

2016 Hard Red 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 Crookston, Lamberton, Morris, Roseau, St. Paul and Waseca and on-farm sites near Benson, Fergus Falls, Hallock, Le Center, Kimball, 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. 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. 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.

During the past few years, leaf rust infections throughout Minnesota have been low. Stripe rust was observed at several locations in 2015 and to a lesser extent, 2016. The majority of varieties are resistant or moderately resistant, but WB9507 is susceptible.

Table 1. Origin and agronomic characteristics of hard red spring wheat varieties in Minnesota in single-year (2016) and multiple-year comparisons.

Entry	Origin ¹	PVP Status	Days to Heading ²	Height Inches ²	Straw Strength ³
Bolles	2015 MN	PVP (pending)	62.1	32.3	4
Boost	2016 SDSU	PVP (pending)	62.7	29.6	5
Chevelle	2014 Meridian Seeds	PVP (94)	58.9	30.6	4
Dyna-Gro Ambush	2016 Dyna-Gro	PVP (pending)	58.4	31.8	5
Elgin-ND	2013 NDSU	PVP (94)	59.8	35.9	6
Faller	2007 NDSU	PVP (94)	61.6	32.9	5
Focus	2015 SDSU	PVP (pending)	55.6	36.4	7
Forefront	2012 SDSU	PVP (94)	57.6	37.2	6
Glenn	2005 NDSU	PVP (94)	57.7	35.3	5
HRS 3361	2013 CROPLAN by WinField	PVP (94)	60.3	31.3	3
HRS 3419	2014 CROPLAN by WinField	PVP (pending)	63.8	31.7	3
HRS 3504	2015 CROPLAN by WinField	PVP (pending)	62.4	28.7	3
HRS 3530	2015 CROPLAN by WinField	PVP (pending)	61.8	35.0	5
HRS 3616	2016 CROPLAN by WinField	PVP (pending)	60.2	31.4	4
LCS Albany	2009 Limagrain Cereal Seeds	PVP (94)	63.4	30.3	5
LCS Anchor	2016 Limagrain Cereal Seeds	PVP (pending)	58.0	28.9	5
LCS Breakaway	2012 Limagrain Cereal Seeds	PVP (94)	59.8	30.2	4
LCS Iguacu	2014 Limagrain Cereal Seeds	PVP (94)	62.3	31.0	4
LCS Nitro	2015 Limagrain Cereal Seeds	PVP (94)	62.3	31.1	5
LCS Prime	2016 Limagrain Cereal Seeds	PVP (pending)	58.1	32.5	5
Linkert	2013 MN	PVP (94)	59.9	29.3	2
Norden	2012 MN	PVP (94)	60.3	30.5	3
Prevail	2014 SDSU	PVP (94)	57.9	32.8	4
Prosper	2011 NDSU	PVP (94)	61.6	33.5	6
RB07	2007 MN	PVP (94)	59.0	31.7	5
Rollag	2011 MN	PVP (94)	59.2	29.9	3
Shelly	2016 MN	PVP (pending)	62.0	30.6	5
Surpass	2016 SDSU	PVP (pending)	57.0	33.7	7
SY Ingmar	2014 AgriPro/Syngenta	PVP (94)	60.5	31.0	4
SY Rowyn	2013 AgriPro/Syngenta	PVP (94)	59.3	30.5	5
SY Soren	2011 AgriPro/Syngenta	PVP (94)	59.6	29.7	4
SY Valda	2015 AgriPro/Syngenta	PVP (94)	60.1	30.7	4
TCG-Cornerstone	2016 21st Century Genetics	PVP (pending)	60.5	29.1	3
TCG-Spittfire	2016 21st Century Genetics	PVP (pending)	63.5	30.1	3
TCG-Wildfire	2016 21st Century Genetics	PVP (pending)	60.7	33.6	4
WB-Mayville	2011 WestBred	PVP (94)	58.8	28.8	3
WB9507	2013 Westbred	PVP (94)	59.8	33.3	5
WB9653	2015 Westbred	PVP (94)	61.8	29.1	4
Mean			60.2	31.6	

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

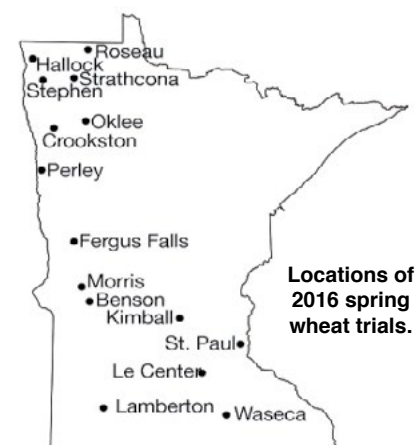
²2016 data.

