

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
MIDWEST AREA
CEREAL CROPS RESEARCH UNIT

**MISSISSIPPI VALLEY REGIONAL SPRING BARLEY NURSERY
2008 Crop**

Preliminary Quality Report

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Detailed Data:

| | |
|----------------|---------------|
| Crookston, MN | Bottineau, ND |
| Carrington, ND | Fargo, ND |
| Aberdeen, ID | |

Appendix:

Methods

Criteria for Quality Score

This is a joint progress report of cooperative investigations being conducted in the Agricultural Research Service of the U.S. Department of Agriculture and State Agricultural Experiment Stations. It contains preliminary data that have not been sufficiently confirmed to justify general release; interpretations may be modified with additional experimentation. Confirmed results will be published through established channels. The report is primarily a tool available to cooperators and their official staffs and for those persons who are interested in the development of improved barleys.

This report includes data furnished by the Agricultural Research Service and by the State Agricultural Experiment Stations. The report is not intended for publication and should not be referred to in literature citations nor quoted in publicity or advertising. Use of the data may be granted for certain purposes upon written request to the agency or agencies involved.

Samples were malted and analyzed by the Cereal Crops Research Unit,
Madison, WI

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Mississippi Valley Regional Spring Barley Nursery – 2008 Crop

Nursery samples were received for malting quality evaluation from four experimental stations located in Minnesota and North Dakota. The parentages of the nursery entries are listed in Table 1. Fourteen of the thirty-eight entries were new in this year's nursery.

These samples were germinated for four days in Joe White micro-malters under conditions that should generate malts having modification levels similar to those produced by industry. Detailed descriptions of the malting conditions and analytical methods employed are listed in Appendix A. The criteria and value assignments, based upon AMBA guidelines (<http://www.ambainc.org/ni/Guidelines.pdf>) used to calculate quality scores are listed in Appendix B.

The mean values for fifteen quality factors are listed over the four stations located in the Mississippi Valley Region (Table 2) and over all lines (Table 3). Data on the nursery lines from an additional station (Aberdeen, ID) located outside the Mississippi Valley Region was generated and that data was combined with the other locations and is presented in Tables 9 and 10. Individual station data are reported in Tables 4 through 8. Evaluations of data from individual locations and overall performance (derived primarily from Tables 2, 3, 8 and 9) are also presented.

The barleys from Aberdeen, ID (Table 4) were plump and generally had very good protein contents. Extract and soluble protein values were very good, but a quarter of the S/T ratios were too high. Most amylolytic values were good, but a quarter of the free amino nitrogen (FAN) levels were too low, with many of these being the experimental controls. A quarter of the β -glucan and viscosity values were too high. The best performers were SR412, 6B02-3120, M137, 2ND21867, ND23497, 6B04-007, SR425, M132, M134 and Tradition. All of these lines showed excellent malting quality, with very few deficiencies. 6B04-007 had a viscosity that was just on the upper edge of the "ideal" range. 2ND21867 and

M134 had FAN values that were slightly below the desired minimum, while M132 had slightly elevated turbidity and viscosity values.

The barleys submitted from Crookston, MN (Table 5) were very plump, with good protein levels. Extract values were generally good, averaging 80.6%. Wort protein levels were generally good and most S/T ratios fell within the desired range. However, nearly half of the diastatic power levels fell below desired limits and half of the β -glucan levels were too high. Most of the viscosity and turbidity values exceeded desired limits, including many of the experimental controls. The best performers were ND23898, ND23497, 6B02-3435, M132 and 2ND24263. ND23898 met AMBA's "ideal" criteria for all quality parameters, except for a viscosity value that was just above the upper limit. ND23497 and M132 had elevated turbidity and viscosity values. 2ND24263 appeared to be a bit under-modified by our standard malting protocol. As a result, this line had elevated β -glucan and viscosity values, while FAN and S/T were good, but low. All of these values would improve with better modification.

Twenty per cent of the barleys from Bottineau, ND (Table 6) had elevated protein contents. Extract values averaged 2% lower than at the other locations, with a third falling below the minimum desired value. Wort protein levels ranged from one that was a bit low to ten that exceeded the desired limits. S/T ratios were quite variable at this location, with 11 that were too high and 18 that fell below the desired limits. Most amylolytic, turbidity and FAN levels were good, while β -glucan and viscosity values were notably low, indicating excessive carbohydrate modification. The best performers were Lacey, 6B02-3120, ND20448, M128, SR412, 6B03-4478 and ND24388. All quality parameters of Lacey, ND20448 and M128 were within desired limits. 6B02-3120 performed well, with only a slightly elevated color value of note. SR412 had slightly elevated color and turbidity values. 6B03-4478 had a slightly elevated F-C, however very low β -glucan and viscosity values would indicate this line was well modified. Though 2ND24388 had a low S/T ratio, the soluble and total protein levels were within the "ideal" ranges and its FAN value was also good, suggesting sufficient protein modification.

The plump barleys from Carrington, ND (Table 7) averaged 13.5% total protein. Eleven lines exceeded the maximum limits, while Pinnacle and ND23311 were a full 2% lower than the average. Extract values were generally good, with the best values being generated by some of the newly introduced North Dakota 2-rowed submissions. A third of the F-C differences were above the desired limit, while three quarters of the β -glucan and viscosity values exceeded the upper limits, indicating insufficient carbohydrate modification for most of these lines. Color values were very good and all worts were clear. Only two turbidities slightly exceeded AMBA's "ideal" upper limit of 10 nephelometric turbidity units. Soluble protein values were generally high, with 21 exceeding the maximum limits. Sixteen S/T ratios were high, indicating excessive protein modification. Nearly all of the amylolytic values were good. The best performers were Lacey, 2ND24388, M134, Pinnacle, Stellar, 6B04-007, ND23422, SR425, 2ND21867 and 6B02-3120. Lacey's malt quality parameters were within AMBA's "ideal" range, with the exception of a slightly elevated soluble protein value. 2ND24388 and 2ND24393 had excellent extract values near 83.0%. Slightly elevated β -glucan values indicated the need for a bit more modification than occurred with our standard malting protocol. M134 and Pinnacle had excellent malt quality, except for elevated β -glucan and viscosity values. Stellar had slightly elevated soluble protein, β -glucan and viscosity values. 6B04-007 had elevated viscosity and β -glucan values. This line had remarkable similarity to Tradition. ND23422 had a modest, but acceptable amylolytic profile. Note the elevated viscosity and β -glucan values. SR425 had an excellent β -glucan level, but its soluble protein level was elevated resulting in an unacceptably high S/T ratio. 2ND21867 had a very good extract value, but its slightly elevated soluble protein value generated an unacceptably high S/T ratio. This line had elevated β -glucan contents suggesting unbalanced modification. 6B02-3120 had slightly elevated soluble protein, β -glucan and viscosity values.

Most of the plump barleys from Fargo, ND (Table 8) had unacceptably high protein contents. Extract values were very good, especially considering the high total protein values. Most soluble protein values exceeded the desired limit

and elevated FAN and S/T values indicated excessive protein modification. Most F-C values were good, however about half of the β -glucan and viscosity values were too high, suggesting less than optimal carbohydrate modification. Most amyolytic and turbidity values were good. The best performers were Pinnacle, 6B04-007, 2ND24388, 2ND24393, Conlon, SR424, SR425, M134 and ND23422. Pinnacle had an exceptional extract of 83%, but had an elevated β -glucan value. 6B04-007 had elevated soluble protein and viscosity values. 2ND24388 had an excellent extract value of 83.7%, but was turbid and had elevated β -glucan contents. 2ND24393 and Conlon had elevated β -glucan levels. SR424 and SR425 had elevated total and soluble protein levels. M134 and ND23422 had elevated protein and β -glucan levels.

The overall performance of the nursery (Table 2) was good at all locations, including Aberdeen, ID (Table 9), which is located outside the Mississippi Valley Region. The submissions were very plump and had excellent extract values, except for those lines submitted from Bottineau. The submissions from Fargo scored poorest, mostly due to the elevated protein levels. Crookston submissions had the lowest protein contents, which adversely impacted the diastatic power levels. The turbidity levels of most lines grown at Crookston were unacceptably high and most viscosity values were above the desired limit. Bottineau submissions generally had very low β -glucan and viscosity values suggesting excessive carbohydrate modification. The mean values of all parameters reported from those lines grown at Aberdeen fell within the range of AMBA's "ideal" commercial malt quality criteria, which factored into this location having the highest quality score.

The best performers in the nursery (Table 3) were 2ND24388, Lacey, Pinnacle, Stellar, 6B04-0007 and 6B02-3435. 2ND24388 was plump and had an excellent mean protein value of 12.5%. This line had an exceptional extract value and appeared to have balanced modification, although this line was slightly under-modified by our standardized malting protocol. As a result this line had an S/T of 42.4%, which is on the low end of "ideal" and also had a slightly elevated mean β -glucan value. A concern of note would be that this line generated hazy

worts from 3 of the 5 locations in this nursery. Lacey and Stellar both performed well. These barleys were plump, had good protein contents and malt quality parameters that fell within the “ideal” range for commercial malt criteria. Both lines had elevated mean turbidity levels, mostly due to the hazy worts generated from the Crookston submissions. Pinnacle was plump and its protein contents averaged nearly 2% less than that of Conlon. This line had good extract, with sufficient amylolytic activity and soluble protein levels. Beta-glucan and viscosity values were a bit high, indicating the malt was under-modified by our standard malting protocol. 6B04-007 performed well in three of five locations. Protein modification was slow at Bottineau, while the wort of the Crookston submission was hazy. This line had moderate extract values, ample amylolytic activity, good soluble protein, S/T and free amino nitrogen values. Mean β -glucan, viscosity and turbidity values were slightly elevated, but not to a point of concern. Turbidity values were good in worts from 4 of 5 locations. Other lines, such as SR412, 6B02-3120 and ND23422, performed very well at some locations, but not so well at others.

