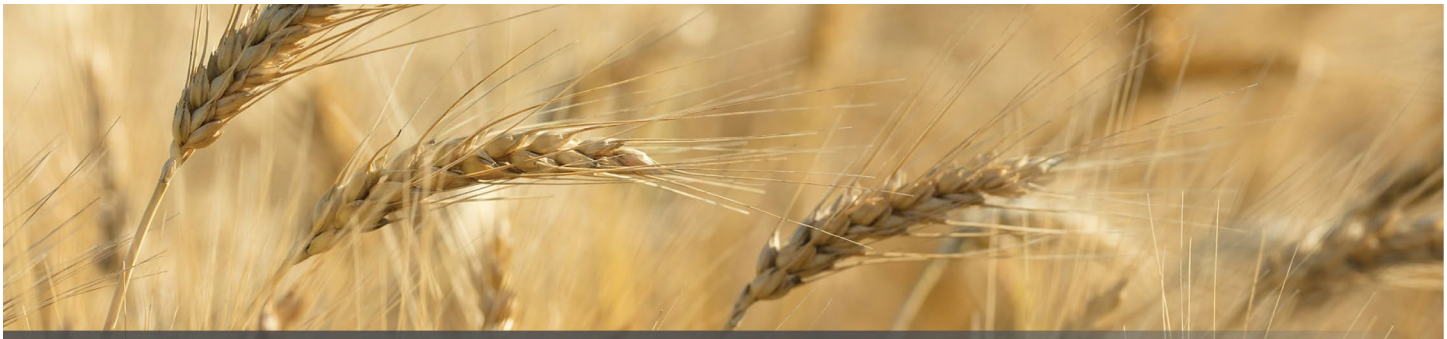


2021 Spring Wheat Field Crop Trials Results

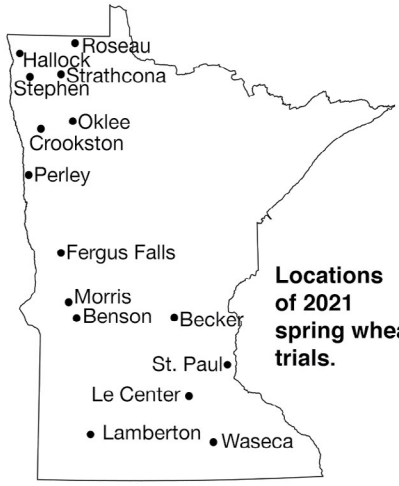
Minnesota Agricultural Experiment Station and the College of Food, Agricultural and Natural Resource Sciences

Spring wheat varieties were sown in trial plots at Becker, Crookston, Lamberton, Morris, Roseau, St. Paul, and Waseca and on-farm sites near Benson, Fergus Falls, Hallock, Le Center, Oklee, Perley, Stephen, and Strathcona. 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 management. 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 four seasons. The majority of varieties



Locations of 2021 spring wheat trials.

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 levels warrant treatment. Varieties

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

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.

Due to dry conditions in 2021, no bacterial leaf streak was observed, so ratings are based on past 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

