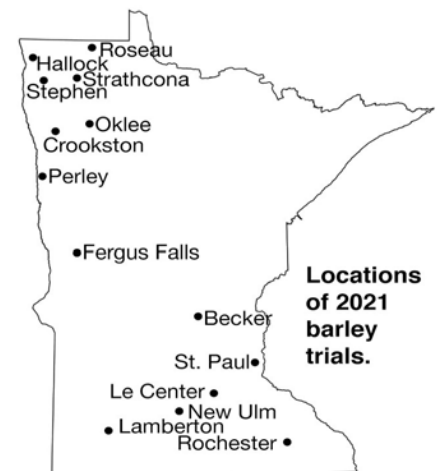


Spring barley varieties were evaluated in 2021 in replicated trials at Crookston, Hallock, Oklee, Perley, Stephen, Roseau, and Strathcona in the northern part of the state and Becker, Fergus Falls, Lamberton, Le Center, New Ulm, Rochester, and St. Paul in the south. Yield is reported for 2021 and multi-year averages as percent of the mean of the trial. Data collected from these trials should be used to make comparisons only among those varieties included in the trials. The average yield across the 14 testing

locations was 80 bu/acre in 2021. The highest yields this year were recorded in Stephen (114 bu/A) while the lowest grain yields were recorded in Becker (29 bu/A). LSD numbers beneath the yield columns indicate whether the difference between yields is due to genetics or to other factors, such as variations in environment. If yield difference between two entries equals or exceeds the LSD value, the higher-yielding entry probably was superior in yield. A difference less than the LSD value was probably due



to environmental factors.

Variety Selection Criteria

Most barley producers in the region grow barley for malt and select varieties approved by the American Malting Barley Association (AMBA). The most important industry specifications for making malting grade are low grain protein (11.5% - 13.5%), kernel plumpness (>80%) and low deoxynivalenol or DON content (<2 ppm). DON is the toxin produced by the Fusarium Head Blight (FHB) pathogen. Additional information about FHB can be found at <https://scabsmart.org>. Please consult the AMBA recommended varieties for the most current information about industry acceptance of malting barley varieties at www.ambainc.org. Variety selection will also be influenced by contracts made available by malting and brewing companies and these vary from year to year.

Table 1. Agronomic characteristics of malting barley varieties, 2019-2021.

| Entry | Origin ³ | Year of Release | PVP Status | Heading (DAP) | Height (inches) | Stem Breakage (%) | Plump (%) ⁴ | Protein (%) ⁴ |
|----------------------------|---------------------|-----------------|------------|---------------|-----------------|-------------------|------------------------|--------------------------|
| 2-row | | | | | | | | |
| AAC Connect ¹ | AAFC | 2017 | Yes | 59 | 28 | 13 | - | - |
| AAC Synergy | AAFC | 2012 | Yes | 60 | 28 | 16 | 92 | 11.4 |
| ABI Cardinal ² | ABI | 2021 | Yes | 61 | 28 | 9 | - | - |
| BC Ellinor ² | LCS/BC | NA | NA | 61 | 29 | 11 | - | - |
| BC Leandra ² | LCS/BC | NA | NA | 62 | 26 | 22 | - | - |
| BC Lexi ² | LCS/BC | NA | NA | 61 | 27 | 22 | - | - |
| Conlon | ND | 1996 | Yes | 56 | 27 | 56 | 92 | 12.3 |
| KWS Fantex ¹ | KWS | NA | Pending | 62 | 26 | 25 | - | - |
| ND Genesis | ND | 2015 | Yes | 59 | 29 | 20 | 96 | 11.2 |
| 6-row | | | | | | | | |
| Lacey | MN | 2000 | Yes | 57 | 30 | 0 | 92 | 12.4 |
| Quest ¹ | MN | 2010 | Yes | 57 | 30 | 63 | - | - |
| Rasmusson ¹ | MN | 2008 | Yes | 57 | 28 | 0 | 92 | 11.3 |
| Robust | MN | 1984 | Expired | 57 | 32 | 7 | 92 | 11.8 |
| Tradition | ABI | 2003 | Yes | 56 | 30 | 0 | 91 | 12.9 |
| No. of Environments | | | | 8 | 8 | 6 | 3 | 3 |

¹Line tested in 2020 and 2021.

²Line tested in 2021 only.

³Agriculture and Agri-Food Canada (AAFC), Anheuser-Busch InBev (ABI), Limagrain Breun (LCS/BC), North Dakota State University (ND), KWS Lochow GmbH (KWS), University of Minnesota (MN).

⁴Data available from 3 locations in 2019 only.