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Table 1

| Entry# | CI # or Contributor | Name | Parentage |
|--------|---------------------|-----------------|--|
| 1. | 15773 | Morex | Cree/Bonanza |
| 2. | 476976 | Robust | Morex/Manker |
| 3. | Busch Ag. Res. | Legacy | Bumper/Karl//Bumper/Manker/3/Bumper/Karl/4/Excel |
| 4. | PI 613603 | Lacey | M78/M79 |
| 5. | North Dakota | Conlon | Bowman*2/Brigitta mutant//ND10232 |
| 6. | Busch Ag. Res. | Tradition | 6B89-2126/ND10981 |
| 7. | North Dakota | Stellar-ND | Foster//ND12200/6B88-3213 |
| 8. | North Dakota | ND20448 | ND16918/C98-10-155-3 |
| 9. | North Dakota | Pinnacle | ND1872/ND19130 |
| 10. | Minnesota | M128 | FEG26-50 / FEG18-27 |
| 11. | Minnesota | M129 | FEG59-09 / M110 |
| 12. | North Dakota | 2ND21867 | ND18172 / ND19130 |
| 13. | North Dakota | 2ND22927 | Rawson sib / ND19931 |
| 14. | Saskatchewan | SR412 (SM03219) | BT459 / BT941 |
| 15. | Minnesota | M130 | FEG26-50 / FEG18-27 |
| 16. | Minnesota | M132 | M96-203 / FEG55-14 |
| 17. | North Dakota | ND22421 | ND18546 / ND19656 |
| 18. | North Dakota | ND23311 | ND19656 / ND19718 |
| 19. | North Dakota | 2ND22182 | ND18413 / ND19134 // ND19164 |
| 20. | Busch Ag. Res. | 6B02-3120 | 6B94-7378 // 6B94-7378 / 6B95-2089 |
| 21. | Busch Ag. Res. | 6B02-3435 | 6B97-2262 / 6B96-3286 |
| 22. | Busch Ag. Res. | 6B03-4478 | 6B98-9438 / 6B97-2311 |
| 23. | Saskatchewan | SR417 (SM04166) | SM99250 / SM99142 |
| 24. | Saskatchewan | SR420 (SM04175) | SM99748 / SM99153 |
| 25. | Minnesota | M134 | FEG69-38 / M114 |
| 26. | Minnesota | M137 | ND20493 / Rasmusson |
| 27. | North Dakota | ND23422 | ND18546/ND20380 |
| 28. | North Dakota | ND23497 | Drummond/ND20414 |
| 29. | North Dakota | ND23753 | ND18546/ND20407 |
| 30. | North Dakota | ND23898 | Drummond/ND17643 |
| 31. | North Dakota | 2ND24263 | 2ND19869/3/2ND18998//2ND16092/2ND17263 |
| 32. | North Dakota | 2ND24388 | 2ND17274/Rawson//2ND19854 |
| 33. | North Dakota | 2ND24393 | 2ND17274/Rawson//2ND19854 |
| 34. | Busch Ag. Res. | 6B03-4301 | 6B98-9022 // 6B94-8253 / 6B97-2245 |
| 35. | Busch Ag. Res. | 6B04-0007 | TRADITION // 6B96-3373 / DRUMMOND |
| 36. | Busch Ag. Res. | 6B04-0075 | 6B95-2089 // 6B97-2232 / 6B98-9022 |
| 37. | Saskatchewan | SR424 | SM01262/SM01147 |
| 38. | Saskatchewan | SR425 | SM00207/SM00150 |

*Entries 25-38 are new for 2008.

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Table 2 - Station Means* of Barley and Malt Quality Factors for 38 Varieties or Selections.**

| LOCATION | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F - C (%) | Wort Color | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (HACH) | Quality Score |
|----------------|--------------------|---------------|-----------------------|------------------|---------------|---------------|--------------------|------------------|---------------|--------------|-----------------------|-------------------|----------------|----------------------|------------------|---------------|
| Crookston, MN | 38.5 A | 98.3 A | 41 B | 80.6 A | 0.8 BC | 3.4 A | 11.8 D | 5.14 D | 45.0 C | 122 C | 46.8 C | 165.2 B | 196.2 C | 1.52 A | 33.6 A | 47 |
| Bottineau, ND | 35.0 C | 91.8 C | 56 A | 78.3 B | 0.9 AB | 2.3 BC | 13.2 C | 5.55 C | 43.4 D | 171 B | 59.8 B | 55.3 C | 215.9 B | 1.45 C | 8.6 B | 48 |
| Carrington, ND | 36.1 B | 91.8 C | 37 D | 80.6 A | 1.0 A | 2.1 C | 13.5 B | 6.08 B | 46.6 B | 193 A | 70.9 A | 217.5 A | 267.2 A | 1.51 A | 7.3 B | 47 |
| Fargo, ND | 36.5 B | 95.4 B | 40 C | 80.7 A | 0.8 C | 2.4 B | 14.1 A | 6.56 A | 48.1 A | 177 B | 71.6 A | 180.5 B | 265.0 A | 1.50 B | 9.5 B | 43 |

* Within each column, means followed by the same letter are not significantly different ($\alpha=0.05$), according to Duncan's Multiple Range test.

** Morex, Robust, Legacy, Lacey, Conlon, Tradition, Stellar, ND20448, Pinnacle, M128, M129, 2ND21867, 2ND22927, SR412, M130, M132, ND22421, ND23311, ND22182, 6B02-3120, 6B02-3435, 6B03-4478, SR 417, SR 420, M134, M137, ND23422, ND23497, ND23753, ND23898, 2ND24263, 2ND24388, 2ND24393, 6B03-4301, 6B04-0007, 6B04-0075, SR424, SR425

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Table 3 - Varietal Means* of Barley and Malt Quality Factor for Four Stations**

