

Wheat, Hard Red Spring

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Spring wheat varieties were compared in trial plots at Crookston, Lamberton, Morris, Roseau, St. Paul and Waseca, and on-farm sites near Fergus Falls, Hallock, Oklee, Perley, Stephen and Strathcona. Beginning this year, the on-farm site yield data are presented as individual locations and used in the calculations of North and State grain yield averages. These plots are handled so that the factors affecting yield and other characteristics are as uniform as possible for all varieties at each location. 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 the tables in alphabetical order.

Variety Selection Criteria

While grain yield is an important economic trait, return per acre also is 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.

Only Briggs maintained a 1 rating for leaf rust. Varieties suspected of relying on the leaf rust resistance gene *Lr21*, including Barlow, Faller, Glenn, Howard and RB07, were assigned a rating of 2, as were the varieties

Blade, Brennan, Kelby, Knudson and Select. Carefully consider a variety's rating for leaf 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.

Table 1. Origin and agronomic characteristics of hard red spring wheat varieties in Minnesota in single-year (2010) and multiple-year comparisons (2008-2010).

| Variety | Origin ¹ | Days to Heading ² | Height Inches ² | Straw Strength ³ |
|-----------|-----------------------------|------------------------------|----------------------------|-----------------------------|
| Ada | 2006 MN | 62.8 | 32.5 | 4 |
| Albany | 2009 Limagrain Cereal Seeds | 65.4 | 32.0 | 5 |
| Barlow | 2009 NDSU | 61.2 | 33.8 | 6 |
| Blade | 2007 WestBred | 64.3 | 33.0 | 4 |
| Breaker | 2008 WestBred | 62.6 | 33.4 | 3 |
| Brennan | 2009 AgriPro | 60.3 | 30.3 | 4 |
| Brick | 2009 NDSU | 58.0 | 34.2 | 6 |
| Briggs | 2002 SDSU | 59.6 | 33.8 | 7 |
| Brogan | 2009 Westbred | 62.6 | 31.7 | 4 |
| Cromwell | 2007 Thunder Seed | 64.7 | 33.4 | 4 |
| Faller | 2007 NDSU | 64.0 | 34.0 | 5 |
| Freyr | 2004 AgriPro | 61.9 | 34.9 | 6 |
| Glenn | 2005 NDSU | 59.9 | 35.1 | 4 |
| Hat Trick | 2006 Limagrain Cereal Seeds | 63.7 | 33.0 | 5 |
| Howard | 2006 NDSU | 62.0 | 34.7 | 6 |
| Jenna | 2009 AgriPro | 65.5 | 32.5 | 4 |
| Kelby | 2006 AgriPro | 60.1 | 30.5 | 4 |
| Knudson | 2001 AgriPro | 63.4 | 31.7 | 5 |
| Kuntz | 2007 AgriPro | 62.7 | 31.3 | 4 |
| Marshall | 1982 MN | 65.7 | 33.1 | 4 |
| Oklee | 2003 MN | 60.5 | 32.3 | 6 |
| Pivot | 2009 Westbred | 63.5 | 27.9 | 3 |
| RB07 | 2007 MN | 61.5 | 32.5 | 5 |
| Sabin | 2009 MN | 63.9 | 31.5 | 6 |
| Samson | 2007 WestBred | 62.9 | 31.5 | 3 |
| Select | 2011 SDSU | 58.8 | 33.5 | 5 |
| Tom | 2008 MN | 61.8 | 33.1 | 6 |
| Vantage | 2007 WestBred | 66.7 | 32.3 | 2 |
| WB-Digger | 2010 Westbred | 63.0 | 33.6 | 5 |
| WB-Lyn | 2010 Westbred | 66.9 | 32.3 | 4 |
| Mean | | 62.7 | 32.7 | |

¹ Abbreviations: MN = Minnesota Agricultural Experiment Station, NDSU = North Dakota State University Research Foundation, SDSU = South Dakota Agricultural Experiment Station, Trigen = Trigen Seed Services LLC.

² 2010 data.

³ 1-9 scale in which 1 is the strongest straw and 9 is the weakest. Based on 2005-2010 data. The rating of newer entries may change by as much as one rating point as more data are collected.

Stripe rust was a serious problem on susceptible varieties in some locations in 2004, and appeared in some locations in 2010. Stripe is less widespread and more sporadic leaf rust, but can be very damaging when temperatures remain unseasonably cool into early July. Most varieties are resistant or moderately resistant. 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.

The foliar disease rating, which represents the total complex of leaf diseases other than leaf and stripe rust, includes the Septoria complex, tan spot, powdery mildew and bacterial leaf streak. Although varieties may differ for their response to each of those diseases, the rating does not differentiate among them.

Exceptions are Ada and Hat Trick, which are rated susceptible to powdery mildew. 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 leaf diseases with fungicides may be warranted, even for varieties with an above-average rating.