³1-9 scale in which 1 is the strongest straw and 9 is the weakest. Based on 2014-2016 data. The rating of newer entries may change by as much as one rating point as more data are collected.

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 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 ratings of all varieties that have been evaluated for at least two years are presented in the disease table. This disease cannot be controlled with fungicides. Selection



Locations of 2016 spring wheat trials.

Table 2. Grain quality of hard red spring wheat varieties in Minnesota in single-year (2016) and multiple-year comparisons.

Entry	Test Weight (Lb/Bu)		Protein (%) ¹		Baking Quality ²	Pre-Harvest Sprouting ³
	2016	2 yr	2016	2 yr		
Bolles	58.3	59.4	15.8	15.9	1	1
Boost	58.7	59.0	14.6	14.8	3	4
Chevelle	59.1	60.2	12.9	13.2	—	3
Dyna-Gro Ambush	60.2	—	14.7	—	—	—
Elgin-ND	58.9	59.6	14.4	14.6	3	2
Faller	58.6	59.6	13.2	13.4	5	1
Focus	60.1	61.3	15.1	15.0	3	4
Forefront	59.8	60.6	14.7	14.6	5	3
Glenn	61.0	62.0	14.8	15.0	1	1
HRS 3361	58.6	59.4	13.8	13.9	3	2
HRS 3419	58.5	58.8	12.9	13.2	6	4
HRS 3504	58.9	58.9	13.3	13.7	—	1
HRS 3530	59.5	60.2	14.4	14.4	—	2
HRS 3616	58.8	—	15.0	—	—	—
LCS Albany	59.3	59.9	13.3	13.3	6	4
LCS Anchor	58.5	—	14.9	—	—	—
LCS Breakaway	59.5	60.6	14.9	14.8	5	2
LCS Iguacu	60.1	60.7	12.5	12.9	7	2
LCS Nitro	58.7	59.6	13.1	13.2	4	4
LCS Prime	58.0	59.4	12.9	13.2	—	2
Linkert	59.6	60.4	14.9	15.0	1	2
Norden	60.2	61.3	13.9	14.0	4	1
Prevail	59.5	60.3	14.1	14.1	4	4
Prosper	58.9	59.9	13.4	13.6	5	2
RB07	58.6	59.8	14.5	14.5	3	2
Rollag	59.9	60.8	14.7	14.8	6	1
Shelly	59.4	60.1	13.4	13.8	5	1
Surpass	58.8	59.6	14.5	14.6	—	2
SY Ingmar	59.9	60.7	14.3	14.7	2	2
SY Rowyn	59.7	60.3	13.7	13.8	3	3
SY Soren	59.1	59.5	14.6	14.7	4	2
SY Valda	59.6	60.2	13.7	13.8	—	3
TCG-Cornerstone	58.9	—	14.6	—	—	—
TCG-Spitfire	57.7	—	13.5	—	—	—
TCG-Wildfire	58.9	—	14.3	—	—	—
WB-Mayville	58.9	59.7	14.7	14.6	3	3
WB9507	58.1	58.8	13.4	13.5	3	4
WB9653	59.0	59.6	13.3	13.5	—	1
Mean	59.3	60.7	14.1	14.2		
No. Environments	9	11	9	11		

¹12% moisture basis.

²2014-2015 crop years.

³1-9 scale in which 1 is best and 9 is worst. Values of 1-3 should be considered as resistant.

of more resistant varieties is the only recommended practice at this time to reduce losses due to this disease. The rating of newer varieties may change by as much as one rating point as more data is collected.