| Variety or Selection | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F - C (%) | Wort Color | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (HACH) | Quality Score | | | | | | | | | | | | | | | |
|----------------------|--------------------|--------------|-----------------------|------------------|-----------|---------------|--------------------|------------------|------------|------------|-----------------------|-------------------|-------------|----------------------|------------------|---------------|-------------|----------------|------------|--------------|-------------|---------------|------------|-----------------|------------|------------------|-------------|---------------|-------------|--------------|-----------|
| Morex | 31.6 | K | 86.1 | H | 43 | BCDEFG | 78.3 | L | 0.8 | ABC | 2.3 | DEFGHIJ | 14.2 | AB | 5.97 | DEFGH | 43.0 | HIJKL | 198 | ABCDE | 69.6 | B | 80 | IJ | 251 | CDEFGHI | 1.46 | H | 14.8 | BCDE | 43 |
| Robust | 34.2 | FGHIJ | 92.2 | DEFG | 44 | ABCDE | 79.5 | GHIJK | 1.1 | ABC | 1.8 | IJ | 13.5 | ABCDEFG | 5.74 | FGHI | 44.3 | FGHIJK | 172 | EFGH | 50.6 | I | 195 | BCDEF | 233 | FGHIJKLM | 1.48 | DEFGH | 6.2 | E | 40 |
| Legacy | 33.4 | HIJK | 92.9 | BCDEFG | 46 | AB | 80.0 | GHIJ | 0.8 | ABC | 3.1 | BCDE | 13.4 | BCDEFGH | 6.47 | ABC | 49.4 | ABCD | 176 | CDEFG | 69.2 | B | 104 | GHIJ | 278 | ABC | 1.48 | DEFGH | 13.6 | BCDE | 45 |
| Lacey | 35.3 | FGHI | 94.5 | ABCDEF | 45 | ABCD | 80.2 | EFGH | 0.9 | ABC | 2.4 | DEFGHIJ | 12.8 | GHIJ | 5.81 | EFGHI | 46.1 | DEFGHI | 176 | DEF | 63.1 | BCDEFG | 98 | GHIJ | 235 | EF | 1.46 | GH | 17.4 | ABCDE | 52 |
| Conlon | 42.6 | CD | 97.3 | ABC | 40 | FGHI | 80.4 | DEFG | 1.3 | A | 1.8 | IJ | 13.2 | DEFGHI | 5.19 | JKLM | 40.4 | L | 144 | H | 63.4 | BCDEFG | 196 | BCDEF | 186 | OP | 1.46 | FGH | 9.4 | DE | 44 |
| Tradition | 34.9 | FGHI | 94.9 | ABCDEF | 47 | AB | 79.9 | GHIJ | 0.9 | ABC | 2.1 | FGHIJ | 13.1 | DEFGHIJ | 5.44 | IJKL | 42.8 | HIJKL | 205 | ABC | 65.5 | BCD | 134 | DEFGHIJ | 217 | JKLMNO | 1.50 | ABCDE | 17.4 | ABCDE | 46 |
| Stellar | 34.9 | FGHI | 93.9 | ABCDEF | 44 | ABCDE | 80.4 | DEFG | 0.9 | ABC | 2.8 | CDEFGH | 13.2 | DEFGHI | 5.85 | DEFGHI | 46.1 | DEFGHI | 201 | ABCD | 63.7 | BCDEFG | 87 | HIJ | 236 | EF | 1.50 | ABCD | 21.9 | ABCD | 51 |
| ND20448 | 34.4 | FGHI | 95.0 | ABCDEF | 47 | A | 79.8 | GHIJ | 0.9 | ABC | 2.2 | EFGHIJ | 13.4 | BCDEFGH | 5.99 | DEFGH | 46.7 | BCDEFG | 182 | BCDEF | 65.8 | BCD | 101 | GHIJ | 249 | CDEFGHIJ | 1.50 | ABCDE | 15.2 | BCDE | 49 |
| Pinnacle | 44.2 | BC | 97.7 | AB | 39 | HI | 81.5 | BC | 0.9 | ABC | 2.0 | GHIJ | 11.5 | KL | 4.83 | M | 42.9 | HIJKL | 117 | I | 55.3 | HI | 197 | BCDEF | 186 | OP | 1.51 | ABCD | 11.5 | BCDE | 52 |
| M128 | 35.4 | FGHI | 93.7 | ABCDEF | 47 | AB | 80.3 | DEFG | 0.6 | BC | 2.8 | CDEFG | 13.2 | DEFGHI | 6.30 | BCD | 48.9 | ABCD | 170 | EFGH | 61.3 | CDEFGH | 126 | EFGHIJ | 257 | CDEFGH | 1.49 | BCDEF | 11.7 | BCDE | 47 |
| M129 | 34.7 | FGHI | 91.9 | FG | 43 | BCDEFG | 80.4 | DEFG | 0.7 | BC | 3.7 | AB | 13.4 | BCDEFGH | 6.79 | A | 51.6 | A | 149 | GH | 63.5 | BCDEFG | 108 | GHIJ | 302 | A | 1.49 | BCDEFG | 13.4 | BCDE | 45 |
| 2ND21867 | 42.6 | CD | 96.9 | ABCDE | 40 | EFGHI | 81.2 | BCD | 1.1 | ABC | 1.8 | J | 12.9 | GHIJ | 5.15 | JKLM | 41.2 | KL | 118 | I | 51.3 | I | 196 | BCDEF | 196 | NOP | 1.48 | DEFGH | 5.3 | E | 47 |
| 2ND22927 | 45.3 | AB | 96.8 | ABCDEF | 45 | ABC | 82.7 | A | 0.9 | ABC | 2.7 | CDEFGHI | 12.2 | JK | 5.59 | GHIJ | 48.1 | ABCDE | 98 | IJ | 64.4 | BCDEF | 168 | BCDEFGH | 242 | DEFGHIJK | 1.49 | BCDEF | 25.3 | ABC | 48 |
| SR412 | 34.6 | FGHI | 94.9 | ABCDEF | 45 | ABCD | 80.2 | DEFGH | 0.7 | BC | 3.0 | BCDE | 13.2 | DEFGHI | 6.21 | BCDE | 48.1 | ABCDE | 172 | EFGH | 63.2 | BCDEFG | 82 | IJ | 273 | ABCD | 1.50 | ABCD | 12.4 | BCDE | 49 |
| M130 | 35.2 | FGHI | 94.8 | ABCDEF | 47 | AB | 79.9 | GHIJ | 0.8 | ABC | 2.7 | CDEFGHI | 13.0 | FGHIJ | 6.26 | BCDE | 49.4 | ABCD | 159 | FGH | 60.0 | CDEFGH | 180 | BCDEFG | 254 | CDEFGHI | 1.49 | BCDEF | 12.2 | BCDE | 45 |
| M132 | 36.2 | EF | 96.5 | ABCDEF | 45 | ABCD | 79.8 | GHIJ | 0.7 | BC | 2.8 | CDEFGH | 13.3 | BCDEFGH | 6.13 | BCDEF | 47.2 | BCDEF | 150 | GH | 57.3 | FGHI | 167 | BCDEFGH | 262 | BCDEF | 1.51 | ABCD | 11.1 | BCDE | 48 |
| ND22421 | 35.0 | FGHI | 94.8 | ABCDEF | 45 | ABCD | 79.5 | GHIJK | 0.8 | ABC | 2.5 | DEFGHIJ | 13.0 | FGHIJ | 5.56 | HIJK | 44.9 | EFGHIJK | 149 | GH | 61.0 | CDEFGH | 135 | DEFGHIJ | 220 | IJKLMN | 1.51 | ABCD | 14.5 | BCDE | 44 |
| ND23311 | 34.8 | FGHI | 94.8 | ABCDEF | 37 | I | 81.1 | CDEF | 1.1 | ABC | 2.4 | DEFGHIJ | 11.0 | L | 5.24 | JKLM | 50.4 | AB | 101 | IJ | 63.0 | BCDEFG | 323 | A | 232 | FGHIJKLM | 1.51 | ABCD | 12.3 | BCDE | 43 |
| 2ND22182 | 47.0 | A | 96.9 | ABCDE | 39 | HI | 81.2 | BCDE | 0.9 | ABC | 2.3 | EFGHIJ | 12.4 | IJ | 5.10 | LM | 42.6 | HIJKL | 89 | J | 56.4 | GHI | 213 | BCD | 202 | MNOP | 1.49 | BCDEFG | 13.4 | BCDE | 43 |
| 6B02-3120 | 34.3 | FGHI | 93.6 | ABCDEF | 46 | ABC | 79.6 | GHIJ | 0.9 | ABC | 2.9 | BCDEF | 13.3 | CDEFGHI | 5.91 | DEFGH | 46.2 | DEFGHI | 161 | FGH | 67.2 | BC | 153 | CDEFGHI | 226 | HIJKLMN | 1.50 | ABCD | 16.2 | BCDE | 49 |
| 6B02-3435 | 33.4 | HIJK | 92.9 | BCDEFG | 45 | ABC | 79.0 | JKL | 0.8 | ABC | 2.6 | DEFGHIJ | 14.0 | ABCDE | 5.89 | DEFGH | 43.2 | GHIJKL | 212 | A | 66.2 | BCD | 92 | HIJ | 221 | IJKLMN | 1.49 | BCDEF | 18.8 | ABCDE | 50 |
| 6B03-4478 | 35.2 | FGHI | 94.6 | ABCDEF | 43 | BCDEFG | 80.4 | DEFG | 1.1 | ABC | 2.6 | DEFGHIJ | 13.2 | CDEFGHI | 6.12 | BCDEF | 48.0 | ABCDE | 171 | EFGH | 64.7 | BCDE | 208 | BCDE | 263 | BCDEF | 1.51 | ABCD | 13.4 | BCDE | 44 |
| SR417 | 37.8 | E | 93.9 | ABCDEF | 42 | CDEFGH | 78.6 | KL | 0.9 | ABC | 3.6 | ABC | 13.2 | CDEFGHI | 6.52 | AB | 50.4 | AB | 157 | FGH | 63.6 | BCDEFG | 137 | DEFGHI | 293 | AB | 1.48 | CDEFGH | 15.3 | BCDE | 41 |
| SR420 | 34.8 | FGHI | 90.0 | GH | 44 | ABCD | 80.5 | DEFG | 1.0 | ABC | 3.9 | A | 13.2 | CDEFGHI | 6.31 | BCD | 50.0 | ABC | 143 | H | 61.5 | CDEFGH | 199 | BCDEF | 253 | CDEFGHI | 1.52 | ABC | 25.9 | AB | 41 |
| M134 | 36.1 | EF | 93.7 | ABCDEF | 44 | ABCD | 79.3 | HIJK | 1.0 | ABC | 2.1 | FGHIJ | 12.7 | GHIJ | 5.29 | JKL | 42.5 | IJKL | 172 | EFGH | 54.9 | HI | 194 | BCDEF | 175 | P | 1.52 | AB | 13.9 | BCDE | 47 |
| M137 | 34.8 | FGHI | 97.1 | ABC | 46 | ABC | 79.2 | IJKL | 1.0 | ABC | 2.2 | EFGHIJ | 14.1 | ABC | 6.19 | BCDEF | 45.0 | EFGHIJ | 204 | ABCD | 60.3 | CDEFGH | 165 | BCDEFGHI | 232 | FGHIJKLM | 1.48 | DEFGH | 15.1 | BCDE | 45 |
| ND23422 | 34.4 | FGHI | 95.0 | ABCDEF | 40 | GHI | 79.6 | GHIJ | 0.8 | ABC | 2.5 | DEFGHIJ | 13.0 | FGHIJ | 5.60 | GHIJ | 44.3 | FGHIJK | 162 | FGH | 59.5 | DEFGH | 193 | BCDEF | 243 | DEFGHIJK | 1.50 | ABCDE | 19.0 | ABCDE | 49 |
| ND23497 | 35.7 | FG | 98.0 | A | 46 | AB | 79.2 | IJKL | 1.0 | ABC | 2.2 | EFGHIJ | 14.3 | A | 6.01 | CDEFGH | 43.3 | GHIJKL | 212 | A | 57.3 | EFGHI | 116 | FGHIJ | 228 | GHIJKLMN | 1.51 | ABCD | 16.8 | ABCDE | 46 |
| ND23753 | 35.0 | FGHI | 97.0 | ABCD | 47 | A | 78.6 | KL | 1.1 | ABC | 2.6 | DEFGHIJ | 14.0 | ABCD | 6.18 | BCDEF | 44.7 | EFGHIJK | 197 | ABCDE | 59.7 | DEFGH | 228 | BC | 237 | EF | 1.53 | A | 17.7 | ABCDE | 44 |
| ND23898 | 33.5 | GHIJK | 92.5 | CDEFG | 45 | ABCD | 79.6 | GHIJ | 0.8 | ABC | 1.9 | HIJ | 13.9 | ABCDEF | 5.92 | DEFGH | 44.6 | EFGHIJK | 195 | ABCDE | 66.4 | BCD | 85 | HIJ | 246 | CDEFGHIJK | 1.49 | BCDEFG | 6.4 | DE | 48 |
| 2ND24263 | 40.8 | D | 97.3 | ABC | 41 | DEFGH | 81.2 | BCDE | 1.2 | AB | 1.8 | IJ | 13.3 | BCDEFGHI | 5.44 | IJKL | 41.7 | JKL | 162 | FGH | 69.7 | B | 330 | A | 198 | NOP | 1.52 | AB | 5.6 | E | 46 |
| 2ND24388 | 43.0 | C | 96.4 | ABCDEF | 39 | GHI | 82.1 | AB | 0.8 | ABC | 2.9 | CDEFG | 12.5 | HIJ | 5.12 | KLM | 42.1 | JKL | 152 | GH | 58.9 | DE | | | | | | | | | |

