	88.3	70.8	85.7	73.0	82.1
LCS Cannon	90.5	102.8	82.8	92.6	80.1	87.9	65.1	69.9	57.1	70.8	58.1	66.2	77.8	86.4	70.0	81.7	69.1	77.1
LCS Dual	88.5	98.8	–	–	–	–	62.6	67.8	–	–	–	–	75.6	83.3	–	–	–	–
LCS Trigger	100.4	111.2	85.8	97.0	87.9	92.9	65.2	75.6	67.0	76.4	67.8	74.8	82.8	93.4	76.4	86.7	77.9	83.9
Linkert	84.9	93.4	78.4	81.5	76.2	80.8	56.4	64.1	54.7	65.2	53.1	60.5	70.6	78.8	66.5	73.4	64.7	70.7
MN-Rothsay	94.6	106.8	87.3	92.8	86.2	89.0	52.9	60.8	54.1	64.7	56.4	61.0	73.7	83.8	70.7	78.8	71.3	75.0
MN-Torgy	92.3	101.6	82.1	87.6	82.3	85.4	58.2	66.1	57.5	66.4	58.9	61.9	75.2	83.8	69.8	77.0	70.6	73.7
MN-Washburn	86.4	100.0	79.4	87.3	75.1	88.3	59.4	67.3	59.4	66.7	57.7	61.9	72.9	83.6	69.4	77.0	66.4	75.1
MS Barracuda	87.1	104.0	78.9	92.0	76.4	85.0	54.6	63.2	51.9	62.3	52.6	58.4	70.9	83.6	65.4	77.1	64.5	71.7
MS Charger	100.3	108.9	–	–	–	–	66.3	73.0	–	–	–	–	83.3	90.9	–	–	–	–
MS Cobra	88.3	98.0	82.1	89.2	–	–	55.9	62.5	56.7	64.6	–	–	72.1	80.2	69.4	76.9	–	–
MS Rancho	79.9	85.2	82.2	83.4	82.8	81.5	44.0	60.8	48.9	62.3	50.6	56.9	62.0	73.0	65.5	72.9	66.7	69.2
ND Froberg	84.5	90.7	82.1	85.8	79.3	81.7	58.7	65.6	57.9	63.8	57.9	61.0	71.6	78.2	70.0	74.8	68.6	71.4
ND Heron	90.0	94.6	–	–	–	–	55.1	65.4	–	–	–	–	72.5	80.0	–	–	–	–
Prosper	84.0	105.2	79.6	94.4	81.5	91.6	65.1	71.7	63.5	71.7	62.6	68.3	74.6	88.4	71.6	83.0	72.1	80.0
Shelly	95.4	106.7	84.5	94.7	81.9	92.6	60.8	64.6	60.6	69.0	59.9	63.0	78.1	85.6	72.5	81.8	70.9	77.8
SY 611 CL2	90.6	102.1	81.5	90.9	81.7	88.3	57.4	64.3	56.7	65.0	54.8	60.7	74.0	83.2	69.1	77.9	68.3	74.5
SY Longmire	79.4	92.0	74.5	84.4	74.1	82.9	52.1	52.5	57.8	60.8	57.4	59.0	65.8	72.3	66.1	72.6	65.7	70.9
SY McCloud	92.0	100.8	85.8	86.9	82.2	83.9	58.0	65.4	54.8	64.5	52.4	58.7	75.0	83.1	70.3	75.7	67.3	71.3
SY Valda	85.1	102.1	80.4	93.1	79.8	90.2	59.2	72.3	58.7	72.1	57.2	66.0	72.1	87.2	69.6	82.6	68.5	78.1
TCG-Heartland	76.2	92.8	75.7	84.1	76.4	83.6	51.2	61.2	52.2	65.1	51.4	58.9	63.7	77.0	63.9	74.6	63.9	71.2
TCG-Spitfire	88.3	103.5	80.1	94.7	80.8	92.9	64.3	69.6	64.1	72.3	66.5	70.6	76.3	86.5	72.1	83.5	73.7	81.8
TCG-Wildcat	95.9	107.6	83.5	94.6	83.5	91.5	66.4	75.4	64.8	69.2	62.3	65.3	81.1	91.5	74.1	81.9	72.9	78.4
WB9479	84.9	97.1	77.5	85.2	77.8	82.6	56.3	64.4	52.8	63.6	51.8	58.5	70.6	80.8	65.2	74.4	64.8	70.6
WB9590	89.1	105.4	81.8	94.2	83.2	91.9	54.5	66.4	54.6	63.4	54.9	60.8	71.8	85.9	68.2	78.8	69.0	76.4
Mean (Bu/Acre)	88.4	100.5	81.4	90.6	80.3	86.7	58.7	65.7	58.0	66.5	56.8	62.1	73.6	83.1	69.7	78.5	68.5	74.4
LSD (0.10)	6.2	5.3	4.8	4.1	3.5	3.4	4.3	4.3	4.0	3.9	2.8	2.9	3.9	3.4	3.1	2.8	2.3	2.2
No. of Environ-ments	2	2	4	4	6	6	2	2	4	4	6	6	4	4	8	8	12	12