The “Other Leaf Diseases” rating represents a combined reaction to septoria 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.

Linkert was the no. 1 variety in Minnesota in 2016, sown on 27.8% of the state's wheat acres. WB-Mayville was the 2nd most popular variety at 13.1%, followed by Prosper (10.2%), Bolles (8.8%) and Faller (6.0%). The 2016 releases Shelly (U of MN); Boost and Surpass (SDSU); Dyna-Gro Ambush (Dyna-Gro); HRS 3616 (CROPLAN by WinField); LCS Anchor and LCS Prime (Limagrain Cereal Seeds); and TCG-Cornerstone, TCG-Spitfire, and TCG-Wildfire (21st Century Genetics) were included in the 2016 trials and their data (multi-year for Boost, LCS Prime, Shelly, and Surpass) is presented for the first time this year. Testing

of Barlow, MS Stingray and Samson was discontinued.

Due to the increased use of fungicides on wheat in Minnesota, we initiated an additional variety trial in 2004 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 Lamberton, Morris, Crookston, and Roseau are included in the 2016 and multi-year summaries. In the two northern locations, the fungicide regime as applied in these trials increased grain yield on average by 5.2 bu/acre in 2016 and by 11.2 bu/acre over the past three years. The two southern locations, Lamberton and Morris, averaged 7.2 and 5.7 bu/acre higher grain yield when fungicide protected in 2016 and over the 3-year average, respectively. Rather than

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
Bolles	1	1	2	4	4	4
Boost	2	2	3	2	7	4
Chevelle	—	1	1	—	6	5
Dyna-Gro Ambush	—	—	—	—	4	—
Elgin-ND	2	2	2	5	5	5
Faller	5	5	2	4	4	4
Focus	3	3	3	3	7	4
Forefront	2	2	4	3	4	3
Glenn	5	1	1	4	5	3
HRS 3361	3	3	3	4	4	5
HRS 3419	4	1	1	6	3	5
HRS 3504	—	2	2	—	4	6
HRS 3530	—	3	1	—	4	4
HRS 3616	—	—	—	—	5	—
LCS Albany	2	3	3	6	5	4
LCS Anchor	—	—	—	—	6	—
LCS Breakaway	3	2	2	3	5	5
LCS Iguacu	4	5	2	4	4	4
LCS Nitro	4	2	2	6	6	5
LCS Prime	—	4	2	—	6	4
Linkert	4	1	1	4	4	5
Norden	2	1	1	4	4	4
Prevail	2	1	5	2	6	4
Prosper	5	5	2	4	4	5
RB07	2	2	2	6	6	4
Rollag	4	1	2	4	5	3
Shelly	4	1	2	4	4	4
Surpass	—	2	5	—	5	4
SY Ingmar	3	2	1	3	5	4
SY Rowyn	3	1	1	2	6	4
SY Soren	2	2	1	4	4	5
SY Valda	—	2	1	—	4	4
TCG-Cornerstone	—	—	—	—	5	—
TCG-Spittfire	—	—	—	—	4	—
TCG-Wildfire	—	—	—	—	4	—
WB-Mayville	3	3	2	6	7	7
WB9507	8	8	3	6	3	4
WB9653	—	2	2	—	4	5

¹1-9 scale where 1=most resistant, 9=most susceptible.

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

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

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

⁵Combined rating of tan spot and septoria.

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.

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Table 4. Relative grain yield of hard red spring wheat varieties in northern Minnesota locations in single-year (2016) and multiple-year comparisons (2014-2016).