Table 2. Disease reactions of barley varieties in multiple-year comparisons.

| Entry | DON ^{3,4} | Spot Blotch ^{3,4} | Stem Rust ^{3,5} | Bacterial Leaf Streak ³ |
|----------------------------|--------------------|----------------------------|--------------------------|------------------------------------|
| 2-row | | | | |
| AAC Connect ¹ | 3 | 1 | 4 | 3 |
| AAC Synergy | 8 | 1 | 5 | 3 |
| ABI Cardinal ² | - | - | 4 | 4 |
| BC Ellinor ² | - | - | 7 | 3 |
| BC Leandra ² | - | - | 7 | 4 |
| BC Lexi ² | - | - | 6 | 2 |
| Conlon | 1 | 7 | 3 | 5 |
| KWS Fantex ¹ | 3 | 9 | 4 | 6 |
| ND Genesis | 4 | 2 | 6 | 5 |
| 6-row | | | | |
| Lacey | 5 | 0 | 5 | 5 |
| Quest ¹ | 3 | 4 | 4 | 5 |
| Rasmusson ¹ | 7 | 0 | 6 | 5 |
| Robust | 7 | 0 | 4 | 4 |
| Tradition | 2 | 1 | 4 | 6 |
| No. of Environments | 4 | 2 | 3 | 3 |

¹Line tested in 2020 and 2021.

²Line tested in 2021 only.

³Trait measured on a scale from 0-9 where 1=resistant and 9=susceptible, NA=not available. Deoxynivalenol (DON) is the mycotoxin produced by the Fusarium head blight pathogen.

⁴Data for 2019 and 2020 only.

⁵Data is for stem rust pathogen QCCJ. All lines were resistant to stem rust pathogen MCCF in years tested.

In addition to yield and acceptable malt quality, disease resistance plays an important role in variety selection. Disease evaluations are carried out in inoculated field and/or greenhouse experiments. Disease ratings are based on the results of two or more experiments and are scored on a 1–9 scale where 1 = most resistant and 9 = most susceptible. For most producers the disease FHB and the presence of DON in harvested grain are the two most important factors limiting production of malting barley in the region. The two-rowed variety Conlon and six-rowed varieties Quest and Tradition have the lowest DON score (the mycotoxin produced by the Fusarium head blight pathogen) compared to the other varieties grown in the region. The varieties AAC Connect and KWS Fantex also had low ratings, but they are based on a single year (2020) and should be interpreted cautiously.

The other diseases listed in the disease reactions table are leaf diseases that

Table 3. Relative grain yield of barley varieties in northern Minnesota locations in single-year (2021) and multiple-year comparisons (2019-2021).

| Entry | Crookston | | | Hallock | | | Oklee | | | Perley | | | Roseau | | Stephen | | | Strathcona | | |
|---------------------------|-------------|-------------------|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------------|-------------|-------------|-------------|------------|-----------|-----------|
| | 2021 | 3 Yr ³ | | 2021 | 2 Yr | 3 Yr | 2021 | 2 Yr | 3 Yr | 2021 | 2 Yr | 3 Yr | 2021 | 3 Yr ³ | 2021 | 2 Yr | 3 Yr | 2021 | 2 Yr | 3 Yr |
| 2-row | | | | | | | | | | | | | | | | | | | | |
| AAC Connect ¹ | 102 | - | | 108 | 113 | - | 98 | 98 | - | 116 | 109 | - | 95 | - | 99 | 97 | - | 104 | 130 | - |
| AAC Synergy | 96 | 102 | | 100 | 107 | 106 | 95 | 106 | 102 | 103 | 103 | 101 | 104 | 104 | 112 | 110 | 103 | 93 | 123 | 127 |
| ABI Cardinal ² | 109 | - | | 114 | - | - | 98 | - | - | 97 | - | - | 106 | - | 98 | - | - | 92 | - | - |
| BC Ellinor ² | 114 | - | | 102 | - | - | 110 | - | - | 104 | - | - | 114 | - | 117 | - | - | 104 | - | - |
| BC Leandra ² | 111 | - | | 101 | - | - | 114 | - | - | 119 | - | - | 99 | - | 102 | - | - | 101 | - | - |
| BC Lexi ² | 97 | - | | 102 | - | - | 106 | - | - | 99 | - | - | 114 | - | 99 | - | - | 112 | - | - |
| Conlon | 82 | 92 | | 97 | 97 | 99 | 101 | 92 | 94 | 87 | 91 | 89 | 105 | 99 | 99 | 110 | 104 | 102 | 67 | 67 |
| KWS Fantex ¹ | 110 | - | | 102 | 103 | - | 97 | 95 | - | 84 | 89 | - | 101 | - | 95 | 92 | - | 94 | 123 | - |
| ND Genesis | 105 | 112 | | 97 | 94 | 103 | 111 | 110 | 109 | 116 | 115 | 109 | 104 | 104 | 97 | 101 | 100 | 106 | 88 | 108 |
| 6-row | | | | | | | | | | | | | | | | | | | | |
| Lacey | 98 | 104 | | 88 | 86 | 87 | 109 | 101 | 99 | 99 | 96 | 98 | 101 | 108 | 99 | 103 | 101 | 100 | 96 | 107 |
| Quest ¹ | 92 | - | | 91 | 87 | - | 92 | 97 | - | 91 | 94 | - | 78 | - | 93 | 95 | - | 96 | 100 | - |
| Rasmusson ¹ | 102 | - | | 114 | 108 | - | 102 | 100 | - | 104 | 97 | - | 109 | - | 83 | 87 | - | 99 | 109 | - |
| Robust | 92 | 92 | | 90 | 94 | 97 | 79 | 92 | 93 | 85 | 95 | 96 | 80 | 91 | 101 | 102 | 95 | 95 | 78 | 92 |
| Tradition | 89 | 98 | | 94 | 111 | 108 | 89 | 108 | 104 | 96 | 112 | 108 | 90 | 94 | 105 | 102 | 98 | 102 | 87 | 98 |
| Mean (Bu/Acre) | 90 | 104 | | 101 | 97 | 85 | 61 | 90 | 90 | 111 | 102 | 98 | 74 | 86 | 114 | 97 | 105 | 89 | 75 | 75 |
| LSD (0.05) | 14.7 | 12.4 | | 20.7 | 21.5 | 19.3 | 17.5 | 20.4 | 16.1 | 14.3 | 26.1 | 17.8 | 18.9 | 16.2 | 24.4 | 16.7 | 13.5 | 8.8 | 55 | 35 |