Table 1. Origin and agronomic characteristics of hard red spring wheat varieties in Minnesota in single-year (2021) 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) (pending)	1.3	55.6	26.2	4–5
AP Murdock	2020 AgriPro/Syngenta	PVP (94) (pending)	1.3	55.3	25.2	5
AP Smith	2021 AgriPro/Syngenta	PVP (94) (pending)	1.3	58.1	24.7	2–3
Bolles	2015 MN	PVP (94)	1.3	58.4	28.3	4
CAG Justify	2021 Champions Alliance Group	PVP (94) (pending)	1.3	57.5	26.8	–
CAG Reckless	2021 Champions Alliance Group	PVP (94) (pending)	1.3	56.3	27.3	–
CP3099A	2020 CROPLAN by WinField United	PVP (94) (pending)	1.3	60.9	27.0	–
CP3119A	2021 CROPLAN by WinField United	PVP (94) (pending)	1.3	61.0	26.3	–
CP3188	2020 CROPLAN by WinField United	PVP (94) (pending)	1.3	56.1	27.7	–
CP3530	2015 CROPLAN by WinField United	Patented	1.3	58.1	28.3	5
CP3915	2019 CROPLAN by WinField United	PVP (94) (pending)	1.3	57.2	26.3	4
Driver	2020 SDSU	PVP (94) (pending)	1.3	57.7	28.2	4
Dyna-Gro Ambush	2016 Dyna-Gro	PVP (94)	1.4	54.5	26.9	4
Dyna-Gro Ballistic	2018 Dyna-Gro	PVP (94)	1.1	57.0	26.3	5
Dyna-Gro Commander	2019 Dyna-Gro	PVP (94)	1.4	54.9	25.9	4
Lang-MN	2017 MN	PVP (94)	0.9	56.9	26.6	4
LCS Buster	2020 Limagrain Cereal Seeds	PVP (94) (pending)	1.3	60.0	27.7	5
LCS Cannon	2018 Limagrain Cereal Seeds	PVP (94)	1.3	53.5	25.5	4
LCS Rebel	2017 Limagrain Cereal Seeds	PVP (94)	1.3	55.0	27.8	6
LCS Trigger	2016 Limagrain Cereal Seeds	PVP (94)	1.3	60.2	26.4	5
Linkert	2013 MN	PVP (94)	1.3	55.2	25.8	2
MN-Torgy	2020 MN	PVP (94) (pending)	1.3	55.7	25.6	4
MN-Washburn	2019 MN	PVP (94)	1.3	57.3	25.3	3
MS Barracuda	2018 Meridian Seeds	PVP (94)	1.3	53.3	26.0	3
MS Cobra	2022 Meridian Seeds	PVP (94) (pending)	1.3	55.3	26.9	–
MS Ranchero	2020 Meridian Seeds	PVP (94) (pending)	1.3	54.8	26.1	4–5
ND Frohberg	2020 NDSU	PVP (94) (pending)	1.3	56.8	28.2	4–5
PFS-Buns	2021 Peterson Farms Seed	PVP (94) (pending)	1.3	62.0	24.7	–
Prosper	2011 NDSU	PVP (94)	1.3	57.8	28.5	6
Shelly	2016 MN	PVP (94)	1.3	57.9	26.3	5
SY 611 CL2[5]	2019 AgriPro/Syngenta	PVP (94)	1.3	56.1	24.9	4
SY Longmire[6]	2019 AgriPro/Syngenta	PVP (94)	1.3	56.9	26.1	4
SY McCloud	2019 AgriPro/Syngenta	PVP (94)	1.3	55.4	26.1	4
SY Valda	2015 AgriPro/Syngenta	PVP (94)	1.3	56.9	25.4	5
TCG-Heartland	2019 21st Century Genetics	PVP (94), Patent pending	1.6	54.3	24.9	3
TCG-Spitfire	2016 21st Century Genetics	PVP (94)	1.5	59.2	26.4	3
TCG-Wildcat	2020 21st Century Genetics	PVP (94) (pending), Patent pending	1.5	57.7	26.9	3
WB9479	2017 WestBred	Patented, PVP (94)	1.3	54.3	24.3	3
WB9590	2017 WestBred	Patented, PVP (94)	1.3	54.7	23.6	3
Mean				**57.0**	**26.2**	

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

[2]Our 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.

[3]2021 data.

[4]1-9 scale in which 1 is the strongest straw and 9 is the weakest. Based on 2014-2021 data. The rating of newer entries may change by as much as one rating point as more data are collected.

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

[6]SY Longmire has solid stems.

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.

After 5 years as the no. 1 variety in Minnesota, Linkert was supplanted by WB9590 in 2021, sown on 18.0% of the state's wheat acres. SY Valda was the 2nd most popular variety at 12.8%, followed by Linkert (11.9%), WB9479 (10.3%), and MN-Torgy (9.7%).

Varieties tested for the first time in 2021 were AP Gunsmoke CL2, AP Smith (both also tested in 2020 under their experimental designations), CAG Justify, CAG Reckless, CP3099A, CP3119A, CP3188, MS Cobra, and PFS-Buns. As in 2019 & 2020, WestBred opted to not submit any HRSW varieties for testing, but WB9479 and WB9590 were both tested in 2021 because each occupied more than 5% of the state's acreage in 2020. Testing of CP3055, CP3903, CP3910, Dyna-Gro Velocity, MS Chevelle, Rollag, SY Ingmar, and WB-Mayville was discontinued.

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 fungicide 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. Data from trials conducted in Crookston, Lamberton, Morris, and Roseau are included in the 2021 and multi-year summaries. In the two northern locations, the fungicide regime as applied in these

Table 2. Grain quality of hard red spring wheat varieties in Minnesota in single-year (2021) and multiple-year comparisons.