Bacterial Leaf Streak cannot be controlled with fungicides. If you have a history of problems with this disease, variety selection of more-resistant varieties is the only recommend practice at this time. Bacterial leaf streak assessments for the most consistently resistant and susceptible varieties are footnoted in the Other Leaf Diseases column of Table 3. These data are based on five locations where this disease was observed from 2007 to 2010. Additional data are needed before a

complete rating of all varieties can be provided. Blade, Cromwell, Howard and Knudson are consistently more resistant to bacterial leaf streak, and Albany, Brogan, Hat Trick, Kelby, RB07, Samson, Select and Vantage have consistently been more susceptible.

Leading varieties in Minnesota, based on acres planted in 2010 are Faller and RB07, with 30% and 24% respectively. Pivot, WB Digger and WB Lyn were new entries in the trials. Select, a 2011 release from SDSU, was evaluated in 2009 and 2010. Testing of Granger, Steele ND and Traverse 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

Table 2. Grain quality of hard red spring wheat varieties in Minnesota in single-year (2010) and multiple-year comparisons (2008-2010).

| Variety | Test Weight (Lb/Bu) | | Protein (%) ¹ | | Baking Quality ² | Pre-Harvest Sprouting ³ |
|-----------|---------------------|--------|--------------------------|--------|-----------------------------|------------------------------------|
| | 2010 | 2-Year | 2010 | 2-Year | | |
| Ada | 60.6 | 61.4 | 14.7 | 14.6 | Medium | 2 |
| Albany | 60.1 | 60.8 | 14.0 | 13.9 | Low-Medium | 4 |
| Barlow | 61.0 | 61.7 | 15.5 | 15.4 | Medium-High | 1 |
| Blade | 61.8 | 62.2 | 15.1 | 15.2 | Medium-High | 5 |
| Breaker | 62.1 | 62.5 | 14.8 | 15.0 | Medium-High | 4 |
| Brennan | 59.5 | 60.1 | 15.0 | 15.1 | Medium | 4 |
| Brick | 60.8 | 61.7 | 14.9 | 15.0 | Medium | 2 |
| Briggs | 60.2 | 61.0 | 15.1 | 15.1 | Medium | 2 |
| Brogan | 59.7 | 60.6 | 14.8 | 14.6 | Low-Medium | — |
| Cromwell | 61.2 | 61.7 | 14.7 | 15.0 | Medium-High | 3 |
| Faller | 59.7 | 60.5 | 14.5 | 14.5 | Medium | 2 |
| Freyr | 59.3 | 60.3 | 15.0 | 15.1 | Medium | 2 |
| Glenn | 62.0 | 63.0 | 15.5 | 15.6 | High | 1 |
| Hat Trick | 60.7 | 61.3 | 14.7 | 14.8 | Medium-low | 4 |
| Howard | 61.0 | 61.9 | 15.1 | 15.1 | Medium-High | 2 |
| Jenna | 59.5 | 59.9 | 14.8 | 14.7 | Medium | — |
| Kelby | 59.2 | 60.1 | 15.3 | 15.4 | Medium | 1 |
| Knudson | 60.2 | 60.7 | 14.3 | 14.3 | Medium-High | 3 |
| Kuntz | 59.2 | 59.9 | 14.4 | 14.5 | Medium | 2 |
| Marshall | 58.1 | 59.1 | 13.8 | 14.1 | Low | 2 |
| Oklee | 60.6 | 61.4 | 15.1 | 15.3 | Low-Medium | 3 |
| Pivot | 57.0 | — | 14.7 | — | — | — |
| RB07 | 59.2 | 60.2 | 15.0 | 15.1 | Medium-High | 2 |
| Sabin | 59.3 | 60.1 | 14.8 | 14.8 | Medium-High | 4 |
| Samson | 58.6 | 59.6 | 14.3 | 14.1 | Medium | 4 |
| Select | 60.4 | 61.6 | 14.5 | 14.8 | Medium-Low | 2 |
| Tom | 59.7 | 60.6 | 14.7 | 14.8 | Medium | 1 |
| Vantage | 61.9 | 62.4 | 15.7 | 15.7 | Medium | 2 |
| WB-Digger | 59.6 | — | 14.5 | — | — | — |
| WB-Lyn | 57.5 | — | 14.0 | — | — | — |
| Mean | 60.1 | 61.0 | 14.8 | 14.9 | | |

¹ 12% moisture basis.

² 2004-2009 crop years.

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

Table 3. Disease response¹ of hard red spring wheat varieties in Minnesota in multiple-year comparisons (2008-2010).