Entry	Crookston			Fergus Falls			Hallock			Oklee			Perley ¹	Roseau			Stephen ¹	Strathcona ¹
	2016	2-Yr	3-Yr	2016	2-Yr	3-Yr	2016	2-Yr	3-Yr	2016	2-Yr	3-Yr	2-Yr	2016	2-Yr	3-Yr	2-Yr	2-Yr
Bolles	95	94	96	98	97	99	89	92	92	97	98	100	97	99	100	101	95	103
Boost	97	92	92	98	94	97	86	93	93	93	98	96	94	83	94	95	94	84
Chevelle	103	103	—	106	102	—	99	96	—	103	104	—	—	85	84	—	—	—
Dyna-Gro Ambush	105	—	—	100	—	—	106	—	—	103	—	—	—	104	—	—	—	—
Elgin-ND	89	94	95	95	96	97	89	87	93	106	104	101	93	104	92	93	95	94
Faller	97	95	104	95	105	108	102	106	109	103	101	104	104	110	107	105	107	105
Focus	89	94	94	100	96	95	105	100	100	96	99	96	97	97	104	105	95	94
Forefront	94	98	99	89	91	97	97	100	101	94	93	95	103	105	99	100	98	101
Glenn	88	89	87	97	94	90	99	94	95	93	96	97	92	103	105	102	98	100
HRS 3361	106	103	101	101	103	104	97	96	97	101	100	101	97	105	97	100	93	99
HRS 3419	108	111	109	95	101	109	109	112	110	108	109	110	106	131	120	116	108	111
HRS 3504	102	102	—	111	108	—	108	102	—	100	100	—	—	93	94	—	—	—
HRS 3530	100	104	—	95	103	—	110	112	—	105	103	—	—	114	107	—	—	—
HRS 3616	100	—	—	105	—	—	97	—	—	96	—	—	—	83	—	—	—	—
LCS Albany	111	107	110	105	108	110	103	106	106	110	107	110	104	120	110	108	106	105
LCS Anchor	96	—	—	95	—	—	94	—	—	95	—	—	—	74	—	—	—	—
LCS Breakaway	105	104	98	99	100	93	101	96	96	94	95	98	103	92	98	97	101	100
LCS Iguacu	107	105	106	94	93	101	111	107	104	101	100	105	107	111	111	110	109	106
LCS Nitro	104	104	103	102	103	109	104	101	100	102	102	103	101	114	105	105	100	106
LCS Prime	96	92	—	104	111	—	93	101	—	109	107	—	—	105	107	—	—	—
Linkert	97	102	99	96	95	91	97	99	98	96	96	96	95	85	94	97	101	103
Norden	103	101	99	100	99	98	98	97	98	99	101	101	97	84	101	97	99	93
Prevail	96	99	98	97	98	104	105	103	102	98	97	98	101	105	106	105	99	101
Prosper	100	100	105	99	104	107	102	106	108	103	100	104	106	119	111	109	105	106
RB07	104	102	102	98	97	97	91	92	93	98	99	99	98	83	88	92	99	97
Rollag	102	105	103	98	99	98	106	103	102	95	94	95	100	81	84	88	92	97
Shelly	103	105	106	106	100	105	102	103	103	107	107	107	108	119	111	107	98	107
Surpass	101	102	—	98	100	—	102	99	—	103	101	—	—	102	104	—	—	—
SY Ingmar	99	97	99	106	102	101	106	102	100	102	99	98	100	99	101	98	101	100
SY Rowyn	100	101	104	101	104	106	101	102	102	100	101	102	98	103	96	97	100	102
SY Soren	102	103	102	107	97	99	102	96	97	100	99	99	95	86	100	102	99	102
SY Valda	108	108	—	107	108	—	119	118	—	110	109	—	—	121	108	—	—	—
TCG-Cornerstone	96	—	—	99	—	—	89	—	—	92	—	—	—	91	—	—	—	—
TCG-Spittfire	102	—	—	111	—	—	101	—	—	103	—	—	—	109	—	—	—	—
TCG-Wildfire	101	—	—	97	—	—	91	—	—	105	—	—	—	100	—	—	—	—
WB-Mayville	96	97	93	107	101	95	92	95	96	98	97	99	97	86	91	96	94	95
WB9507	104	99	103	97	104	107	112	111	111	90	93	98	106	108	99	100	104	103
WB9653	103	100	—	110	109	—	106	96	—	97	99	—	—	96	95	—	—	—
Mean (Bu/Acre)	102.1	92.2	93.5	87.6	98.7	92.1	79.6	85.4	86.3	99.4	101.2	98.4	95.4	63.0	73.8	78.7	72.8	77.6
LSD (0.10)	3.4	3.7	3.7	3.9	3.5	3.7	4.3	4.0	4.0	3.5	3.4	3.5	3.6	5.5	4.7	4.4	4.7	4.4

¹Data from 2016 sites at Perley (hail), Stephen and Strathcona (excessive water) were excluded from analyses. 2-year data for these locations is from 2014 and 2015.