	Test Weight (lb/Bu)		Protein (%)[1]		Baking	Pre-Harvest
Entry	2021	2 Yr	2021	2 Yr	Quality[2]	Sprouting[3]
AP Gunsmoke CL2	60.8	60.0	15.0	15.3	–	3
AP Murdock	60.9	60.3	14.8	14.8	5	1
AP Smith	61.5	60.5	15.0	15.2	–	4
Bolles	61.2	60.1	16.5	16.6	1	1
CAG Justify	59.3	–	14.0	–	–	3
CAG Reckless	62.3	–	14.9	–	–	4
CP3099A	59.2	–	12.8	–	–	1
CP3119A	57.1	–	13.3	–	–	3
CP3188	59.6	–	13.3	–	–	3
CP3530	60.8	60.1	15.0	15.1	3	1
CP3915	62.2	61.4	15.0	15.0	4	1
Driver	63.1	61.8	14.0	14.4	–	3
Dyna-Gro Ambush	62.4	61.9	14.9	15.0	2	3*
Dyna-Gro Ballistic	61.1	60.2	14.0	14.1	5	3*
Dyna-Gro Commander	62.1	61.0	14.7	14.9	6	1
Lang-MN	61.8	61.1	15.0	15.2	3	1
LCS Buster	59.1	58.2	12.8	12.8	–	4
LCS Cannon	63.4	62.1	14.6	14.6	4	3*
LCS Rebel	63.0	62.1	15.0	15.1	3	5
LCS Trigger	61.0	60.5	13.4	13.1	7	1
Linkert	62.6	61.4	15.9	15.8	1	1
MN-Torgy	62.4	61.2	15.3	15.2	4	1
MN-Washburn	61.6	60.7	14.4	14.6	3	1
MS Barracuda	62.1	61.0	14.9	15.1	4	3
MS Cobra	62.3	–	14.8	–	–	4
MS Ranchero	61.1	59.7	14.0	14.4	–	4
ND Frohberg	62.1	61.3	14.8	14.9	–	4
PFS-Buns	58.8	–	14.4	–	–	4
Prosper	61.1	60.3	14.2	14.3	5	1
Shelly	62.2	60.9	14.1	14.2	5	1
SY 611 CL2	62.3	61.3	14.7	15.0	6	2*
SY Longmire	62.0	60.8	14.9	15.1	3	2*
SY McCloud	63.0	62.0	15.6	15.6	3	2*
SY Valda	62.0	61.1	14.2	14.5	6	2
TCG-Heartland	62.6	61.8	15.3	15.5	2	2
TCG-Spitfire	60.8	60.3	14.2	14.2	3	3*
TCG-Wildcat	62.2	61.4	14.7	15.1	–	1
WB9479	62.0	61.2	15.7	15.8	2	1
WB9590	61.9	60.9	15.4	15.5	4	1
Mean	**61.5**	**60.9**	**14.6**	**14.9**		
No. of Environments	**11**	**21**	**11**	**21**		

[1] 12% moisture basis.
[2] 2014-2020 crop years, where applicable.
[3] 1-9 scale in which 1 = best and 9 = worst. Values of 1-2 should be considered as resistant. Falling number data was collected from nine 2019 locations. Varieties with an * following their pre-harvest sprouting rating had lower than expected falling numbers based on their PHS rating.

trials increased grain yield on average by 5.8 bu/acre in 2021 and by 4.0 bu/acre over the past three years. The two southern locations, Lamberton and Morris, averaged 10.2 bu/acre higher grain yield when fungicide protected in 2021 and 5.4 bu/acre higher from 2019-2021. Rather than the average increases in grain yield, the responses of individual varieties provide the most useful information; varieties rated susceptible to leaf rust, stripe rust, and other fungal leaf diseases usually benefited most from fungicide applications.

Project Leaders

James Anderson, Jochum Wiersma, Ruth Dill-Macky, James Kolmer, Matt Rouse, Yue Jin, and Linda Dykes

Test Plot Managers

Test plot establishment and management were supervised by Matt Bickell, Robert Bouvette, Dave Grafstrom, Mark Hanson, Tom Hoverstad, Mike Leiseth, Houston Lindell, Steve Quiring, Curtis Reese, Susan Reynolds, Nathan Stuart, Donn Vellekson, and Joe Wodarek.

Table 3. Disease reactions[1] 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	7	6	4
AP Murdock	3	–	1	4	6	7
AP Smith	6	–	1	4	4	6
Bolles	2	1	2	4	3	5
CAG Justify	–	–	2	–	–	–
CAG Reckless	–	–	1	–	–	–
CP3099A	–	–	8	–	–	–
CP3119A	–	–	2	–	–	–
CP3188	–	–	6	–	–	–
CP3530	3	3	1	4	4	4
CP3915	1	–	1	2	5	4
Driver	3	–	1	3–4	5	4
Dyna-Gro Ambush	2	–	2	5	4	4
Dyna-Gro Ballistic	3	–	3	3	5	5
Dyna-Gro Commander	2	–	1	4	6	5
Lang-MN	1	–	2	3	4	3
LCS Buster	2	–	1	4	3	3
LCS Cannon	3	–	2	5	7	4
LCS Rebel	6	–	2	3	4	4
LCS Trigger	1	–	2	2	3	3
Linkert	3	1	1	5	4	5
MN-Torgy	3	–	1	3	3	4
MN-Washburn	1	2	1	3	3	4
MS Barracuda	6	–	2	7	5	5
MS Cobra	–	–	1	–	–	–
MS Ranchero	1	–	1	6–7	3	4
ND Frohberg	3	–	1	3	4	5
PFS-Buns	–	–	1	–	–	–
Prosper	6	5	2	4	4	5
Shelly	3	1	2	6	4	4
SY 611 CL2	3	–	5	4	4	4
SY Longmire	5	–	1	3	5	7
SY McCloud	3	–	1	5	5	5
SY Valda	1	2	1	3	4	4
TCG-Heartland	3	–	2	5	5	6
TCG-Spitfire	4	–	2	3	4	5
TCG-Wildcat	3	–	3	6–7	7	6
WB9479	6	–	2	6	5	7
WB9590	6	–	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.
[6]Varieties showing a ratings range are based on initial data. With further testing, a single numerical rating will be assigned.