| Variety | Leaf Rust | Stem Rust ² | Other Leaf Diseases ³ | Scab |
|-----------|-----------|------------------------|----------------------------------|------|
| Ada | 5 | 2 | 5 ⁴ | 6 |
| Albany | 3 | 3 | 5 ⁵ | 4 |
| Barlow | 2 | 1 | 4 | 4 |
| Blade | 2 | 2 | 3 ⁶ | 4 |
| Breaker | 3 | 2 | 3 | 4 |
| Brennan | 2 | 2 | 5 | 7 |
| Brick | 3 | 3 | 7 | 3 |
| Briggs | 1 | 2 | 5 | 5 |
| Brogan | 3 | 2 | 6 ⁵ | 6 |
| Cromwell | 4 | 1 | 4 ⁶ | 4 |
| Faller | 2 | 1 | 3 | 4 |
| Freyr | 4 | 4 | 4 | 4 |
| Glenn | 2 | 1 | 4 | 3 |
| Hat Trick | 5 | 4 | 5 ^{4,5} | 4 |
| Howard | 2 | 1 | 4 ⁶ | 6 |
| Jenna | 4 | 2 | 4 | 6 |
| Kelby | 2 | 1 | 4 ⁵ | 5 |
| Knudson | 2 | 3 | 3 ⁶ | 6 |
| Kuntz | 3 | 1 | 4 | 6 |
| Marshall | 8 | 1 | 7 | 7 |
| Oklee | 4 | 1 | 5 | 5 |
| Pivot | — | — | — | — |
| RB07 | 2 | 2 | 5 ⁵ | 5 |
| Sabin | 3 | 1 | 6 | 4 |
| Samson | 5 | 1 | 6 ⁵ | 7 |
| Select | 2 | 4 | 7 ⁵ | 4 |
| Tom | 4 | 1 | 5 | 4 |
| Vantage | 5 | 3 | 6 ⁵ | 5 |
| WB-Digger | — | — | — | — |
| WB-Lyn | — | — | — | — |

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

² Stem rust levels have been very low in production fields in recent years. Even on susceptible varieties.

³ Includes tan spot, septoria, bacterial leaf stripe and powdery mildew.

⁴ These varieties are more susceptible to powdery mildew.

⁵ These varieties were more susceptible to bacterial leaf stripe based on three environments with this disease from 2007 and 2010.

⁶ These varieties were more resistant to bacterial leaf stripe based on three environments with this disease from 2007 and 2010.

10.51). The practice of three fungicide applications during the growing season is not recommended. This fungicide regime was implemented to measure the performance of varieties when fungal diseases were controlled to the maximum extent possible. Growers' decisions regarding fungicide applications should be based on the available decision support systems, and only if and when disease levels are forecasted to reach economic 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, Crookston and Roseau are included in the 2010 and multi-year summaries. In 2010, the fungicide regime as applied in these trials increased grain yield on average by more than 6 bu/acre, compared to about 5 bu/acre in 2009 and 4 bu/acre in 2008. The 3-year comparisons showed an increase in grain yield of about 5 bu/acre. Rather than the average increases in grain yield, the responses of individual varieties provide the most useful information; varieties rated susceptible to leaf rust and other fungal leaf diseases benefited most from fungicide applications.

Test Plot Research

Test plot establishment and management were supervised by Matt Bickell, Robert Bouvette, James Cameron, Dave Grafstrom, Mark Hanson, George Nelson, Steve Quiring, Galen Thompson and Donn Vellekson

Hard red spring wheat planting rate and date.

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 4. Relative grain yield (as percent of the mean) of hard red spring wheat varieties in northern Minnesota locations in single-year (2010) and multiple-year comparisons (2008-2010).