2008 MISSISSIPPI VALLEY UNIFORM SPRING BARLEY NURSERY AND ADDITIONS - ABERDEEN, ID

Table 4

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agron) | Malt Extract (%) | F-C (%) | Wort Color | Wort Clarity | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (Hach) | Quality Score | Overall Rank |
|---------|----------------------|-------|--------------------|--------------|----------------------|------------------|---------|------------|--------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|--------------|
| 5383 | Barbless | 6 | 35.6 | *95.4 | 77 | *76.2 | 2.2 | 1.4 | 1 | 14.1 | 4.33 | *31.8 | 133 | *36.9 | *470 | 153 | 1.56 | 13.7 | 16 | 40 |
| 5384 | Morex | 6 | 36.3 | 97.4 | 74 | 79.6 | 1.0 | 1.5 | 1 | 13.0 | 4.88 | 37.8 | 168 | 50.7 | 122 | 150 | 1.49 | 8.3 | 52 | 26 |
| 5385 | Robust | 6 | 36.1 | 97.5 | 77 | 80.5 | 0.6 | 1.5 | 1 | 12.1 | 5.01 | 43.9 | 148 | 46.2 | 154 | 156 | 1.49 | 5.2 | 54 | 20 |
| 5386 | Legacy | 6 | 35.9 | 97.9 | 79 | 81.4 | 0.7 | 1.5 | 1 | 11.0 | 5.16 | 48.3 | 171 | 69.8 | 127 | 174 | 1.47 | 4.3 | 47 | 32 |
| 5387 | Lacey | 6 | 37.7 | 97.7 | 79 | 81.9 | 0.7 | 1.5 | 1 | 10.8 | 4.97 | 49.0 | 130 | 53.3 | 87 | 167 | 1.46 | 7.2 | 48 | 31 |
| 5388 | Conlon | 2 | 48.5 | 99.6 | 65 | 80.7 | 1.2 | 2.1 | 2 | 12.8 | 5.40 | 44.0 | 118 | 54.1 | 267 | 177 | 1.49 | 9.5 | 51 | 30 |
| 5389 | Tradition | 6 | 39.4 | 99.0 | 80 | 80.9 | 0.7 | 1.5 | 1 | 12.2 | 5.44 | 46.0 | 155 | 61.1 | 143 | 192 | 1.47 | 3.4 | 61 | 4 |
| 5390 | Stellar | 6 | 38.0 | 99.0 | 75 | 81.2 | 0.5 | 1.9 | 2 | 11.7 | 4.99 | 45.6 | 138 | 60.0 | 144 | 164 | 1.53 | 18.9 | 53 | 21 |
| 5391 | ND20448 | 6 | 47.1 | 99.0 | 68 | 81.4 | 1.3 | 1.7 | 1 | 12.8 | 5.48 | 44.5 | 129 | 52.8 | 138 | 175 | 1.50 | 5.8 | 58 | 12 |
| 5392 | Pinnacle | 2 | 50.9 | 99.2 | 62 | 81.9 | 0.7 | 1.8 | 1 | 11.5 | 5.18 | 45.5 | 105 | 53.0 | 242 | 173 | 1.54 | 8.0 | 55 | 19 |
| 5393 | M128 | 6 | 38.8 | 97.3 | 73 | 80.5 | 1.1 | 1.9 | 1 | 13.8 | 5.94 | 46.2 | 179 | 64.4 | 127 | 193 | 1.47 | 4.7 | 52 | 26 |
| 5394 | M129 | 6 | 38.1 | *95.5 | 79 | 81.7 | 1.2 | 1.8 | 1 | 12.7 | 5.97 | 48.9 | 147 | 69.7 | 106 | 221 | 1.46 | 3.8 | 56 | 16 |
| 5395 | 2ND21867 | 2 | 49.0 | 99.3 | 71 | 81.2 | 1.1 | 1.3 | 1 | 12.5 | 5.19 | 41.8 | 131 | 52.3 | 105 | 166 | 1.46 | 4.6 | 61 | 4 |
| 5396 | 2ND22927 | 2 | 51.1 | 99.4 | 80 | 82.8 | 1.0 | n.d | 3 | 11.3 | 5.46 | 49.5 | 78 | 51.2 | 291 | 196 | 1.55 | 27.0 | 44 | 36 |
| 5397 | SR412 | 6 | 39.9 | 99.1 | 82 | 81.7 | 0.8 | 1.7 | 1 | 12.1 | 5.50 | 46.5 | 160 | 68.5 | 92 | 197 | 1.47 | 5.7 | 65 | 1 |
| 5398 | M130 | 6 | 37.9 | 97.6 | 78 | 80.9 | 1.2 | 1.7 | 1 | 11.7 | 5.32 | 48.2 | 141 | 62.5 | 198 | 215 | 1.49 | 5.0 | 53 | 21 |
| 5399 | M132 | 6 | 38.0 | 99.1 | 79 | 80.9 | 0.6 | 1.7 | 2 | 12.2 | 4.95 | 42.8 | 166 | 59.9 | 111 | 187 | 1.51 | 14.8 | 60 | 9 |
| 5400 | ND22421 | 6 | 39.1 | 98.8 | 75 | 79.9 | 0.8 | 1.9 | 2 | 12.9 | 5.43 | 42.6 | 119 | 61.1 | 128 | 199 | 1.52 | 10.7 | 53 | 21 |
| 5401 | ND23311 | 6 | 39.0 | 99.0 | 74 | 82.0 | 1.2 | 2.2 | 1 | 11.6 | 5.49 | 51.1 | 90 | 60.4 | 231 | 228 | 1.52 | 10.6 | 46 | 34 |
| 5402 | 2ND22182 | 2 | 51.1 | 99.5 | 60 | 80.6 | 1.2 | 2.3 | 2 | 13.4 | 5.19 | 39.5 | 79 | 51.5 | *445 | 200 | 1.56 | 20.0 | 37 | 39 |
| 5403 | 6B02-3120 | 6 | 39.6 | 99.0 | 79 | 81.5 | 0.7 | 1.6 | 1 | 11.7 | 5.39 | 46.8 | 147 | 62.2 | 97 | 212 | 1.47 | 6.9 | 65 | 1 |
| 5404 | 6B02-3435 | 6 | 36.6 | 98.1 | 80 | 79.9 | 0.8 | 2.1 | 3 | 12.7 | 5.13 | 42.3 | 179 | 59.7 | 75 | 189 | 1.49 | 25.0 | 59 | 11 |
| 5405 | 6B03-4478 | 6 | 38.5 | 99.3 | 82 | 81.8 | 0.4 | 1.5 | 1 | 10.9 | 5.34 | 51.8 | 133 | 62.6 | 74 | 229 | 1.46 | 6.6 | 52 | 26 |
| 5406 | SR417 | 6 | 41.2 | 98.4 | 78 | 80.8 | 0.6 | 1.6 | 1 | 11.2 | 5.29 | 49.5 | 135 | 60.8 | 99 | 216 | 1.46 | 5.1 | 52 | 26 |
| 5407 | SR420 | 6 | 39.7 | 97.8 | 83 | 82.0 | 0.8 | 1.7 | 1 | 12.1 | 5.65 | 48.3 | 119 | 68.2 | 96 | 227 | 1.46 | 4.7 | 53 | 21 |
| 5408 | M134 | 6 | 40.4 | 98.9 | 80 | 80.4 | 0.8 | 1.9 | 2 | 11.7 | 5.01 | 44.3 | 163 | 53.6 | 106 | 178 | 1.48 | 12.7 | 60 | 9 |
| 5409 | M137 | 6 | 36.1 | 98.2 | 79 | 79.4 | 0.3 | 1.4 | 1 | 13.1 | 5.62 | 45.9 | 184 | 60.3 | 76 | 219 | 1.45 | 6.3 | 65 | 1 |
| 5410 | ND23422 | 6 | 37.1 | 97.6 | 76 | 80.9 | 0.8 | 1.9 | 1 | 12.4 | 5.56 | 46.3 | 127 | 58.2 | 137 | 227 | 1.49 | 10.7 | 58 | 12 |
| 5411 | ND23497 | 6 | 37.6 | 99.6 | 81 | 80.1 | 1.0 | 1.7 | 1 | 13.4 | 5.84 | 45.6 | 190 | 60.6 | 77 | 215 | 1.49 | 8.6 | 61 | 4 |
| 5412 | ND23753 | 6 | 37.5 | 98.8 | 80 | 79.1 | 1.1 | 1.5 | 1 | 13.8 | 5.92 | 43.4 | 184 | 63.2 | 80 | 222 | 1.46 | 7.5 | 56 | 16 |