Table 4. Relative grain yield of hard red spring wheat varieties in northern Minnesota locations in single-year (2021) and multiple-year comparisons (2019-2021).

	Crookston			Fergus Falls			Hallock			Oklee			Perley			Roseau			Stephen			Strathcona		
Entry	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr
AP Gunsmoke CL2	107	106	–	100	101	–	102	101	–	107	113	–	107	100	–	101	100	–	102	101	–	108	100	–
AP Murdock	92	100	104	89	94	97	92	95	101	86	100	103	98	103	106	95	101	104	89	105	105	95	109	109
AP Smith	99	98	–	106	101	–	100	95	–	101	98	–	98	97	–	95	99	–	103	105	–	106	95	–
Bolles	90	92	96	99	96	95	88	91	94	91	91	92	104	102	98	99	97	94	89	91	94	90	87	89
CAG Justify	89	–	–	111	–	–	109	–	–	106	–	–	107	–	–	102	–	–	103	–	–	100	–	–
CAG Reckless	113	–	–	107	–	–	105	–	–	103	–	–	103	–	–	105	–	–	108	–	–	105	–	–
CP3099A	87	–	–	120	–	–	113	–	–	140	–	–	103	–	–	110	–	–	121	–	–	98	–	–
CP3119A	110	–	–	115	–	–	100	–	–	116	–	–	92	–	–	122	–	–	128	–	–	99	–	–
CP3188	112	–	–	107	–	–	102	–	–	106	–	–	107	–	–	106	–	–	111	–	–	104	–	–
CP3530	74	84	91	99	98	100	93	102	102	90	96	96	95	99	102	106	100	101	108	102	102	100	105	102
CP3915	86	95	100	95	98	102	108	99	99	94	91	96	100	98	96	93	105	107	88	95	102	103	92	95
Driver	99	99	–	108	107	–	103	108	–	121	114	–	108	109	–	101	99	–	103	106	–	105	98	–
Dyna-Gro Ambush	118	111	108	107	103	103	96	100	100	89	98	100	103	105	98	104	98	95	90	99	98	105	105	104
Dyna-Gro Ballistic	96	101	105	106	107	110	102	102	105	116	110	112	98	102	101	102	110	110	106	107	108	100	96	99
Dyna-Gro Commander	104	98	100	98	100	101	96	99	101	96	98	100	101	97	103	104	101	104	98	103	103	111	106	103
Lang-MN	104	101	100	91	97	97	98	100	98	89	93	96	96	96	97	88	95	96	105	97	98	94	105	105
LCS Buster	90	97	–	107	112	–	106	108	–	111	120	–	108	113	–	103	112	–	109	113	–	99	106	–
LCS Cannon	87	93	97	92	95	99	103	96	100	101	103	104	104	108	111	110	101	103	109	101	104	110	105	103
LCS Rebel	94	96	100	101	102	99	92	99	99	119	105	104	93	100	102	103	107	106	85	91	96	111	107	106
LCS Trigger	96	106	111	96	109	110	102	114	113	102	111	115	103	113	113	96	107	111	108	110	111	99	106	110
Linkert	111	100	98	92	94	93	104	100	99	78	86	89	88	89	88	88	89	89	101	92	93	98	89	89
MN-Torgy	104	105	103	98	103	104	99	96	100	94	101	102	104	100	100	93	98	101	101	108	106	102	103	103
MN-Washburn	89	94	97	88	95	98	101	99	100	96	97	100	99	98	99	103	88	92	90	94	97	94	82	88
MS Barracuda	81	88	93	94	95	95	102	98	97	111	106	107	101	92	96	105	96	97	94	93	96	112	110	108
MS Cobra	99	–	–	109	–	–	101	–	–	89	–	–	102	–	–	104	–	–	95	–	–	104	–	–
MS Ranchero	127	113	–	95	95	–	101	104	–	100	102	–	102	101	–	105	108	–	91	104	–	100	114	–
ND Frohberg	119	105	–	97	101	–	89	88	–	104	101	–	96	94	–	100	96	–	96	91	–	104	100	–
PFS-Buns	105	–	–	98	–	–	98	–	–	116	–	–	111	–	–	107	–	–	113	–	–	85	–	–
Prosper	94	102	105	109	110	110	102	103	102	103	107	107	109	105	100	106	107	105	114	113	110	93	95	100
Shelly	98	102	105	109	109	112	103	106	108	102	104	105	91	92	94	100	95	101	103	99	103	105	109	107
SY 611 CL2	92	97	100	113	108	107	106	98	101	102	107	106	98	98	96	101	103	102	95	99	104	103	97	100
SY Longmire	92	94	98	101	99	102	95	94	96	98	95	99	100	98	91	95	92	93	106	103	105	99	83	89
SY McCloud	109	99	98	95	98	98	104	103	100	99	101	99	95	96	95	106	102	101	93	85	92	100	101	100
SY Valda	94	98	102	96	101	99	105	106	108	109	105	106	96	101	99	107	102	109	110	115	116	102	105	106
TCG-Heartland	101	101	100	92	97	96	93	90	90	95	94	94	78	94	98	101	98	96	87	98	98	99	93	92
TCG-Spitfire	95	102	103	118	112	110	106	98	98	92	99	101	116	111	111	98	99	104	106	101	102	106	101	100
TCG-Wildcat	88	95	–	107	104	–	100	98	–	101	99	–	107	104	–	101	104	–	92	104	–	111	106	–
WB9479	97	104	–	89	94	–	90	96	–	96	101	–	99	92	–	92	92	–	89	96	–	103	102	–
WB9590	98	106	–	102	102	–	93	106	–	90	98	–	98	103	–	101	103	–	87	90	–	100	105	–
Mean (Bu/Acre)	**57.8**	**64.1**	**68.6**	**74.9**	**78.3**	**79.7**	**72.0**	**68.8**	**74.3**	**69.7**	**74.7**	**71.0**	**85.3**	**76.4**	**73.8**	**90.7**	**89.5**	**87.9**	**68.6**	**70.6**	**73.8**	**60.2**	**65.4**	**68.0**
LSD (0.10)	**24.2**	**14.0**	**9.4**	**11.0**	**8.7**	**6.7**	**9.8**	**12.6**	**7.9**	**17.6**	**14.0**	**9.9**	**10.4**	**11.8**	**10.8**	**9.0**	**14.2**	**11.0**	**12.6**	**14.8**	**9.9**	**6.3**	**15.9**	**10.5**