| Variety | Crookston | | | Roseau | | Stephen | | | Fergus Falls | | | Perley | | | Oklee | | | Strathcona | | Hallock | |
|----------------|-----------|--------|--------|--------|---------------------|---------|--------|--------|--------------|--------|--------|--------|--------|--------|-------|--------|--------|------------|---------------------|---------|---------------------|
| | 2010 | 2-Year | 3-Year | 2010 | 2-Year ¹ | 2010 | 2-Year | 3-Year | 2010 | 2-Year | 3-Year | 2010 | 2-Year | 3-Year | 2010 | 2-Year | 3-Year | 2010 | 2-Year ² | 2010 | 2-Year ² |
| Ada | 104 | 100 | 99 | 115 | 103 | 90 | 94 | 96 | 96 | 95 | 100 | 106 | 102 | 99 | 102 | 98 | 99 | 100 | 101 | 95 | 96 |
| Albany | 124 | 118 | 115 | 112 | 102 | 119 | 113 | 103 | 124 | 113 | 115 | 128 | 119 | 116 | 130 | 129 | 127 | 122 | 116 | 116 | 112 |
| Barlow | 90 | 97 | 95 | 96 | 96 | 93 | 102 | 102 | 100 | 101 | 102 | 100 | 96 | 97 | 84 | 90 | 94 | 92 | 99 | 100 | 101 |
| Blade | 109 | 105 | 103 | 85 | 93 | 101 | 98 | 96 | 92 | 97 | 98 | 109 | 105 | 106 | 99 | 101 | 102 | 105 | 102 | 97 | 94 |
| Breaker | 106 | 104 | 103 | 101 | 102 | 102 | 100 | 102 | 108 | 107 | 103 | 97 | 100 | 101 | 105 | 93 | 98 | 98 | 98 | 101 | 98 |
| Brennan | 96 | 96 | 97 | 84 | 94 | 91 | 95 | 98 | 89 | 94 | 99 | 88 | 91 | 93 | 107 | 103 | 105 | 105 | 101 | 98 | 95 |
| Brick | 96 | 89 | 93 | 92 | 93 | 82 | 89 | 95 | 88 | 95 | 100 | 97 | 95 | 98 | 89 | 97 | 99 | 100 | 102 | 101 | 103 |
| Briggs | 86 | 92 | 93 | 90 | 93 | 86 | 95 | 92 | 105 | 99 | 99 | 98 | 96 | 97 | 78 | 86 | 90 | 81 | 87 | 90 | 94 |
| Brogan | 84 | 91 | — | 97 | — | 86 | 91 | — | 110 | 106 | — | 103 | 103 | — | 94 | 98 | — | 106 | — | 99 | — |
| Cromwell | 100 | 101 | 101 | 110 | 106 | 100 | 99 | 98 | 90 | 94 | 97 | 99 | 99 | 101 | 93 | 96 | 99 | 106 | 102 | 94 | 91 |
| Faller | 113 | 118 | 116 | 117 | 120 | 112 | 115 | 111 | 119 | 116 | 114 | 107 | 111 | 113 | 114 | 118 | 114 | 103 | 102 | 114 | 114 |
| Freyr | 102 | 100 | 101 | 98 | 96 | 106 | 101 | 99 | 94 | 97 | 97 | 104 | 101 | 101 | 98 | 100 | 101 | 101 | 102 | 109 | 103 |
| Glenn | 86 | 87 | 89 | 77 | 91 | 84 | 89 | 95 | 101 | 93 | 93 | 95 | 93 | 95 | 75 | 84 | 87 | 97 | 94 | 85 | 91 |
| Hat Trick | 94 | 90 | 93 | 93 | 98 | 108 | 109 | 106 | 81 | 94 | 96 | 93 | 97 | 99 | 102 | 104 | 105 | 88 | 82 | 100 | 107 |
| Howard | 104 | 107 | 103 | 99 | 101 | 97 | 100 | 98 | 104 | 103 | 101 | 106 | 102 | 102 | 83 | 98 | 98 | 89 | 96 | 95 | 96 |
| Jenna | 101 | 104 | 102 | 103 | 106 | 114 | 105 | 105 | 98 | 100 | 101 | 102 | 104 | 106 | 108 | 103 | 104 | 119 | 117 | 103 | 106 |
| Kelby | 97 | 91 | 94 | 87 | 96 | 97 | 94 | 99 | 88 | 88 | 93 | 86 | 89 | 91 | 102 | 97 | 96 | 101 | 100 | 98 | 95 |
| Knudson | 107 | 107 | 104 | 100 | 99 | 102 | 103 | 102 | 100 | 104 | 106 | 97 | 102 | 103 | 99 | 99 | 101 | 101 | 101 | 108 | 106 |
| Kuntz | 111 | 103 | 104 | 93 | 99 | 97 | 97 | 100 | 105 | 98 | 100 | 96 | 99 | 98 | 119 | 107 | 105 | 110 | 111 | 108 | 106 |
| Marshall | 85 | 91 | 92 | 110 | 99 | 88 | 87 | 87 | 85 | 89 | 87 | 96 | 92 | 81 | 102 | 98 | 94 | 86 | 84 | 79 | 90 |
| Oklee | 96 | 97 | 95 | 87 | 96 | 94 | 96 | 98 | 95 | 97 | 96 | 93 | 84 | 87 | 94 | 95 | 97 | 89 | 95 | 92 | 96 |
| Pivot | 107 | — | — | 102 | — | 113 | — | — | 101 | — | — | 98 | — | — | 116 | — | — | 101 | — | 112 | — |
| RB07 | 95 | 98 | 100 | 102 | 97 | 106 | 103 | 106 | 104 | 110 | 107 | 107 | 105 | 108 | 102 | 102 | 98 | 95 | 101 | 105 | 103 |
| Sabin | 96 | 96 | 98 | 99 | 97 | 89 | 94 | 94 | 110 | 106 | 104 | 109 | 107 | 111 | 95 | 100 | 101 | 100 | 101 | 93 | 96 |
| Samson | 113 | 116 | 113 | 114 | 112 | 111 | 112 | 111 | 97 | 98 | 100 | 104 | 102 | 102 | 114 | 107 | 106 | 111 | 109 | 104 | 106 |
| Select | 88 | 94 | 98 | 92 | 94 | 95 | 97 | 95 | 101 | 101 | 102 | 103 | 100 | 103 | 87 | 92 | 95 | 91 | 97 | 97 | 97 |
| Tom | 93 | 92 | 95 | 90 | 95 | 95 | 101 | 107 | 90 | 90 | 95 | 90 | 97 | 100 | 97 | 97 | 97 | 100 | 102 | 95 | 101 |
| Vantage | 96 | 100 | 96 | 108 | 115 | 103 | 100 | 97 | 98 | 101 | 98 | 92 | 95 | 92 | 106 | 100 | 98 | 104 | 98 | 100 | 97 |
| WB-Digger | 110 | — | — | 104 | — | 115 | — | — | 105 | — | — | 95 | — | — | 98 | — | — | 103 | — | 102 | — |
| WB-Lyn | 94 | — | — | 101 | — | 111 | — | — | 106 | — | — | 110 | — | — | 110 | — | — | 97 | — | 99 | — |
| Mean (Bu/Acre) | 81.6 | 84.2 | 89.1 | 58.9 | 63.5 | 75.8 | 77.5 | 78.2 | 81.1 | 82.3 | 88.0 | 70.5 | 81.3 | 79.6 | 92.9 | 90.2 | 93.4 | 87.9 | 89.2 | 95.9 | 91.8 |
| LSD (0.10) | 6.6 | 9.6 | 7.2 | 11.5 | 14.4 | 12.4 | 10.6 | 9.7 | 7.8 | 12.6 | 8.8 | 15.3 | 7.9 | 9.2 | 7.5 | 15.1 | 10.2 | 9.2 | 11.7 | 5.3 | 12.5 |