Table 4

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F-C (%) | Wort Color | Wort Clarity | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (Hach) | Quality Score | Overall Rank |
|---------------------------|-----------------------|-------|--------------------|--------------|-----------------------|------------------|---------|------------|--------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|--------------|
| 5415 | ND23898 | 6 | 35.0 | 97.9 | 68 | 78.8 | 1.2 | 1.6 | 1 | 15.1 | 6.20 | 42.4 | 201 | 65.6 | 109 | 234 | 1.49 | 6.4 | 45 | 35 |
| 5416 | 2ND24263 | 2 | 43.9 | 99.8 | 62 | 79.5 | 0.8 | 1.5 | 1 | 14.0 | 5.69 | 42.1 | 174 | 65.7 | 165 | 201 | 1.50 | 6.8 | 41 | 38 |
| 5417 | 2ND24388 | 2 | 47.5 | 98.9 | 73 | 82.0 | 0.9 | n.d | 3 | 12.1 | 5.25 | 43.6 | 138 | 51.7 | 206 | 194 | 1.50 | 23.0 | 56 | 16 |
| 5418 | 2ND24393 | 2 | 47.7 | 99.4 | 68 | 81.4 | 1.2 | 1.9 | 1 | 12.9 | 5.54 | 43.4 | 151 | 50.9 | 295 | 209 | 1.52 | 9.2 | 58 | 12 |
| 5419 | 6B03-4301 | 6 | 41.1 | 98.5 | 69 | 79.7 | 0.7 | 2.1 | 1 | 14.2 | 6.45 | 47.1 | 150 | 65.4 | 110 | 275 | 1.47 | 8.3 | 43 | 37 |
| 5420 | 6B04-0007 | 6 | 38.2 | 98.7 | 81 | 80.1 | 0.8 | 1.9 | 1 | 12.5 | 5.19 | 44.0 | 145 | 57.7 | 105 | 203 | 1.50 | 10.4 | 61 | 4 |
| 5421 | 6B04-0075 | 6 | 36.0 | 98.8 | 78 | 80.8 | 0.8 | 1.8 | 1 | 11.9 | 5.42 | 47.2 | 127 | 63.5 | 77 | 205 | 1.45 | 5.6 | 57 | 15 |
| 5422 | SR424 | 6 | 37.1 | 98.6 | 78 | 80.7 | 0.8 | 2.3 | 1 | 12.2 | 5.60 | 48.2 | 127 | 66.3 | 135 | 243 | 1.49 | 5.7 | 53 | 21 |
| 5423 | SR425 | 6 | 36.9 | 98.5 | 82 | 81.2 | 1.0 | 2.1 | 1 | 13.3 | 5.97 | 45.7 | 140 | 63.9 | 100 | 236 | 1.45 | 6.3 | 61 | 4 |
| 5424 | 02Ab17271 | 2 | 48.1 | 99.2 | 73 | 81.5 | 1.0 | 2.3 | 1 | 13.9 | 5.77 | 42.6 | 130 | 60.4 | 131 | 237 | 1.51 | 9.6 | 47 | 32 |
| 5413 | HARRINGTON MALT CHECK | 2 | 35.4 | 91.2 | 82 | 79.6 | 0.8 | 1.4 | 1 | 12.9 | 5.19 | 41.3 | 141 | 71.9 | 75 | 202 | 1.45 | 6.3 | 57 | |
| 5414 | MOREX MALT CHECK | 6 | 34.0 | 94.4 | 78 | 80.6 | 0.6 | 2.0 | 1 | 12.0 | 6.06 | 53.5 | 138 | 76.4 | 66 | 259 | 1.46 | 6.5 | 50 | |
| Minima | | | 35.0 | 97.3 | 60 | 78.8 | 0.3 | 1.3 | | 10.8 | 4.33 | 37.8 | 78 | 46.2 | 74 | 150 | 1.45 | 3.4 | 16 | |
| Maxima | | | 51.1 | 99.8 | 83 | 82.8 | 2.2 | 2.3 | | 15.1 | 6.45 | 51.8 | 201 | 69.8 | 295 | 275 | 1.56 | 27.0 | 65 | |
| Means | | | 40.6 | 98.7 | 75 | 80.9 | 0.9 | 1.8 | | 12.5 | 5.43 | 45.4 | 143 | 59.6 | 136 | 201 | 1.49 | 9.4 | 53 | |
| Standard Deviations | | | 5.0 | 0.7 | 6 | 0.9 | 0.3 | 0.3 | | 1.0 | 0.40 | 3.0 | 28 | 6.1 | 60 | 28 | 0.03 | 5.9 | 9 | |
| Coefficients of Variation | | | 12.2 | 0.7 | 8 | 1.1 | 35.3 | 15.5 | | 8.1 | 7.35 | 6.7 | 20 | 10.2 | 44 | 14 | 2.02 | 62.2 | 17 | |

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics

For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by D. Obert, USDA/ARS - Aberdeen

2008 MISSISSIPPI VALLEY UNIFORM SPRING BARLEY NURSERY - CROOKSTON, MN

Table 5

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F-C (%) | Wort Color | Wort Clarity | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (Hach) | Quality Score | Overall Rank |
|---------|----------------------|-------|--------------------|--------------|-----------------------|------------------|---------|------------|--------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|--------------|
| 5203 | Morex | 6 | 33.9 | 96.0 | 43 | 79.5 | 1.1 | n.d. | 3 | 11.7 | 4.71 | 40.7 | 121 | 48.0 | 112 | 192 | 1.50 | 38.0 | 45 | 23 |
| 5204 | Robust | 6 | 36.7 | 98.8 | 41 | 79.4 | 1.0 | 1.9 | 1 | 12.1 | 4.59 | 39.3 | 117 | 38.6 | 308 | 183 | 1.52 | 7.9 | 32 | 37 |
| 5205 | Legacy | 6 | 34.3 | 98.3 | 43 | 81.5 | 0.8 | 3.8 | 2 | 11.5 | 5.60 | 49.7 | 109 | 52.1 | 92 | 226 | 1.51 | 26.0 | 52 | 8 |
| 5206 | Lacey | 6 | 36.8 | 99.0 | 42 | 80.8 | 0.8 | n.d. | 3 | 10.9 | 4.89 | 45.4 | 116 | 43.7 | 131 | 173 | 1.49 | 47.0 | 40 | 34 |
| 5207 | Conlon | 2 | 46.1 | 99.7 | 35 | 80.9 | 0.6 | 1.8 | 2 | 11.8 | 4.64 | 40.8 | 105 | 48.3 | 155 | 153 | 1.45 | 16.0 | 48 | 13 |
| 5208 | Tradition | 6 | 36.5 | 98.4 | 44 | 80.2 | 0.7 | n.d. | 3 | 12.1 | 4.78 | 41.3 | 160 | 49.5 | 96 | 177 | 1.49 | 49.0 | 48 | 13 |
| 5209 | Stellar | 6 | 37.1 | 99.2 | 40 | 80.8 | 0.5 | n.d. | 3 | 11.9 | 5.42 | 47.2 | 137 | 43.1 | 85 | 211 | 1.53 | 61.0 | 52 | 8 |
| 5210 | ND20448 | 6 | 36.1 | 98.7 | 41 | 79.5 | 0.6 | n.d. | 3 | 11.8 | 4.99 | 43.6 | 137 | 42.1 | 120 | 191 | 1.51 | 39.0 | 49 | 12 |
| 5211 | Pinnacle | 2 | 47.0 | 99.2 | 37 | 81.5 | 0.8 | 2.0 | 2 | 10.9 | 4.41 | 40.8 | 90 | 42.1 | 195 | 158 | 1.51 | 18.9 | 42 | 31 |
| 5212 | M128 | 6 | 37.6 | 98.5 | 44 | 81.1 | 0.3 | 3.7 | 2 | 12.0 | 6.03 | 50.9 | 121 | 45.2 | 119 | 229 | 1.51 | 17.5 | 46 | 17 |
| 5213 | M129 | 6 | 36.9 | 97.7 | 38 | 81.0 | 0.6 | 4.1 | 2 | 12.3 | 6.04 | 51.0 | 101 | 50.7 | 88 | 255 | 1.50 | 16.8 | 45 | 23 |
| 5214 | 2ND21867 | 2 | 46.7 | 99.4 | 37 | 81.3 | 1.1 | 2.0 | 1 | 11.9 | 4.74 | 40.4 | 99 | 38.0 | 159 | 174 | 1.48 | 8.1 | 44 | 28 |
| 5215 | 2ND22927 | 2 | 49.3 | 99.1 | 39 | 82.1 | 0.9 | n.d. | 3 | 11.7 | 5.00 | 44.6 | 80 | 47.3 | 230 | 190 | 1.49 | 57.0 | 46 | 17 |
| 5216 | SR412 | 6 | 35.5 | 99.1 | 36 | 81.3 | 0.7 | 3.5 | 2 | 12.1 | 5.71 | 48.1 | 118 | 48.9 | 102 | 221 | 1.52 | 20.0 | 45 | 23 |
| 5217 | M130 | 6 | 36.1 | 96.9 | 46 | 80.6 | 0.5 | n.d. | 3 | 11.8 | 5.45 | 47.3 | 126 | 48.3 | 153 | 208 | 1.51 | 27.0 | 48 | 13 |
| 5218 | M132 | 6 | 36.7 | 98.8 | 40 | 80.7 | 0.2 | 3.2 | 2 | 12.1 | 5.52 | 46.4 | 121 | 45.2 | 106 | 225 | 1.56 | 22.0 | 58 | 4 |
| 5219 | ND22421 | 6 | 36.7 | 98.7 | 41 | 79.7 | 0.7 | n.d. | 3 | 12.2 | 4.94 | 42.7 | 111 | 46.2 | 121 | 166 | 1.53 | 34.0 | 45 | 23 |
| 5220 | ND23311 | 6 | 36.4 | 99.0 | 32 | 81.5 | 1.3 | n.d. | 3 | *9.8 | 4.76 | 49.6 | 95 | 55.0 | 327 | 179 | 1.52 | 30.0 | 32 | 37 |
| 5221 | 2ND22182 | 2 | 52.8 | 99.9 | 37 | 81.7 | 1.3 | n.d. | 3 | 11.5 | 4.38 | 38.7 | 87 | 44.7 | 190 | 153 | 1.50 | 25.0 | 37 | 35 |
| 5224 | 6B02-3120 | 6 | 36.2 | 97.9 | 42 | 80.4 | 1.4 | n.d. | 3 | 12.3 | 5.32 | 44.6 | 123 | 48.2 | 206 | 191 | 1.55 | 43.0 | 50 | 11 |
| 5225 | 6B02-3435 | 6 | 35.7 | 98.7 | 44 | 79.7 | 1.3 | n.d. | 3 | 12.8 | 5.48 | 44.3 | 159 | 44.6 | 100 | 191 | 1.52 | 56.0 | 60 | 2 |
| 5226 | 6B03-4478 | 6 | 36.6 | 99.3 | 40 | 80.9 | 1.2 | n.d. | 3 | 11.7 | 5.43 | 47.7 | 120 | 46.0 | 312 | 192 | 1.56 | 37.0 | 41 | 32 |
| 5227 | SR417 | 6 | 37.7 | 96.9 | 39 | 79.7 | 0.4 | n.d. | 3 | 11.2 | 5.66 | 51.5 | 118 | 52.7 | 65 | 236 | 1.52 | 34.0 | 46 | 17 |
| 5228 | SR420 | 6 | 35.6 | 97.1 | 40 | 81.5 | 1.5 | n.d. | 3 | 11.5 | 5.68 | 52.3 | 93 | 48.4 | 196 | 213 | 1.58 | 75.0 | 41 | 32 |
| 5229 | M134 | 6 | 36.5 | 97.7 | 42 | 79.5 | 1.3 | 2.6 | 2 | 11.2 | 4.44 | 40.2 | 123 | 40.7 | 207 | 141 | 1.56 | 30.0 | 34 | 36 |
| 5230 | M137 | 6 | 36.7 | 99.0 | 46 | 79.3 | 1.2 | n.d. | 3 | 12.7 | 5.32 | 43.3 | 152 | 43.4 | 251 | 189 | 1.52 | 41.0 | 53 | 6 |
| 5231 | ND23422 | 6 | 36.0 | 98.8 | 38 | 80.0 | 0.8 | n.d. | 3 | 11.6 | 5.19 | 46.2 | 137 | 48.5 | 209 | 209 | 1.52 | 49.0 | 46 | 17 |
| 5232 | ND23497 | 6 | 38.0 | 99.7 | 44 | 79.2 | 0.7 | n.d. | 3 | 12.7 | 5.24 | 42.4 | 164 | 43.6 | 108 | 201 | 1.53 | 45.0 | 60 | 2 |
| 5233 | ND23753 | 6 | 37.0 | 99.6 | 46 | 78.4 | 1.4 | n.d. | 3 | 12.6 | 5.39 | 43.4 | 144 | 39.9 | 406 | 195 | 1.61 | 49.0 | 46 | 17 |
| 5234 | ND23898 | 6 | 35.6 | 98.7 | 44 | 80.7 | 0.8 | 1.9 | 1 | 12.5 | 5.40 | 44.9 | 159 | 55.5 | 58 | 229 | 1.50 | 7.6 | 65 | 1 |