Table 5. Relative grain yield of hard red spring wheat varieties in southern Minnesota locations in single-year (2021) and multiple-year comparisons (2019-2021).

	Becker[1]		Benson			Le Center			Lamberton			Morris			St Paul			Waseca[2]
Entry	2021	2 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2 Yr
AP Gunsmoke CL2	104	–	96	100	–	110	106	–	106	91	–	105	103	–	89	94	–	–
AP Murdock	104	112	89	93	99	93	101	106	99	100	104	91	98	99	110	109	112	123
AP Smith	92	–	103	104	–	102	98	–	103	101	–	104	108	–	105	99	–	–
Bolles	79	83	102	100	100	89	87	87	90	96	91	101	100	99	101	99	100	99
CAG Justify	87	–	112	–	–	88	–	–	99	–	–	128	–	–	106	–	–	–
CAG Reckless	125	–	99	–	–	96	–	–	99	–	–	103	–	–	109	–	–	–
CP3099A	103	–	113	–	–	90	–	–	119	–	–	135	–	–	92	–	–	–
CP3119A	123	–	108	–	–	105	–	–	110	–	–	125	–	–	91	–	–	–
CP3188	108	–	110	–	–	109	–	–	121	–	–	125	–	–	107	–	–	–
CP3530	95	103	101	107	111	109	106	110	100	99	102	95	95	102	103	103	106	103
CP3915	109	102	99	94	99	95	96	95	100	103	104	97	100	104	77	82	86	84
Driver	104	–	109	103	–	100	98	–	118	113	–	106	106	–	103	102	–	–
Dyna-Gro Ambush	91	103	104	104	99	110	107	109	95	94	99	65	87	91	118	112	113	114
Dyna-Gro Ballistic	112	109	94	105	105	104	104	103	97	103	106	107	107	111	84	97	98	108
Dyna-Gro Commander	112	109	111	112	105	106	104	102	96	99	98	101	109	111	119	111	110	114
Lang-MN	98	98	90	95	95	99	97	99	96	94	99	98	101	98	115	106	105	106
LCS Buster	125	–	103	105	–	99	103	–	102	109	–	95	106	–	111	105	–	–
LCS Cannon	101	111	111	101	96	111	111	110	101	102	100	68	91	94	115	118	115	113
LCS Rebel	96	101	103	101	100	97	99	98	104	106	105	113	105	103	107	106	100	109
LCS Trigger	116	111	106	118	118	116	112	114	117	119	121	124	129	123	122	111	109	116
Linkert	98	100	92	97	93	100	94	91	94	92	91	91	91	91	101	101	99	91
MN-Torgy	105	102	102	102	104	105	106	106	95	104	103	104	107	108	112	105	104	106
MN-Washburn	94	92	96	93	93	100	102	100	96	100	97	111	102	100	102	95	101	101
MS Barracuda	93	106	95	95	94	109	108	107	99	100	91	71	81	84	116	114	113	101
MS Cobra	96	–	94	–	–	105	–	–	100	–	–	101	–	–	114	–	–	–
MS Ranchero	92	–	111	102	–	102	96	–	97	95	–	90	96	–	103	109	–	–
ND Frohberg	101	–	109	104	–	102	99	–	97	98	–	103	106	–	102	103	–	–
PFS-Buns	100	–	106	–	–	102	–	–	99	–	–	112	–	–	85	–	–	–
Prosper	111	104	105	105	104	104	106	104	97	107	109	120	112	115	88	99	98	95
Shelly	97	100	103	107	103	105	106	103	102	101	95	109	112	109	117	106	107	102
SY 611 CL2	104	105	106	98	102	96	91	93	102	97	95	92	93	98	89	96	92	96
SY Longmire	107	90	99	94	97	96	94	92	107	109	106	114	105	96	63	78	81	71
SY McCloud	83	92	96	93	91	103	100	96	98	90	94	81	86	91	92	100	99	94
SY Valda	95	102	97	102	106	105	105	110	104	100	102	99	100	101	101	99	100	110
TCG-Heartland	92	100	88	95	97	97	96	93	97	96	91	88	87	90	91	97	101	101
TCG-Spitfire	107	103	111	109	114	106	103	105	118	122	124	104	117	116	95	96	100	94
TCG-Wildcat	108	–	96	96	–	103	103	–	114	110	–	106	103	–	110	104	–	–
WB9479	89	–	96	92	–	103	99	–	86	88	–	86	89	–	92	95	–	–
WB9590	86	–	97	98	–	101	105	–	104	103	–	86	91	–	96	103	–	–
Mean (Bu/Acre)	**42.4**	**60.1**	**60.8**	**72.7**	**81.2**	**70.9**	**74.8**	**69.8**	**60.1**	**61.6**	**49.1**	**54.7**	**50.7**	**55.8**	**48.1**	**61.3**	**64.8**	**44.3**
LSD (0.10)	**19.2**	**16.0**	**11.0**	**10.8**	**10.4**	**8.0**	**8.4**	**8.0**	**17.5**	**14.3**	**13.6**	**18.7**	**18.3**	**14.5**	**8.9**	**10.6**	**8.8**	**15.6**

[1]2020 Becker was discarded due to drought. 2 yr data is the mean of 2021 Becker and 2019 Kimball.
[2]2021 Waseca was discarded due to excessive within trial variation. 2 year is the mean of 2019 and 2020.

Table 6. Relative grain yield of hard red spring wheat varieties in Minnesota in single-year (2021) and multiple-year comparisons (2019-2021).