¹Line tested in 2020 and 2021.

²Line tested in 2021 only.

³Trial data is from 2019 and 2021 only.

can be a problem in Minnesota. Pinnacle is very susceptible to net blotch (data not shown). All varieties have resistance to the dominant race of stem rust (MCCF) and are susceptible to the QCCJ race also known as African stem rust or Ug99. FHB severity and DON can be reduced with fungicides, but they are not always effective. Bacterial leaf streak disease has become more prominent in recent years and tends to become more severe following heavy rain events. This disease cannot be controlled with fungicides.

PVP Status

All varieties shown in tables except Robust, Conlon and AC Metcalf are

covered by the Plant Variety Protection Act, PVP (94). Growers can save seed of PVP protected varieties for their own planting only; it cannot be sold to anyone else, not even a relative or a neighbor without specific permission of the applicant for protection.

Authors

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Researchers

Guillermo Velasquez, Curtis Reese, Joseph Wodarek, Mike Leiseth, Steve Quiring and Donn Vellekson supervised and carried out test plot establishment and management.

Barley

Planting Rate and Date

| | |
|----------------------------------|--------------|
| Bushel Weight, Pounds..... | 48 |
| Seeds/Pound..... | 14,300 |
| Planting Rate, Pounds/Acre..... | 85 |
| Planting Rate, Seeds/Sq. Ft..... | 28 |
| Planting Date..... | Early Spring |

Table 4. Relative grain yield of barley varieties in southern Minnesota locations in single-year (2021) and multiple-year comparisons (2019-2021).