Table 5. Relative grain yield of hard red spring wheat varieties in southern Minnesota locations in single-year (2016) and multiple-year comparisons (2014-2016).

Entry	Benson			Kimball			Le Center			Lamberton			Morris			St. Paul			Waseca		
	2016	2-Yr	3-Yr	2016	2-Yr	3-Yr	2016	2-Yr	3-Yr	2016	2-Yr	3-Yr	2016	2-Yr	3-Yr	2016	2-Yr	3-Yr	2016	2-Yr	3-Yr
Bolles	92	95	95	98	98	98	104	95	89	101	95	97	97	97	99	102	103	104	99	99	104
Bovest	93	94	96	89	93	94	96	93	98	106	97	99	101	97	103	103	98	99	102	106	106
Chevelle	108	111	—	88	104	—	96	100	—	99	101	—	109	109	—	106	105	—	107	101	—
Dyna-Gro Ambush	94	—	—	100	—	—	100	—	—	102	—	—	107	—	—	97	—	—	93	—	—
Elgin-ND	93	97	95	81	86	88	80	86	82	84	90	94	99	100	100	99	100	99	99	91	87
Faller	101	101	104	95	90	96	99	102	105	109	109	108	88	92	97	76	89	95	92	98	98
Focus	94	94	97	90	88	87	81	87	90	96	103	103	95	94	101	77	88	91	100	98	96
Forefront	88	90	92	106	104	103	94	101	101	98	102	101	91	98	102	95	90	95	96	98	101
Glenn	82	83	88	94	91	89	71	77	79	85	93	93	81	84	90	81	78	78	89	93	90
HRS 3361	101	94	96	94	96	99	108	106	104	107	102	101	97	100	99	95	98	99	111	112	111
HRS 3419	110	104	103	130	128	122	136	126	127	116	113	114	115	115	111	114	116	113	115	115	115
HRS 3504	114	110	—	101	102	—	100	105	—	107	108	—	115	115	—	101	102	—	112	107	—
HRS 3530	115	114	—	108	101	—	106	107	—	105	104	—	104	97	—	108	107	—	119	126	—
HRS 3616	99	—	—	101	—	—	113	—	—	93	—	—	104	—	—	104	—	—	96	—	—
LCS Albany	107	108	109	113	116	114	120	112	107	114	107	111	105	103	106	107	112	114	102	104	111
LCS Anchor	93	—	—	108	—	—	77	—	—	75	—	—	86	—	—	91	—	—	83	—	—
LCS Breakaway	92	94	96	110	99	98	89	93	93	89	90	91	99	93	94	105	102	96	91	94	91
LCS Iguacu	98	99	101	117	109	108	120	108	110	103	101	102	98	98	99	112	116	116	103	92	95
LCS Nitro	106	105	108	118	116	115	129	118	120	110	106	107	107	110	108	126	123	119	110	105	109
LCS Prime	110	108	—	94	102	—	95	98	—	97	103	—	100	95	—	86	86	—	86	82	—
Linkert	93	92	92	114	103	101	87	96	94	85	88	89	94	96	93	109	105	99	92	95	97
Norden	97	95	98	102	98	96	95	95	92	96	97	98	99	100	97	105	103	101	88	93	98
Prevail	101	96	100	115	114	110	101	103	105	105	103	101	89	95	102	99	103	105	117	118	120
Prosper	104	109	110	90	93	96	98	99	100	109	105	105	95	92	100	86	94	98	96	99	104
RB07	99	99	98	96	99	98	88	88	89	89	93	97	95	95	94	96	98	94	81	89	87
Rollag	95	96	98	97	98	98	91	91	88	84	89	91	98	101	98	94	94	94	75	79	80
Shelly	105	107	107	92	103	104	109	99	93	112	109	109	118	115	107	115	115	113	114	112	112
Surpass	97	99	—	79	85	—	76	88	—	101	100	—	104	102	—	79	78	—	112	108	—
SY Ingmar	109	105	108	125	115	111	115	111	114	110	105	104	106	100	103	113	100	100	105	94	94
SY Rowyn	108	104	106	106	106	106	112	104	106	109	107	106	108	110	113	111	106	104	113	107	110
SY Soren	101	97	98	110	103	101	109	97	95	89	90	96	102	93	97	113	106	103	112	98	97
SY Valda	113	110	—	98	101	—	114	114	—	111	110	—	113	112	—	103	106	—	105	102	—
TCG-Cornerstone	96	—	—	98	—	—	104	—	—	93	—	—	94	—	—	105	—	—	93	—	—
TCG-Spittfire	95	—	—	103	—	—	100	—	—	99	—	—	102	—	—	103	—	—	89	—	—
TCG-Wildfire	100	—	—	104	—	—	110	—	—	103	—	—	103	—	—	99	—	—	98	—	—
WB-Mayville	100	95	97	108	99	95	104	105	104	100	96	93	98	105	97	105	106	103	94	99	95
WB9507	100	104	104	97	94	99	118	115	115	107	100	102	76	80	89	87	103	106	112	101	106
WB9653	108	109	—	91	103	—	101	105	—	106	106	—	109	115	—	102	106	—	110	110	—
Mean (Bu/Acre)	113.0	109.2	109.9	64.6	81.1	84.1	78.4	82.9	74.3	72.0	84.4	83.3	78.3	71.6	74.7	65.7	76.7	74.1	74.2	61.5	53.6
LSD (0.10)	3.6	8.0	6.5	19.9	12.5	9.3	14.6	14.6	12.0	9.2	8.6	7.1	10.1	10.2	11.4	12.3	11.6	11.6	11.1	15.9	14.2