	State			North			South		
Entry	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr	2021	2 Yr	3 Yr
AP Gunsmoke CL2	103	101	–	104	102	–	102	100	–
AP Murdock	94	101	104	92	101	103	97	101	106
AP Smith	101	99	–	101	98	–	102	101	–
Bolles	94	94	94	94	93	94	94	95	95
CAG Justify	104	–	–	104	–	–	103	–	–
CAG Reckless	105	–	–	106	–	–	104	–	–
CP3099A	111	–	–	112	–	–	109	–	–
CP3119A	110	–	–	110	–	–	110	–	–
CP3188	109	–	–	107	–	–	114	–	–
CP3530	98	100	102	96	98	99	101	101	106
CP3915	96	96	98	96	97	99	96	95	97
Driver	106	105	–	106	105	–	107	104	–
Dyna-Gro Ambush	100	102	102	101	102	100	97	102	104
Dyna-Gro Ballistic	102	104	106	103	105	106	100	104	105
Dyna-Gro Commander	103	103	103	101	100	102	107	108	106
Lang-MN	96	98	99	95	98	98	99	99	99
LCS Buster	105	109	–	104	110	–	105	108	–
LCS Cannon	102	102	103	103	100	102	102	106	105
LCS Rebel	101	102	101	100	101	101	103	103	102
LCS Trigger	106	113	113	100	109	111	116	118	116
Linkert	95	93	92	94	92	92	96	95	94
MN-Torgy	101	102	103	99	101	102	104	104	105
MN-Washburn	97	95	97	96	93	96	100	99	98
MS Barracuda	99	98	99	100	97	98	98	100	99
MS Cobra	101	–	–	101	–	–	102	–	–
MS Ranchero	101	103	–	102	105	–	100	99	–
ND Frohberg	101	99	–	100	97	–	102	102	–
PFS-Buns	103	–	–	104	–	–	101	–	–
Prosper	104	105	105	104	105	105	104	105	105
Shelly	103	103	104	101	102	104	105	105	103
SY 611 CL2	100	99	100	101	101	102	98	95	97
SY Longmire	98	95	95	98	95	96	98	95	92
SY McCloud	98	96	96	100	98	97	93	93	94
SY Valda	102	103	105	103	104	105	100	101	104
TCG-Heartland	93	95	95	93	96	95	93	95	96
TCG-Spitfire	106	105	106	105	103	103	107	108	109
TCG-Wildcat	103	102	–	101	102	–	106	103	–
WB9479	94	95	–	94	97	–	93	93	–
WB9590	96	101	–	96	102	–	96	100	–
Mean (Bu/Acre)	**65.4**	**68.1**	**69.0**	**72.4**	**73.6**	**74.9**	**56.2**	**60.9**	**61.6**
LSD (0.10)	**5.1**	**3.5**	**2.8**	**6.2**	**4.5**	**3.3**	**8.9**	**5.4**	**4.7**
No. of Environments	**14**	**28**	**43**	**8**	**16**	**24**	**6**	**12**	**19**