¹ The 2009 Roseau site was not planted due to excessive wetness. 2-year data are 2008 and 2010.

² The 2009 Hallock and Strathcona sites were abandoned due to excessive field variability.

Table 5. Relative grain yield (as percent of the mean) of hard red spring wheat varieties in southern Minnesota locations in single-year (2010) and multiple-year comparisons (2008-2010).

| Variety | Lamberton | | | Morris ¹ | | St. Paul | | | Waseca | | |
|-----------|-----------|--------|--------|---------------------|--------|----------|--------|--------|--------|--------|--------|
| | 2010 | 2-Year | 3-Year | 2010 | 2-Year | 2010 | 2-Year | 3-Year | 2010 | 2-Year | 3-Year |
| Ada | 90 | 90 | 87 | 97 | 101 | 64 | 82 | 79 | 93 | 93 | 96 |
| Albany | 105 | 117 | 106 | 116 | 113 | 126 | 117 | 112 | 137 | 135 | 131 |
| Barlow | 112 | 103 | 102 | 101 | 104 | 110 | 102 | 103 | 95 | 97 | 98 |
| Blade | 98 | 96 | 99 | 90 | 91 | 90 | 94 | 96 | 94 | 96 | 96 |
| Breaker | 102 | 105 | 103 | 106 | 103 | 82 | 92 | 95 | 98 | 102 | 103 |
| Brennan | 106 | 108 | 110 | 100 | 102 | 98 | 106 | 106 | 89 | 100 | 103 |
| Brick | 95 | 92 | 97 | 93 | 94 | 83 | 88 | 94 | 104 | 98 | 95 |
| Briggs | 105 | 98 | 99 | 102 | 98 | 93 | 93 | 99 | 94 | 94 | 90 |
| Brogan | 103 | 103 | — | 104 | 107 | 95 | 101 | — | 106 | 103 | — |
| Cromwell | 108 | 102 | 100 | 104 | 102 | 100 | 93 | 95 | 107 | 103 | 99 |
| Faller | 112 | 116 | 114 | 119 | 115 | 126 | 111 | 101 | 114 | 117 | 109 |
| Freyr | 92 | 99 | 100 | 96 | 95 | 94 | 96 | 100 | 104 | 101 | 99 |
| Glenn | 109 | 103 | 101 | 95 | 86 | 89 | 97 | 98 | 76 | 81 | 83 |
| Hat Trick | 93 | 87 | 88 | 88 | 89 | 85 | 77 | 76 | 95 | 101 | 99 |
| Howard | 111 | 110 | 110 | 111 | 108 | 120 | 121 | 117 | 95 | 94 | 101 |
| Jenna | 109 | 107 | 110 | 108 | 107 | 127 | 114 | 112 | 106 | 114 | 111 |
| Kelby | 94 | 92 | 92 | 91 | 92 | 95 | 100 | 107 | 87 | 86 | 90 |
| Knudson | 116 | 108 | 112 | 102 | 103 | 101 | 96 | 94 | 107 | 103 | 105 |
| Kuntz | 95 | 94 | 93 | 99 | 101 | 108 | 98 | 100 | 104 | 104 | 100 |
| Marshall | 92 | 95 | 88 | 89 | 94 | 91 | 90 | 83 | 82 | 78 | 74 |

¹ Morris 2010 was a fungicide-treated trial. The 2008 trial was abandoned due to herbicide drift damage.