Table 5

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agron) | Malt Extract (%) | F-C (%) | Wort Color | Wort Clarity | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (Hach) | Quality Score | Overall Rank |
|---------------------------|-----------------------|-------|--------------------|--------------|----------------------|------------------|---------|------------|--------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|--------------|
| 5235 | 2ND24263 | 2 | 42.9 | 99.7 | 38 | 81.2 | 1.0 | 1.7 | 1 | 12.6 | 5.03 | 41.1 | 136 | 57.0 | 339 | 188 | 1.53 | 6.6 | 58 | 4 |
| 5236 | 2ND24388 | 2 | 46.6 | 99.1 | 36 | 81.9 | 0.8 | n.d. | 3 | 11.6 | 4.51 | 39.9 | 125 | 45.5 | 170 | 168 | 1.54 | 57.0 | 48 | 13 |
| 5237 | 2ND24393 | 2 | 45.4 | 99.5 | 41 | 81.4 | 0.8 | n.d. | 3 | 12.1 | 4.50 | 38.5 | 113 | 40.2 | 305 | 168 | 1.55 | 54.0 | 45 | 23 |
| 5238 | 6B03-4301 | 6 | 38.7 | 98.1 | 43 | 79.6 | 0.5 | 3.2 | 2 | 11.9 | 5.09 | 44.8 | 141 | 44.2 | 151 | 216 | 1.57 | 19.1 | 53 | 6 |
| 5239 | 6B04-0007 | 6 | 38.6 | 98.7 | 44 | 80.0 | 0.3 | n.d. | 3 | 11.7 | 4.63 | 40.8 | 163 | 54.3 | 99 | 190 | 1.51 | 35.0 | 51 | 10 |
| 5240 | 6B04-0075 | 6 | 34.5 | 96.8 | 43 | 80.7 | 0.6 | n.d. | 3 | 11.1 | 5.37 | 50.5 | 111 | 50.8 | 102 | 208 | 1.52 | 22.0 | 46 | 17 |
| 5241 | SR424 | 6 | 32.7 | *94.3 | 42 | 81.2 | 0.5 | n.d. | 3 | 10.8 | 5.42 | 51.5 | 99 | 49.0 | 66 | 239 | 1.51 | 37.0 | 43 | 30 |
| 5242 | SR425 | 6 | 33.3 | *92.9 | 47 | 81.7 | 0.6 | 3.9 | 2 | 11.0 | 5.55 | 52.1 | 95 | 48.0 | 40 | 228 | 1.53 | 21.0 | 44 | 28 |
| 5222 | HARRINGTON MALT CHECK | 2 | 35.3 | 86.3 | 80 | 78.9 | 1.0 | 1.7 | 1 | 13.2 | 5.50 | 42.9 | 141 | 69.9 | 87 | 218 | 1.45 | 5.0 | 47 | |
| 5223 | MOREX MALT CHECK | 6 | 35.4 | 95.1 | 78 | 80.5 | 0.9 | 2.3 | 1 | 12.2 | 6.11 | 51.4 | 146 | 74.2 | 66 | 260 | 1.49 | 7.6 | 53 | |
| Minima | | | 32.7 | 96.0 | 32 | 78.4 | 0.2 | 1.7 | | 10.8 | 4.38 | 38.5 | 80 | 38.0 | 40 | 141 | 1.45 | 6.6 | 32 | |
| Maxima | | | 52.8 | 99.9 | 47 | 82.1 | 1.5 | 4.1 | | 12.8 | 6.04 | 52.3 | 164 | 57.0 | 406 | 255 | 1.61 | 75.0 | 65 | |
| Means | | | 38.5 | 98.6 | 41 | 80.6 | 0.8 | 2.8 | | 11.8 | 5.14 | 45.0 | 122 | 46.8 | 165 | 196 | 1.52 | 33.6 | 47 | |
| Standard Deviations | | | 4.8 | 0.9 | 3 | 0.9 | 0.3 | 0.9 | | 0.5 | 0.46 | 4.2 | 23 | 4.7 | 90 | 27 | 0.03 | 16.9 | 7 | |
| Coefficients of Variation | | | 12.5 | 1.0 | 8 | 1.1 | 41.1 | 32.4 | | 4.6 | 8.89 | 9.4 | 19 | 10.0 | 54 | 14 | 2.01 | 50.1 | 16 | |

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics

For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by K. Smith, University of Minnesota - St. Paul