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

	North						South						State					
	2021		2 Yr		3 Yr		2021		2 Yr		3 Yr		2021		2 Yr		3 Yr	
Entry	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int
AP Gunsmoke CL2	76.6	83.5	78.8	83.9	–	–	60.4	70.6	54.1	61.3	–	–	68.5	77.1	66.5	72.6	–	–
AP Murdock	69.7	71.2	77.2	81.3	81.3	84.2	54.6	61.6	55.7	58.3	55.2	60.2	62.2	66.4	66.4	69.8	68.2	72.2
AP Smith	71.6	73.7	75.7	75.4	–	–	59.6	68.0	58.5	59.7	–	–	65.6	70.9	67.1	67.6	–	–
Bolles	70.9	74.9	72.6	73.9	74.1	74.9	54.4	61.3	54.7	58.7	52.1	56.9	62.6	68.1	63.7	66.3	63.1	65.9
CAG Justify	71.7	88.8	–	–	–	–	64.7	70.2	–	–	–	–	68.2	79.5	–	–	–	–
CAG Reckless	80.5	81.9	–	–	–	–	57.9	61.1	–	–	–	–	69.2	71.5	–	–	–	–
CP3099A	75.0	88.2	–	–	–	–	72.6	87.6	–	–	–	–	73.8	87.9	–	–	–	–
CP3119A	87.3	101.0	–	–	–	–	67.3	77.7	–	–	–	–	77.3	89.3	–	–	–	–
CP3188	80.4	89.2	–	–	–	–	70.7	73.7	–	–	–	–	75.6	81.5	–	–	–	–
CP3530	69.3	75.9	71.6	80.9	75.5	84.1	56.0	64.5	54.6	60.6	54.6	60.7	62.6	70.2	63.1	70.7	65.1	72.4
CP3915	66.9	81.4	77.3	83.9	81.2	85.3	56.6	67.7	57.2	61.8	53.8	59.9	61.7	74.6	67.2	72.9	67.5	72.6
Driver	74.4	88.1	76.1	80.6	–	–	64.5	65.7	61.7	60.2	–	–	69.4	76.9	68.9	70.4	–	–
Dyna-Gro Ambush	81.0	78.4	79.3	77.5	78.9	76.6	46.1	64.4	51.5	59.5	51.1	60.1	63.5	71.4	65.4	68.5	65.0	68.3
Dyna-Gro Ballistic	73.7	87.3	81.5	84.3	84.5	88.9	58.3	66.8	58.9	65.2	57.9	65.0	66.0	77.0	70.2	74.7	71.2	76.9
Dyna-Gro Commander	77.3	83.0	76.8	80.2	80.0	83.1	56.6	64.8	58.1	61.1	56.3	59.3	66.9	73.9	67.4	70.6	68.2	71.2
Lang-MN	69.8	73.3	74.8	76.6	76.7	80.0	55.5	65.0	54.6	60.6	53.3	60.2	62.6	69.2	64.7	68.6	65.0	70.1
LCS Buster	72.4	87.8	81.2	87.2	–	–	56.9	78.6	60.8	70.7	–	–	64.6	83.2	71.0	79.0	–	–
LCS Cannon	75.1	82.3	74.9	80.4	78.4	82.9	49.0	71.6	54.6	64.4	52.6	60.9	62.1	77.0	64.8	72.4	65.5	71.9
LCS Rebel	73.9	82.2	78.4	79.7	80.9	80.1	62.1	61.8	59.2	59.2	55.8	59.0	68.0	72.0	68.8	69.4	68.4	69.6
LCS Trigger	71.3	82.8	81.7	83.8	87.0	90.2	68.9	77.2	69.1	74.4	64.3	71.6	70.1	80.0	75.4	79.1	75.7	80.9
Linkert	71.9	69.6	71.9	74.6	72.6	76.7	53.0	66.3	51.5	58.7	48.7	54.8	62.4	67.9	61.7	66.7	60.7	65.7