Table 5. (continued) Relative grain yield (as percent of the mean) of hard red spring wheat varieties in southern Minnesota locations in single- year (2010) and multiple-year comparisons (2008-2010).

| Variety | Lamberton | | | Morris ¹ | | St. Paul | | | Waseca | | |
|----------------|-----------|--------|--------|---------------------|--------|----------|--------|--------|--------|--------|--------|
| | 2010 | 2-Year | 3-Year | 2010 | 2-Year | 2010 | 2-Year | 3-Year | 2010 | 2-Year | 3-Year |
| Oklee | 102 | 104 | 101 | 105 | 106 | 86 | 94 | 100 | 102 | 102 | 101 |
| Pivot | 91 | — | — | 95 | — | 92 | — | — | 90 | — | — |
| RB07 | 86 | 92 | 94 | 94 | 94 | 118 | 107 | 107 | 106 | 103 | 105 |
| Sabin | 113 | 105 | 109 | 93 | 94 | 103 | 108 | 107 | 114 | 107 | 110 |
| Samson | 99 | 99 | 99 | 98 | 103 | 118 | 115 | 112 | 107 | 101 | 104 |
| Select | 104 | 96 | 98 | 102 | 107 | 113 | 108 | 107 | 97 | 96 | 99 |
| Tom | 97 | 98 | 99 | 94 | 88 | 98 | 98 | 100 | 86 | 94 | 91 |
| Vantage | 99 | 104 | 102 | 115 | 111 | 102 | 99 | 99 | 106 | 99 | 99 |
| WB-Digger | 101 | — | — | 89 | — | 84 | — | — | 90 | — | — |
| WB-Lyn | 97 | — | — | 93 | — | 107 | — | — | 95 | — | — |
| Mean (Bu/Acre) | 73.1 | 70.0 | 59.7 | 71.4 | 59.7 | 57.2 | 57.4 | 61.8 | 63.8 | 58.8 | 58.9 |
| LSD (0.10) | 11.3 | 14.2 | 11.9 | 12.9 | 9.8 | 18.8 | 18.0 | 13.5 | 10.6 | 12.9 | 10.8 |

¹ Morris 2010 was a fungicide-treated trial. The 2008 trial was abandoned due to herbicide drift damage.

Table 6. Relative grain yield (as percent of the mean) of hard red spring wheat varieties in Minnesota in single-year (2010) and multiple-year comparisons (2008-2010).

| Variety | State | | | North | | | South | | |
|------------------|-------|--------|--------|-------|--------|--------|-------|--------|--------|
| | 2010 | 2-Year | 3-Year | 2010 | 2-Year | 3-Year | 2010 | 2-Year | 3-Year |
| Ada | 96 | 97 | 97 | 100 | 99 | 99 | 87 | 92 | 90 |
| Albany | 121 | 118 | 114 | 122 | 118 | 115 | 120 | 120 | 116 |
| Barlow | 97 | 98 | 99 | 94 | 97 | 98 | 104 | 102 | 102 |
| Blade | 98 | 98 | 98 | 100 | 100 | 100 | 93 | 95 | 96 |
| Breaker | 101 | 100 | 101 | 102 | 100 | 100 | 98 | 100 | 101 |
| Brennan | 96 | 99 | 100 | 96 | 96 | 98 | 98 | 104 | 105 |
| Brick | 93 | 94 | 97 | 93 | 94 | 97 | 94 | 93 | 95 |
| Briggs | 92 | 93 | 94 | 89 | 92 | 94 | 99 | 96 | 96 |
| Brogan | 99 | 100 | — | 97 | 98 | — | 102 | 104 | — |
| Cromwell | 100 | 99 | 99 | 98 | 99 | 99 | 105 | 100 | 98 |
| Faller | 114 | 114 | 111 | 112 | 114 | 113 | 117 | 115 | 109 |
| Freyr | 100 | 100 | 100 | 102 | 101 | 100 | 96 | 99 | 99 |
| Glenn | 89 | 89 | 92 | 88 | 89 | 91 | 93 | 92 | 93 |
| Hat Trick | 94 | 95 | 96 | 95 | 97 | 98 | 90 | 88 | 88 |
| Howard | 100 | 103 | 102 | 96 | 100 | 100 | 109 | 108 | 109 |
| Jenna | 108 | 106 | 106 | 106 | 104 | 105 | 112 | 111 | 110 |
| Kelby | 94 | 93 | 96 | 95 | 93 | 94 | 92 | 92 | 96 |
| Knudson | 103 | 103 | 103 | 102 | 103 | 103 | 107 | 103 | 103 |
| Kuntz | 104 | 101 | 101 | 106 | 102 | 102 | 101 | 99 | 98 |
| Marshall | 90 | 91 | 88 | 91 | 91 | 89 | 88 | 90 | 83 |
| Oklee | 94 | 96 | 97 | 93 | 93 | 95 | 99 | 102 | 101 |
| Pivot | 102 | — | — | 107 | — | — | 92 | — | — |
| RB07 | 101 | 101 | 102 | 102 | 103 | 103 | 100 | 99 | 101 |
| Sabin | 100 | 101 | 102 | 99 | 100 | 101 | 105 | 104 | 106 |
| Samson | 107 | 107 | 107 | 108 | 107 | 107 | 104 | 105 | 105 |
| Select | 97 | 98 | 99 | 94 | 96 | 98 | 104 | 101 | 102 |
| Tom | 94 | 95 | 98 | 94 | 95 | 98 | 94 | 95 | 95 |
| Vantage | 103 | 101 | 99 | 102 | 101 | 99 | 106 | 104 | 102 |
| WB-Digger | 100 | — | — | 104 | — | — | 91 | — | — |
| WB-Lyn | 102 | — | — | 103 | — | — | 97 | — | — |
| Mean (Bu/Acre) | 75.9 | 74.7 | 75.6 | 80.6 | 82.7 | 84.5 | 66.4 | 61.4 | 60.1 |
| LSD (0.10) | 5.0 | 3.7 | 3.2 | 5.4 | 4.2 | 3.6 | 9.3 | 6.9 | 6.3 |
| No. Environments | 11 | 21 | 32 | 8 | 13 | 21 | 4 | 8 | 11 |