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 1.25 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)
1.25 million	0.20	14,000	0.95	117

Table 6. Relative grain yield of hard red spring wheat varieties in Minnesota in single-year (2016) and multiple-year comparisons (2014-2016).

Entry	State			North			South		
	2016	2-Year	3-Year	2016	2-Year	3-Year	2016	2-Year	3-Year
Bolles	97	97	98	95	97	98	99	97	98
Boost	96	94	96	92	92	94	98	96	99
Chevelle	102	101	—	100	98	—	103	105	—
Dyna-Gro Ambush	101	—	—	104	—	—	99	—	—
Elgin-ND	93	93	94	96	94	96	91	93	93
Faller	98	100	103	101	103	106	95	98	101
Focus	94	96	96	97	98	97	91	93	95
Forefront	95	97	99	95	96	99	95	97	99
Glenn	88	91	91	95	95	95	83	86	87
HRS 3361	102	100	100	102	99	100	102	101	101
HRS 3419	115	113	112	109	110	110	119	116	115
HRS 3504	106	104	—	103	102	—	108	107	—
HRS 3530	107	108	—	104	107	—	110	108	—
HRS 3616	99	—	—	97	—	—	102	—	—
LCS Albany	109	108	109	109	106	108	109	109	110
LCS Anchor	90	—	—	92	—	—	88	—	—
LCS Breakaway	97	98	96	99	100	98	96	95	95
LCS Iguacu	106	104	105	104	104	106	107	104	105
LCS Nitro	110	107	108	105	103	104	114	112	112
LCS Prime	99	101	—	101	104	—	96	98	—
Linkert	95	97	96	95	98	97	95	96	95
Norden	98	98	98	98	98	98	97	97	97
Prevail	102	102	103	100	100	101	103	104	105
Prosper	100	102	104	104	104	106	98	99	102
RB07	94	95	96	96	96	97	92	95	95
Rollag	94	95	95	97	97	97	91	93	93
Shelly	108	106	106	107	105	105	110	108	107
Surpass	97	98	—	101	103	—	93	94	—
SY Ingmar	107	103	103	102	100	100	111	105	106
SY Rowyn	106	104	104	101	101	102	110	106	107
SY Soren	103	98	99	100	99	99	105	98	99
SY Valda	110	109	—	112	110	—	109	108	—
TCG-Cornerstone	96	—	—	93	—	—	97	—	—
TCG-Spitfire	101	—	—	105	—	—	98	—	—
TCG-Wildfire	101	—	—	99	—	—	103	—	—
WB-Mayville	99	98	97	97	96	96	101	101	98
WB9507	100	101	104	102	102	104	100	100	103
WB9653	104	104	—	103	101	—	104	107	—
Mean (Bu/Acre)	81.5	85.0	83.3	86.2	89.4	87.5	78.0	81.0	79.0
LSD (0.10)	4.8	3.4	2.5	6.0	4.4	2.9	6.8	4.9	3.9
No. Environments	12	27	42	5	13	21	7	14	21