2008 MISSISSIPPI VALLEY UNIFORM SPRING BARLEY NURSERY AND ADDITIONS - BOTTINEAU, ND

Table 6

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F-C (%) | Wort Color | Wort Clarity | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (*ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (Hach) | Quality Score | Overall Rank |
|---------|----------------------|-------|--------------------|--------------|-----------------------|------------------|---------|------------|--------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|--------------|
| 5243 | Morex | 6 | 31.7 | 84.9 | 56 | 77.6 | 0.7 | 1.7 | 1 | 13.4 | 5.38 | 42.6 | 183 | 63.1 | 46 | 222 | 1.43 | 5.9 | 54 | 9 |
| 5244 | Robust | 6 | 32.3 | 86.6 | 56 | 78.6 | 0.9 | 1.5 | 1 | 12.9 | 4.97 | 41.0 | 146 | 47.7 | 46 | 195 | 1.43 | 5.1 | 50 | 14 |
| 5245 | Legacy | 6 | 31.4 | 88.2 | 58 | 77.9 | 0.8 | 2.8 | 2 | 12.7 | 6.16 | 48.4 | 178 | 62.9 | 32 | 256 | 1.44 | 10.7 | 45 | 26 |
| 5246 | Lacey | 6 | 33.4 | 91.1 | 58 | 78.9 | 0.7 | 2.0 | 1 | 12.8 | 5.46 | 43.8 | 178 | 63.6 | 34 | 220 | 1.41 | 8.1 | 62 | 1 |
| 5247 | Conlon | 2 | 40.0 | 97.7 | 53 | 78.0 | 1.6 | 1.6 | 1 | 13.8 | 4.66 | 34.2 | 147 | 55.3 | *145 | 157 | 1.44 | 9.1 | 33 | 39 |
| 5248 | Tradition | 6 | 33.0 | 90.3 | 62 | 78.2 | 0.7 | 1.4 | 1 | 12.4 | 4.73 | 39.7 | 196 | 60.2 | 40 | 185 | 1.45 | 7.0 | 47 | 22 |
| 5249 | Stellar | 6 | 32.8 | 89.8 | 57 | 78.1 | 1.1 | 1.9 | 1 | 12.8 | 5.10 | 40.6 | 209 | 64.4 | 26 | 202 | 1.45 | 9.4 | 50 | 14 |
| 5250 | ND20448 | 6 | 32.7 | 90.8 | 64 | 78.3 | 0.9 | 2.0 | 1 | 13.3 | 5.71 | 46.2 | 197 | 67.7 | 29 | 233 | 1.44 | 8.4 | 58 | 3 |
| 5251 | Pinnacle | 2 | 43.4 | 98.4 | 48 | 79.4 | 0.8 | 1.8 | 1 | 11.9 | 4.44 | 38.5 | 127 | 49.6 | 114 | 162 | 1.48 | 9.3 | 50 | 14 |
| 5252 | M128 | 6 | 34.3 | 91.7 | 60 | 78.7 | 0.6 | 2.6 | 1 | 13.2 | 5.84 | 44.8 | 180 | 62.6 | 41 | 243 | 1.45 | 11.5 | 58 | 3 |
| 5253 | M129 | 6 | 32.3 | 85.8 | 56 | 79.0 | 0.4 | *4.8 | 1 | 13.4 | 7.18 | 54.2 | 163 | 68.0 | 26 | *334 | 1.45 | 14.0 | 53 | 10 |
| 5256 | 2ND21867 | 2 | 42.0 | 98.2 | 49 | 79.3 | 1.1 | 1.5 | 1 | 12.6 | 4.82 | 39.7 | 120 | 47.1 | 81 | 166 | 1.44 | 4.6 | 50 | 14 |
| 5257 | 2ND22927 | 2 | 45.2 | 97.6 | 57 | 80.1 | 0.8 | n.d. | 3 | 13.0 | 5.51 | 44.9 | 108 | 59.0 | 67 | 213 | 1.46 | *30 | 57 | 7 |
| 5258 | SR412 | 6 | 32.6 | 91.3 | 60 | 78.3 | 0.6 | 2.8 | 1 | 12.7 | 5.79 | 46.5 | 178 | 60.8 | 27 | 275 | 1.47 | 12.3 | 58 | 3 |
| 5259 | M130 | 6 | 33.5 | 92.1 | 58 | 78.4 | 0.8 | 2.7 | 1 | 12.7 | 6.03 | 48.3 | 150 | 57.9 | 42 | 236 | 1.45 | 7.2 | 50 | 14 |
| 5260 | M132 | 6 | 33.5 | 93.3 | 57 | 78.6 | 0.9 | 3.1 | 1 | 12.5 | 6.09 | 48.8 | 141 | 56.0 | 34 | 242 | 1.44 | 6.9 | 50 | 14 |
| 5261 | ND22421 | 6 | 32.7 | 89.7 | 59 | 77.5 | 0.7 | 2.0 | 1 | 12.3 | 4.90 | 41.8 | 140 | 55.2 | 26 | 181 | 1.45 | 7.7 | 43 | 29 |
| 5262 | ND23311 | 6 | 34.4 | 94.3 | 53 | 79.6 | 0.8 | 2.3 | 1 | 11.6 | 5.21 | 48.8 | 105 | 60.6 | 70 | 216 | 1.44 | 5.6 | 53 | 10 |
| 5263 | 2ND22182 | 2 | 47.3 | 97.6 | 54 | 79.1 | 0.8 | 2.2 | 2 | 12.7 | 4.61 | 38.0 | 92 | 47.7 | 87 | 169 | 1.46 | 13.1 | 43 | 29 |
| 5264 | 6B02-3120 | 6 | 32.2 | 87.6 | 58 | 78.0 | 0.9 | 2.6 | 1 | 12.6 | 5.50 | 45.2 | 155 | 63.5 | 33 | 201 | 1.45 | 8.5 | 59 | 2 |
| 5265 | 6B02-3435 | 6 | 31.0 | 84.1 | 62 | 76.8 | 1.0 | 1.9 | 1 | 14.0 | 5.39 | 39.5 | 201 | 61.3 | 28 | 203 | 1.45 | 6.6 | 44 | 28 |
| 5266 | 6B03-4478 | 6 | 33.9 | 93.0 | 57 | 78.9 | 1.3 | 2.3 | 1 | 13.1 | 5.79 | 45.8 | 156 | 59.4 | 30 | 238 | 1.43 | 5.0 | 58 | 3 |
| 5267 | SR417 | 6 | 35.1 | 88.7 | 55 | 76.8 | 0.9 | 3.6 | 1 | 13.8 | 6.72 | 49.4 | 161 | 60.3 | 18 | 315 | 1.43 | 8.0 | 38 | 36 |
| 5268 | SR420 | 6 | 31.5 | 79.5 | 55 | 78.9 | 1.0 | 3.2 | 1 | 13.5 | 6.35 | 49.0 | 152 | 62.6 | 29 | 243 | 1.44 | 8.0 | 42 | 31 |
| 5269 | M134 | 6 | 33.6 | 88.8 | 58 | 78.0 | 1.4 | 1.7 | 1 | 13.0 | 5.08 | 40.7 | 164 | 52.6 | 84 | 169 | 1.47 | 6.2 | 50 | 14 |
| 5270 | M137 | 6 | 33.8 | 96.9 | 57 | 78.0 | 1.3 | 1.8 | 1 | 14.0 | 5.87 | 43.0 | 197 | 60.7 | 45 | 217 | 1.42 | 4.1 | 45 | 26 |
| 5271 | ND23422 | 6 | 33.5 | 92.6 | 49 | 78.5 | 1.5 | 2.5 | 2 | 13.5 | 5.27 | 40.3 | 161 | 57.2 | 57 | 201 | 1.46 | 7.7 | 51 | 12 |
| 5272 | ND23497 | 6 | 33.7 | 98.5 | 58 | 78.2 | 1.4 | 1.7 | 1 | 14.2 | 5.85 | 41.8 | 231 | 59.8 | 38 | 217 | 1.46 | 5.1 | 40 | 32 |
| 5273 | ND23753 | 6 | 34.0 | 98.4 | 60 | 77.7 | 1.1 | 2.0 | 1 | 13.3 | 5.88 | 44.6 | 206 | 62.3 | 35 | 215 | 1.44 | 5.5 | 51 | 12 |
| 5274 | ND23898 | 6 | 32.1 | 90.2 | 57 | 77.6 | 1.3 | 1.9 | 1 | 14.5 | 5.38 | 38.3 | 215 | 61.1 | 28 | 190 | 1.46 | 5.2 | 40 | 32 |

Table 6

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F-C (%) | Wort Color | Wort Clarity | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (Hach) | Quality Score | Overall Rank |
|---------------------------|-----------------------|-------|--------------------|--------------|-----------------------|------------------|---------|------------|--------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|--------------|
| 5275 | 2ND24263 | 2 | 40.3 | 97.9 | 50 | 78.9 | 1.9 | 1.7 | 1 | 14.1 | 5.03 | 36.3 | 177 | 59.0 | *341 | 164 | 1.53 | 4.2 | 36 | 38 |
| 5276 | 2ND24388 | 2 | 41.5 | 96.9 | 48 | 79.6 | 1.1 | 2.1 | 1 | 12.7 | 5.04 | 40.0 | 175 | 57.7 | 50 | 211 | 1.45 | 9.8 | 56 | 8 |
| 5277 | 2ND24393 | 2 | 43.9 | 98.1 | 46 | 79.5 | 1.0 | 2.0 | 1 | 13.5 | 5.15 | 39.5 | 180 | 52.7 | 117 | 188 | 1.46 | 11.0 | 48 | 21 |
| 5278 | 6B03-4301 | 6 | 35.0 | 95.4 | 56 | 77.3 | 0.6 | 2.2 | 1 | 13.9 | 5.76 | 43.7 | 223 | 64.4 | 31 | 224 | 1.43 | 5.7 | 46 | 24 |
| 5279 | 6B04-0007 | 6 | 34.0 | 89.2 | 58 | 77.3 | 0.4 | 1.5 | 1 | 13.1 | 5.03 | 38.5 | 217 | 65.2 | 50 | 172 | 1.44 | 4.8 | 46 | 24 |
| 5280 | 6B04-0075 | 6 | 31.3 | 85.9 | 60 | 76.9 | 0.6 | 2.5 | 1 | 14.4 | 6.24 | 44.4 | 231 | 76.5 | 26 | 212 | 1.41 | 7.7 | 37 | 37 |
| 5281 | SR424 | 6 | 30.4 | 93.5 | 56 | 77.1 | 0.6 | 3.6 | 1 | 14.1 | 6.66 | 48.5 | 192 | 62.9 | 26 | 255 | 1.45 | 15.5 | 32 | 40 |
| 5282 | SR425 | 6 | 29.6 | 83.3 | 57 | 78.1 | 0.8 | 3.0 | 1 | 13.6 | 6.50 | 49.8 | 176 | 63.9 | 22 | 262 | 1.46 | 13.5 | 39 | 34 |
| 5283 | 6B05-0717 | 6 | 31.5 | 90.8 | 60 | 76.7 | 0.6 | 1.7 | 1 | 14.1 | 5.55 | 39.9 | 232 | 70.2 | 26 | 191 | 1.41 | 5.3 | 39 | 34 |
| 5284 | 6B05-1058 | 6 | 33.4 | 88.6 | 59 | 77.8 | 0.6 | 2.6 | 1 | 13.2 | 6.19 | 47.2 | 173 | 59.7 | 47 | 211 | 1.44 | 8.4 | 47 | 22 |
| 5254 | HARRINGTON MALT CHECK | 2 | 35.5 | 90.6 | 81 | 79.4 | 1.3 | 1.7 | 1 | 12.9 | 5.33 | 43.7 | 112 | 71.3 | 98 | 224 | 1.46 | 4.3 | 54 | |
| 5255 | MOREX MALT CHECK | 6 | 34.6 | 95.0 | 80 | 80.2 | 0.7 | 2.4 | 1 | 11.9 | 5.99 | 51.7 | 131 | 70.1 | 90 | 243 | 1.47 | 5.7 | 53 | |
| 5285 | HARRINGTON MALT CHECK | 2 | 35.8 | 91.2 | 82 | 79.4 | 1.0 | 1.6 | 1 | 13.2 | 5.34 | 42.1 | 136 | 71.8 | 106 | 180 | 1.46 | 5.0 | 45 | |
| 5286 | MOREX MALT CHECK | 6 | 34.3 | 95.0 | 78 | 80.2 | 0.6 | 2.3 | 1 | 12.2 | 6.18 | 53.7 | 126 | 67.4 | 128 | 240 | 1.49 | 7.1 | 46 | |
| Minima | | | 29.6 | 79.5 | 46 | 76.7 | 0.4 | 1.4 | | 11.6 | 4.44 | 34.2 | 92 | 47.1 | 18 | 157 | 1.41 | 4.1 | 32 | |
| Maxima | | | 47.3 | 98.5 | 64 | 80.1 | 1.9 | 3.6 | | 14.5 | 7.18 | 54.2 | 232 | 76.5 | 117 | 315 | 1.53 | 15.5 | 62 | |
| Means | | | 34.8 | 91.7 | 56 | 78.3 | 0.9 | 2.2 | | 13.2 | 5.57 | 43.4 | 173 | 60.1 | 44 | 212 | 1.45 | 8.0 | 48 | |
| Standard Deviations | | | 4.4 | 4.9 | 4 | 0.9 | 0.3 | 0.6 | | 0.7 | 0.63 | 4.4 | 35 | 6.0 | 24 | 34 | 0.02 | 2.9 | 8 | |
| Coefficients of Variation | | | 12.6 | 5.4 | 7 | 1.1 | 36.7 | 26.5 | | 5.3 | 11.39 | 10.2 | 20 | 10.1 | 55 | 16 | 1.40 | 36.7 | 16 | |