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

| Variety | North | | | | | | South | | | | | | State | | | | | |
|---------------------|-------|------|--------|------|--------|------|-------|------|--------|------|--------|------|-------|------|--------|------|--------|------|
| | 2010 | | 2-Year | | 3-Year | | 2010 | | 2-Year | | 3-Year | | 2010 | | 2-Year | | 3-Year | |
| | Conv | Int | Conv | Int | Conv | Int | Conv | Int | Conv | Int | Conv | Int | Conv | Int | Conv | Int | Conv | Int |
| Ada | 76.3 | 79.8 | 78.7 | 83.0 | 79.1 | 82.9 | 66.0 | 64.6 | 58.5 | 58.3 | 51.8 | 55.3 | 72.8 | 74.8 | 69.2 | 70.6 | 67.6 | 70.6 |
| Albany | 83.7 | 78.3 | 88.3 | 87.5 | 87.5 | 88.2 | 76.6 | 88.2 | 70.6 | 80.2 | 60.4 | 72.3 | 81.3 | 81.6 | 80.0 | 83.8 | 76.0 | 81.1 |
| Barlow | 64.9 | 74.9 | 73.3 | 81.1 | 75.1 | 80.8 | 81.7 | 91.2 | 65.8 | 72.8 | 58.7 | 65.4 | 70.5 | 80.3 | 69.8 | 77.0 | 68.1 | 73.9 |
| Blade | 69.7 | 79.5 | 75.5 | 82.4 | 78.7 | 83.0 | 71.5 | 69.7 | 59.9 | 62.7 | 55.6 | 57.8 | 70.3 | 76.2 | 67.7 | 72.5 | 68.4 | 71.8 |
| Breaker | 73.0 | 75.8 | 78.5 | 80.9 | 81.0 | 83.1 | 74.7 | 82.8 | 63.8 | 67.1 | 57.4 | 61.6 | 73.6 | 78.1 | 71.6 | 74.0 | 71.0 | 73.6 |
| Brennan | 63.8 | 69.8 | 70.5 | 79.1 | 75.9 | 84.5 | 77.4 | 82.8 | 66.9 | 73.2 | 61.6 | 67.8 | 68.3 | 74.1 | 68.7 | 76.1 | 69.6 | 77.1 |
| Brick | 66.2 | 73.5 | 68.0 | 78.1 | 73.3 | 80.9 | 69.5 | 79.5 | 58.5 | 65.6 | 54.9 | 61.0 | 67.3 | 75.5 | 63.5 | 71.8 | 65.5 | 72.1 |
| Briggs | 61.7 | 69.2 | 69.4 | 75.7 | 73.5 | 78.6 | 76.8 | 82.7 | 60.4 | 67.3 | 55.3 | 61.8 | 66.7 | 73.7 | 64.9 | 71.5 | 65.4 | 71.1 |
| Brogan | 62.7 | 68.2 | 70.0 | 75.4 | — | — | 75.1 | 75.6 | 66.0 | 67.2 | — | — | 66.9 | 70.6 | 68.0 | 71.3 | — | — |
| Cromwell | 73.1 | 84.4 | 78.1 | 86.2 | 80.6 | 87.3 | 79.1 | 84.8 | 63.3 | 67.8 | 56.3 | 60.8 | 75.1 | 84.5 | 70.7 | 77.0 | 69.8 | 75.5 |
| Faller | 80.6 | 89.3 | 89.2 | 95.6 | 92.4 | 97.4 | 82.2 | 84.1 | 71.6 | 77.1 | 64.2 | 69.5 | 81.1 | 87.5 | 80.4 | 86.4 | 79.9 | 85.0 |
| Freyr | 70.4 | 80.8 | 75.2 | 84.9 | 78.5 | 85.8 | 67.5 | 50.8 | 61.4 | 60.6 | 56.0 | 57.1 | 69.4 | 70.8 | 68.3 | 72.7 | 68.5 | 73.1 |
| Glenn | 58.0 | 64.2 | 63.8 | 68.6 | 70.5 | 75.3 | 80.0 | 90.5 | 60.0 | 67.2 | 54.2 | 60.4 | 65.3 | 73.0 | 61.9 | 67.9 | 63.3 | 68.6 |
| Hat Trick | 65.4 | 75.8 | 68.4 | 79.5 | 74.7 | 82.5 | 68.1 | 67.6 | 56.1 | 58.0 | 50.8 | 53.3 | 66.3 | 73.0 | 63.0 | 68.7 | 65.1 | 69.5 |