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

Entry	North						South						State					
	2016		2-Year		3-Year		2016		2-Year		3-Year		2016		2-Year		3-Year	
	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int	Conv	Int
Bolles	79.6	86.4	80.3	89.4	84.8	93.5	74.4	82.5	74.9	81.1	77.6	83.1	77.0	84.4	77.6	85.2	81.2	88.3
Boost	75.8	78.0	76.9	86.8	80.5	92.8	77.6	79.2	75.5	80.1	79.8	83.1	76.7	78.6	76.2	83.4	80.2	87.9
Chevelle	79.3	87.7	78.4	94.1	—	—	78.3	84.7	81.7	87.0	—	—	78.8	86.2	80.1	90.5	—	—
Dyna-Gro Ambush	86.4	91.2	—	—	—	—	78.5	76.9	—	—	—	—	82.5	84.1	—	—	—	—
Elgin-ND	78.2	83.4	77.2	86.9	81.3	92.1	69.2	75.0	73.8	78.6	76.7	81.2	73.7	79.2	75.5	82.8	79.0	86.7
Faller	84.1	93.0	83.3	99.1	89.9	105.1	73.7	87.6	78.7	90.1	81.2	90.2	78.9	90.3	81.0	94.6	85.6	97.6
Focus	76.0	80.5	81.8	88.5	85.1	93.6	71.7	82.9	76.9	82.5	80.4	84.1	73.9	81.7	79.4	85.5	82.8	88.9
Forefront	80.8	87.7	81.4	85.4	85.5	92.3	70.6	74.4	77.9	80.1	80.0	81.6	75.7	81.1	79.7	82.8	82.8	87.0
Glenn	77.2	80.8	79.5	84.9	80.7	89.8	62.1	68.7	69.4	72.1	72.4	76.6	69.7	74.8	74.4	78.5	76.6	83.2
HRS 3361	87.1	91.3	83.5	91.6	86.7	97.7	76.6	86.6	79.2	83.0	79.2	83.3	81.8	89.0	81.4	87.3	83.0	90.5
HRS 3419	96.5	100.7	95.6	99.5	96.8	105.7	86.9	88.7	89.0	92.7	88.9	93.1	91.7	94.7	92.3	96.1	92.9	99.4
HRS 3504	81.5	82.9	81.5	92.7	—	—	83.3	90.1	86.9	90.5	—	—	82.4	86.5	84.2	91.6	—	—
HRS 3530	87.3	89.7	87.4	94.5	—	—	78.5	90.4	78.6	89.2	—	—	82.9	90.1	83.0	91.9	—	—
HRS 3616	77.1	83.9	—	—	—	—	74.2	81.4	—	—	—	—	75.6	82.6	—	—	—	—
LCS Albany	94.4	98.9	90.1	100.0	93.7	103.7	82.3	86.7	82.1	91.1	85.6	89.7	88.3	92.8	86.1	95.6	89.7	96.7
LCS Anchor	72.3	75.4	—	—	—	—	60.7	69.7	—	—	—	—	66.5	72.6	—	—	—	—
LCS Breakaway	82.4	86.3	84.3	93.4	83.9	97.1	71.2	75.6	71.4	79.6	73.2	82.3	76.8	80.9	77.9	86.5	78.6	89.7
LCS Iguacu	89.8	92.4	89.3	92.6	92.8	99.1	75.6	87.2	78.0	88.7	79.4	88.6	82.7	89.8	83.7	90.7	86.1	93.9
LCS Nitro	89.0	97.7	86.8	94.4	89.8	100.5	81.4	82.0	84.0	83.8	84.9	87.9	85.2	89.8	85.4	89.1	87.4	94.2