MN-Torgy	72.0	73.7	77.3	77.3	79.6	82.3	56.9	66.6	59.3	59.8	57.4	59.0	64.4	70.1	68.3	68.6	68.5	70.6
MN-Washburn	72.4	74.6	69.5	82.5	73.5	83.8	59.4	66.0	56.9	59.3	55.0	59.2	65.9	70.3	63.2	70.9	64.2	71.5
MS Barracuda	70.8	80.0	71.1	75.5	74.8	78.2	49.2	61.4	51.6	56.0	47.7	53.5	60.0	70.7	61.3	65.8	61.3	65.9
MS Cobra	75.9	80.5	–	–	–	–	57.6	66.6	–	–	–	–	66.7	73.6	–	–	–	–
MS Ranchero	84.5	81.6	84.3	79.7	–	–	53.7	63.8	53.8	54.9	–	–	69.1	72.7	69.1	67.3	–	–
ND Frohberg	79.8	80.9	76.7	77.2	–	–	57.2	62.0	57.5	58.7	–	–	68.5	71.4	67.1	68.0	–	–
PFS-Buns	78.9	91.0	–	–	–	–	60.4	72.1	–	–	–	–	69.7	81.5	–	–	–	–
Prosper	75.1	83.6	80.3	84.8	82.4	88.8	62.0	71.7	61.4	66.7	60.0	66.3	68.5	77.7	70.8	75.7	71.2	77.5
Shelly	73.5	82.7	75.2	85.5	80.4	87.6	60.4	73.4	59.4	62.2	55.6	61.2	67.0	78.1	67.3	73.9	68.0	74.4
SY 611 CL2	72.5	79.6	77.3	81.4	79.1	86.2	56.0	65.7	53.5	58.9	51.9	56.8	64.2	72.7	65.4	70.2	65.5	71.5
SY Longmire	69.6	76.7	71.5	78.3	74.7	81.2	63.5	69.2	60.0	62.3	54.9	58.9	66.5	73.0	65.7	70.3	64.8	70.0
SY McCloud	79.6	73.0	77.3	75.5	77.7	78.4	51.6	63.7	49.6	55.3	48.9	53.9	65.6	68.3	63.4	65.4	63.3	66.2
SY Valda	75.8	84.0	77.2	84.3	82.7	88.3	58.1	71.8	56.3	62.8	54.6	60.9	67.0	77.9	66.7	73.6	68.7	74.6
TCG-Heartland	75.2	75.4	76.5	79.0	76.4	80.5	53.2	69.0	51.6	57.7	49.3	56.0	64.2	72.2	64.0	68.3	62.8	68.3
TCG-Spitfire	72.0	85.9	77.0	87.7	81.2	89.7	63.9	74.9	67.7	71.1	63.6	67.5	67.9	80.4	72.3	79.4	72.4	78.6
TCG-Wildcat	71.0	81.7	77.4	83.5	–	–	63.2	63.0	60.2	60.2	–	–	67.1	72.4	68.8	71.8	–	–
WB9479	70.1	73.3	74.3	75.3	–	–	49.4	62.7	49.5	55.5	–	–	59.7	68.0	61.9	65.4	–	–
WB9590	74.4	83.0	80.2	85.2	–	–	54.7	60.3	55.1	58.0	–	–	64.5	71.7	67.7	71.6	–	–
Mean (Bu/Acre)	**74.3**	**80.1**	**76.8**	**79.8**	**78.5**	**82.6**	**57.4**	**67.6**	**56.3**	**60.6**	**53.9**	**59.4**	**65.8**	**73.8**	**66.5**	**70.2**	**66.2**	**71.0**
LSD (0.10)	**11.7**	**9.9**	**7.8**	**7.7**	**5.9**	**6.0**	**8.7**	**9.1**	**5.8**	**6.0**	**4.8**	**4.8**	**7.6**	**6.5**	**5.0**	**4.8**	**3.8**	**3.8**
No. of Environments	**2**	**2**	**4**	**4**	**6**	**6**	**2**	**2**	**4**	**4**	**6**	**6**	**4**	**4**	**8**	**8**	**12**	**12**