| Howard | 71.7 | 83.6 | 79.6 | 85.1 | 79.7 | 85.3 | 81.1 | 88.2 | 66.9 | 66.9 | 61.5 | 63.1 | 74.8 | 85.1 | 73.6 | 76.0 | 71.7 | 75.4 |
| Jenna | 71.8 | 81.7 | 78.7 | 87.8 | 81.3 | 87.1 | 80.0 | 71.1 | 67.0 | 68.7 | 61.9 | 64.7 | 74.6 | 78.1 | 72.8 | 78.2 | 72.7 | 77.1 |
| Kelby | 65.0 | 64.5 | 67.9 | 68.8 | 74.5 | 74.1 | 68.9 | 73.5 | 57.4 | 59.3 | 52.1 | 58.0 | 66.3 | 67.5 | 63.3 | 64.0 | 65.6 | 66.9 |
| Knudson | 73.1 | 80.0 | 79.8 | 86.5 | 80.7 | 84.4 | 84.7 | 93.7 | 66.9 | 73.3 | 62.5 | 68.3 | 76.9 | 84.6 | 73.4 | 79.9 | 72.6 | 77.3 |
| Kuntz | 72.6 | 76.8 | 74.6 | 80.4 | 80.0 | 81.7 | 69.1 | 74.5 | 60.7 | 68.6 | 54.2 | 62.7 | 71.4 | 76.0 | 67.3 | 74.5 | 68.1 | 72.9 |
| Marshall | 67.4 | 75.3 | 72.5 | 81.0 | 74.3 | 81.8 | 67.0 | 78.4 | 61.1 | 68.1 | 50.9 | 61.6 | 67.2 | 76.3 | 67.1 | 74.6 | 64.4 | 72.8 |
| Oklee | 64.9 | 66.5 | 71.3 | 71.4 | 75.2 | 76.8 | 74.8 | 83.2 | 66.3 | 69.4 | 57.9 | 63.3 | 68.2 | 72.1 | 68.9 | 70.4 | 67.9 | 70.8 |
| Pivot | 73.7 | 82.2 | — | — | — | — | 66.4 | 68.5 | — | — | — | — | 71.3 | 77.7 | — | — | — | — |
| RB07 | 68.8 | 83.6 | 75.0 | 86.8 | 79.4 | 87.1 | 63.1 | 68.1 | 58.2 | 63.8 | 53.7 | 59.9 | 66.9 | 78.4 | 66.6 | 75.3 | 67.5 | 75.0 |
| Sabin | 68.3 | 82.3 | 73.6 | 87.0 | 77.3 | 87.7 | 82.3 | 81.7 | 64.2 | 72.8 | 60.2 | 66.1 | 73.0 | 82.1 | 68.9 | 80.3 | 69.7 | 78.6 |
| Samson | 79.4 | 86.8 | 87.2 | 91.1 | 88.8 | 94.0 | 72.2 | 87.9 | 64.5 | 70.9 | 57.4 | 66.7 | 77.0 | 87.2 | 76.5 | 81.0 | 75.5 | 81.8 |
| Select | 62.9 | 64.0 | 70.7 | 73.3 | 76.0 | 78.2 | 76.3 | 82.7 | 62.8 | 72.4 | 57.1 | 66.7 | 67.4 | 70.2 | 67.0 | 72.9 | 68.0 | 73.6 |
| Tom | 64.3 | 69.8 | 69.6 | 73.4 | 74.6 | 78.9 | 70.6 | 65.1 | 58.4 | 59.7 | 54.0 | 55.7 | 66.4 | 68.3 | 64.0 | 66.5 | 65.4 | 68.6 |
| Vantage | 72.3 | 77.8 | 79.4 | 85.5 | 80.9 | 87.0 | 72.2 | 71.1 | 65.5 | 64.8 | 58.5 | 61.0 | 72.3 | 75.6 | 72.0 | 75.1 | 70.6 | 75.4 |
| WB-Digger | 75.3 | 78.7 | — | — | — | — | 73.8 | 65.5 | — | — | — | — | 74.8 | 74.3 | — | — | — | — |
| WB-Lyn | 68.1 | 81.8 | — | — | — | — | 70.7 | 75.3 | — | — | — | — | 69.0 | 79.6 | — | — | — | — |
| Mean (Bu/Acre) | 70.3 | 77.2 | 75.8 | 81.8 | 78.9 | 83.7 | 73.1 | 77.5 | 62.4 | 67.1 | 56.6 | 62.2 | 71.2 | 77.3 | 69.3 | 74.5 | 69.2 | 74.1 |
| LSD (0.10) | 7.9 | 10.5 | 6.3 | 7.7 | 5.1 | 5.9 | 8.3 | 9.6 | 6.9 | 8.7 | 5.7 | 7.3 | 7.9 | 10.8 | 4.9 | 6.1 | 4.0 | 4.7 |
| No. of Environments | 2 | 2 | 3 | 3 | 5 | 5 | 1 | 1 | 3 | 3 | 4 | 4 | 3 | 3 | 6 | 6 | 9 | 9 |