LCS Prime	82.1	89.7	82.0	97.0	—	—	73.8	85.1	77.2	90.8	—	—	78.0	87.4	79.6	93.9	—	—
Linkert	76.2	80.0	81.5	89.0	84.5	93.9	67.2	78.5	71.5	79.9	72.0	79.4	71.7	79.3	76.5	84.4	78.3	86.7
Norden	79.1	80.2	83.8	87.2	84.4	92.5	73.3	76.3	76.8	79.6	76.9	81.1	76.2	78.3	80.3	83.4	80.7	86.8
Prevail	82.0	86.2	84.9	93.9	87.3	97.0	72.8	84.4	77.6	86.0	80.0	84.9	77.4	85.3	81.2	89.9	83.6	90.9
Prosper	88.6	89.3	86.9	93.7	91.9	101.0	76.5	87.4	77.3	89.4	81.1	89.6	82.6	88.4	82.1	91.5	86.5	95.3
RB07	79.0	84.5	79.4	92.5	83.7	97.9	69.2	67.8	73.3	77.6	75.6	79.7	74.1	76.1	76.4	85.0	79.7	88.8
Rollag	77.6	86.9	79.4	92.8	82.7	96.4	68.6	73.3	73.5	77.0	74.4	77.9	73.1	80.1	76.5	84.9	78.6	87.2
Shelly	90.2	97.0	89.3	100.7	91.8	104.4	86.8	94.0	87.2	91.8	85.6	89.8	88.5	95.5	88.2	96.2	88.7	97.1
Surpass	83.6	83.9	85.4	90.2	—	—	77.0	80.7	78.7	83.7	—	—	80.3	82.3	82.1	86.9	—	—
SY Ingmar	81.7	90.7	81.9	95.4	84.8	98.0	81.2	87.3	80.1	85.4	81.6	86.5	81.4	89.0	81.0	90.4	83.2	92.2
SY Rowyn	83.6	89.1	81.9	94.6	86.6	98.7	81.6	90.4	84.7	88.7	86.3	89.7	82.6	89.8	83.3	91.6	86.5	94.2
SY Soren	79.1	88.7	84.3	92.9	87.6	97.7	71.8	81.2	71.4	82.5	76.3	83.7	75.5	85.0	77.8	87.7	82.0	90.7
SY Valda	93.5	94.6	89.5	97.0	—	—	84.1	90.1	86.8	91.6	—	—	88.8	92.3	88.2	94.3	—	—
TCG-Cornerstone	77.5	83.9	—	—	—	—	70.3	76.7	—	—	—	—	73.9	80.3	—	—	—	—
TCG-Spitfire	86.2	91.0	—	—	—	—	75.7	80.6	—	—	—	—	80.9	85.8	—	—	—	—
TCG-Wildfire	82.9	85.9	—	—	—	—	77.7	78.2	—	—	—	—	80.3	82.1	—	—	—	—
WB-Mayville	76.2	89.5	78.3	95.6	81.3	98.7	74.6	83.8	78.3	82.1	75.0	81.6	75.4	86.7	78.3	88.8	78.1	90.2
WB9507	87.0	96.7	82.4	99.6	87.5	103.2	68.2	92.6	70.8	91.5	75.9	92.0	77.6	94.6	76.6	95.5	81.7	97.6
WB9653	82.7	84.6	—	—	—	—	80.7	94.1	—	—	—	—	81.7	89.3	—	—	—	—
Mean (Bu/Acre)	82.5	87.7	83.0	92.5	86.0	97.2	75.2	82.4	77.8	84.5	78.9	84.6	78.8	85.0	80.4	88.5	82.5	90.9
LSD (0.10)	9.9	12.5	7.1	7.9	5.5	5.8	8.1	6.8	7.3	7.0	5.1	5.0	6.1	6.9	5.1	5.2	3.7	3.8
No. Environments	2	2	4	4	6	6	2	2	4	4	6	6	4	4	8	8	12	12