| Entry | Becker | Fergus Falls | | | Lamberton | | Le Center | | | New Ulm | | Rochester | | | St. Paul | | |
|---------------------------|-------------------|--------------|-------------|------------|-------------------|-------------------|-------------|-------------|-----------|-------------|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | 2021 ³ | 2021 | 2 Yr | 3 Yr | 2021 ² | 2 Yr ⁴ | 2021 | 2 Yr | 3 Yr | 2021 | 2 Yr ⁴ | 2021 | 2 Yr | 3 Yr | 2021 | 2 Yr | 3 Yr |
| 2-row | | | | | | | | | | | | | | | | | |
| AAC Connect ¹ | 93 | 100 | 108 | - | 102 | 102 | 110 | 101 | - | 108 | 107 | 111 | 88 | - | 102 | 111 | - |
| AAC Synergy | 142 | 98 | 103 | 100 | 101 | 109 | 89 | 99 | 101 | 73 | 90 | 95 | 100 | 100 | 100 | 115 | 117 |
| ABI Cardinal ² | 131 | 115 | - | - | 114 | - | 83 | - | - | 96 | - | 68 | - | - | 94 | - | - |
| BC Ellinor ² | 112 | 105 | - | - | 96 | - | 101 | - | - | 103 | - | 96 | - | - | 123 | - | - |
| BC Leandra ² | 113 | 107 | - | - | 120 | - | 108 | - | - | 101 | - | 101 | - | - | 130 | - | - |
| BC Lexi ² | 106 | 95 | - | - | 88 | - | 104 | - | - | 108 | - | 111 | - | - | 122 | - | - |
| Conlon | 61 | 94 | 91 | 89 | 86 | 83 | 106 | 95 | 97 | 89 | 91 | 91 | 83 | 79 | 82 | 73 | 72 |
| KWS Fantex ¹ | 88 | 85 | 97 | - | 68 | 77 | 82 | 99 | - | 76 | 88 | 85 | 81 | - | 137 | 125 | - |
| ND Genesis | 120 | 96 | 101 | 105 | 102 | 99 | 105 | 107 | 108 | 114 | 107 | 109 | 101 | 102 | 91 | 105 | 111 |
| 6-row | | | | | | | | | | | | | | | | | |
| Lacey | 96 | 104 | 98 | 99 | 109 | 111 | 103 | 99 | 99 | 116 | 109 | 107 | 110 | 112 | 77 | 100 | 107 |
| Quest ¹ | 125 | 99 | 96 | - | 122 | 97 | 104 | 104 | - | 107 | 100 | 109 | 104 | - | 75 | 89 | - |
| Rasmusson ¹ | 89 | 102 | 106 | - | 112 | 117 | 102 | 103 | - | 109 | 111 | 126 | 120 | - | 101 | 105 | - |
| Robust | 63 | 98 | 96 | 99 | 89 | 96 | 97 | 90 | 92 | 99 | 93 | 89 | 103 | 98 | 64 | 84 | 92 |
| Tradition | 60 | 101 | 104 | 108 | 90 | 108 | 104 | 105 | 103 | 100 | 104 | 104 | 109 | 108 | 101 | 94 | 102 |
| Mean (Bu/Acre) | 29 | 81 | 96 | 79 | 58 | 62 | 70 | 88 | 86 | 99 | 84 | 84 | 95 | 90 | 57 | 71 | 66 |
| LSD (0.05) | 8.1 | 10.8 | 15.9 | 9.9 | 13 | 21.1 | 10.4 | 20.1 | 12 | 11.3 | 31.9 | 10.4 | 28.9 | 16.4 | 13.6 | 23.4 | 18.1 |

¹Line tested in 2020 and 2021.

²Line tested in 2021 only.

³Trial data is from 2021 only.

⁴Trial data is from 2021 and 2020 only.

Table 5. Relative grain yield of barley varieties in a single-year (2021) and multiple-year comparisons (2019-2021).

| Entry | State | | | North | | | South | | |
|----------------------------|------------|------------|------------|------------|-------------|------------|------------|------------|-----------|
| | 2021 | 2 Yr | 3 Yr | 2021 | 2 Yr | 3 Yr | 2021 | 2 Yr | 3 Yr |
| 2-row | | | | | | | | | |
| AAC Connect ¹ | 104 | 105 | - | 104 | 108 | - | 105 | 102 | - |
| AAC Synergy | 98 | 106 | 105 | 101 | 108 | 106 | 94 | 103 | 104 |
| ABI Cardinal ² | 100 | - | - | 102 | - | - | 96 | - | - |
| BC Ellinor ² | 107 | - | - | 109 | - | - | 104 | - | - |
| BC Leandra ² | 108 | - | - | 107 | - | - | 110 | - | - |
| BC Lexi ² | 104 | - | - | 103 | - | - | 105 | - | - |
| Conlon | 93 | 90 | 89 | 96 | 93 | 92 | 90 | 86 | 85 |
| KWS Fantex ¹ | 93 | 98 | - | 97 | 101 | - | 87 | 94 | - |
| ND Genesis | 105 | 104 | 106 | 105 | 103 | 106 | 105 | 104 | 106 |
| 6-row | | | | | | | | | |
| Lacey | 101 | 101 | 102 | 98 | 97 | 100 | 104 | 104 | 106 |
| Quest ¹ | 97 | 97 | - | 91 | 94 | - | 105 | 100 | - |
| Rasmusson ¹ | 104 | 105 | - | 101 | 101 | - | 108 | 110 | - |
| Robust | 90 | 93 | 94 | 90 | 92 | 94 | 89 | 93 | 94 |
| Tradition | 97 | 103 | 103 | 96 | 103 | 102 | 98 | 103 | 105 |
| Mean (Bu/Acre) | 80 | 84 | 84 | 92 | 91 | 92 | 68 | 78 | 75 |
| LSD (0.05) | 6.1 | 6.6 | 4.8 | 7.8 | 10.6 | 7.5 | 9.5 | 7.9 | 6 |
| No. of Environments | 14 | 25 | 36 | 7 | 12 | 19 | 7 | 13 | 17 |

¹Line tested in 2020 and 2021.²Line tested in 2021 only.