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics

For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by D. B. Cooper and C. Allen, Busch Agricultural Resources, LLC - Fort Collins, CO

2008 MISSISSIPPI VALLEY UNIFORM SPRING BARLEY NURSERY - CARRINGTON, ND

Table 7

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F-C (%) | Wort Color | Wort Clarity | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (Hach) | Quality Score | Overall Rank |
|---------|----------------------|-------|--------------------|--------------|-----------------------|------------------|---------|------------|--------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|--------------|
| 5121 | Morex | 6 | 28.8 | *72.5 | 34 | 77.7 | 0.8 | 2.2 | 1 | 15.4 | 6.57 | 43.7 | 244 | 83.9 | 84 | 296 | 1.45 | 6.2 | 30 | 38 |
| 5122 | Robust | 6 | 33.0 | 88.4 | 36 | 79.8 | 1.5 | 1.8 | 1 | 14.4 | 6.41 | 45.4 | 221 | 54.5 | 200 | 275 | 1.49 | 6.9 | 41 | 29 |
| 5123 | Legacy | 6 | 33.8 | 89.1 | 39 | 80.5 | 1.1 | 2.5 | 1 | 13.8 | 6.64 | 49.3 | 224 | 81.6 | 163 | 307 | 1.49 | 9.6 | 44 | 26 |
| 5124 | Lacey | 6 | 34.5 | 91.2 | 39 | 80.5 | 1.2 | 2.0 | 1 | 13.5 | 5.97 | 45.8 | 211 | 71.1 | 115 | 259 | 1.47 | 7.7 | 61 | 1 |
| 5125 | Conlon | 2 | 42.5 | 96.1 | 32 | 80.8 | 1.8 | 2.0 | 1 | 13.8 | 5.49 | 41.0 | 174 | 71.1 | 260 | 210 | 1.49 | 7.2 | 45 | 24 |
| 5128 | Tradition | 6 | 34.5 | 93.0 | 41 | 80.1 | 1.6 | 1.7 | 1 | 13.6 | 5.73 | 44.2 | 240 | 73.0 | 215 | 244 | 1.53 | 6.7 | 49 | 13 |
| 5129 | Stellar | 6 | 34.6 | 90.8 | 37 | 81.4 | 1.5 | 2.0 | 1 | 13.5 | 5.98 | 46.5 | 245 | 76.1 | 128 | 255 | 1.52 | 9.4 | 57 | 6 |
| 5130 | ND20448 | 6 | 33.5 | 93.9 | 41 | 80.5 | 1.3 | 1.9 | 1 | 14.2 | 6.35 | 45.9 | 212 | 77.6 | 139 | 282 | 1.52 | 7.0 | 44 | 26 |
| 5131 | Pinnacle | 2 | 44.6 | 97.2 | 33 | 82.2 | 1.2 | 2.3 | 1 | 11.5 | 5.15 | 46.4 | 128 | 61.9 | 261 | 209 | 1.55 | 12.1 | 58 | 2 |
| 5132 | M128 | 6 | 34.5 | 89.7 | 38 | 80.7 | 1.4 | 2.5 | 1 | 13.1 | 6.30 | 48.5 | 196 | 69.1 | 185 | 270 | 1.50 | 9.3 | 46 | 18 |
| 5133 | M129 | 6 | 34.7 | 89.5 | 37 | 80.9 | 1.2 | 2.8 | 1 | 13.8 | 6.86 | 50.5 | 165 | 72.4 | 174 | 324 | 1.51 | 9.7 | 41 | 29 |
| 5134 | 2ND21867 | 2 | 40.7 | 94.8 | 36 | 81.8 | 1.1 | 1.8 | 1 | 13.3 | 5.35 | 42.1 | 128 | 56.3 | 306 | 220 | 1.50 | 4.2 | 52 | 9 |
| 5135 | 2ND22927 | 2 | 43.3 | 94.0 | 41 | 83.9 | 1.2 | 2.1 | 1 | 12.3 | 5.76 | 49.2 | 100 | 73.6 | 206 | 297 | 1.51 | 7.1 | 46 | 18 |
| 5136 | SR412 | 6 | 34.4 | 92.4 | 40 | 80.6 | 0.8 | 2.8 | 1 | 13.6 | 6.61 | 48.9 | 216 | 74.9 | 94 | 311 | 1.53 | 8.8 | 48 | 15 |
| 5137 | M130 | 6 | 34.7 | 93.0 | 40 | 80.2 | 1.3 | 2.5 | 1 | 13.0 | 6.38 | 50.2 | 182 | 67.5 | 285 | 288 | 1.50 | 6.7 | 46 | 18 |
| 5138 | M132 | 6 | 37.6 | 96.1 | 40 | 79.6 | 1.0 | 2.3 | 1 | 13.7 | 6.21 | 47.1 | 178 | 66.4 | 313 | 310 | 1.52 | 6.7 | 41 | 29 |
| 5139 | ND22421 | 6 | 34.9 | 93.4 | 39 | 80.4 | 0.9 | 2.1 | 1 | 13.3 | 5.92 | 47.3 | 189 | 72.8 | 229 | 274 | 1.54 | 7.7 | 49 | 13 |
| 5140 | ND23311 | 6 | 33.4 | 89.9 | 32 | 81.0 | 1.2 | 2.2 | 1 | 11.4 | 5.37 | 49.2 | 123 | 67.8 | *493 | 304 | 1.54 | 6.4 | 45 | 24 |
| 5141 | 2ND22182 | 2 | 44.0 | 93.9 | 28 | 81.6 | 0.9 | 2.1 | 1 | 12.8 | 5.49 | 44.6 | 91 | 62.6 | 303 | 245 | 1.49 | 8.3 | 51 | 11 |
| 5142 | 6B02-3120 | 6 | 33.8 | 93.1 | 41 | 80.7 | 0.8 | 1.9 | 1 | 13.4 | 6.05 | 46.9 | 190 | 77.4 | 187 | 250 | 1.52 | 4.8 | 51 | 11 |
| 5143 | 6B02-3435 | 6 | 33.1 | 93.7 | 39 | 79.9 | 0.7 | 1.8 | 1 | 14.2 | 5.89 | 42.3 | 248 | 76.1 | 129 | 249 | 1.51 | 5.2 | 47 | 17 |
| 5144 | 6B03-4478 | 6 | 34.6 | 91.1 | 36 | 80.8 | 1.2 | 2.0 | 1 | 13.9 | 6.45 | 49.8 | 206 | 75.1 | 280 | 344 | 1.54 | 5.2 | 41 | 29 |
| 5145 | SR417 | 6 | 39.7 | 94.0 | 35 | 79.4 | 0.9 | 2.6 | 1 | 13.4 | 6.46 | 49.4 | 182 | 70.1 | 265 | 306 | 1.51 | 7.7 | 46 | 18 |
| 5146 | SR420 | 6 | 35.5 | 87.7 | 41 | 81.1 | 0.8 | 2.4 | 1 | 13.5 | 6.46 | 50.0 | 180 | 69.6 | 309 | 275 | 1.53 | 7.9 | 46 | 18 |
| 5147 | M134 | 6 | 35.7 | 91.4 | 38 | 79.9 | 0.4 | 1.7 | 1 | 12.8 | 5.47 | 43.9 | 197 | 59.9 | 227 | 189 | 1.54 | 6.6 | 58 | 2 |
| 5148 | M137 | 6 | 34.1 | 96.0 | 38 | 79.8 | 0.3 | 1.9 | 1 | 14.5 | 6.41 | 44.4 | 222 | 67.9 | 210 | 257 | 1.50 | 5.2 | 41 | 29 |
| 5149 | ND23422 | 6 | 34.8 | 93.5 | 38 | 80.7 | 0.7 | 2.1 | 1 | 12.9 | 5.85 | 45.9 | 177 | 62.3 | 290 | 298 | 1.53 | 8.2 | 54 | 7 |
| 5150 | ND23497 | 6 | 36.1 | 96.7 | 42 | 80.1 | 0.8 | 2.0 | 1 | 14.8 | 6.34 | 45.3 | 233 | 66.0 | 181 | 269 | 1.53 | 6.7 | 41 | 29 |
| 5151 | ND23753 | 6 | 34.6 | 94.3 | 41 | 79.5 | 0.7 | 2.0 | 1 | 15.0 | 6.68 | 45.7 | 228 | 70.2 | 239 | 271 | 1.54 | 6.6 | 41 | 29 |
| 5152 | ND23898 | 6 | 33.3 | 87.0 | 38 | 80.2 | 0.8 | 1.9 | 1 | 14.0 | 6.21 | 46.5 | 206 | 73.1 | 156 | 264 | 1.51 | 5.5 | 44 | 26 |

Table 7

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F-C (%) | Wort Color | Wort Clarity | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (*ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (Hach) | Quality Score | Overall Rank |
|---------------------------|-----------------------|-------|--------------------|--------------|-----------------------|------------------|---------|------------|--------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|--------------|
| 5153 | 2ND24263 | 2 | 40.5 | 96.7 | 36 | 82.4 | 1.0 | 1.9 | 1 | 13.2 | 5.69 | 44.1 | 187 | 78.8 | 340 | 188 | 1.52 | 5.8 | 48 | 15 |
| 5154 | 2ND24388 | 2 | 43.3 | 95.4 | 33 | 83.2 | 0.4 | 2.0 | 1 | 12.7 | 5.29 | 43.9 | 163 | 65.9 | 155 | 202 | 1.49 | 13.1 | 58 | 2 |
| 5155 | 2ND24393 | 2 | 43.3 | 95.4 | 32 | 83.0 | 0.9 | 1.9 | 1 | 12.9 | 5.57 | 46.6 | 148 | 60.6 | 285 | 254 | 1.50 | 7.9 | 58 | 2 |
| 5156 | 6B03-4301 | 6 | 36.3 | 95.4 | 37 | 79.7 | 0.6 | 1.9 | 1 | 14.4 | 6.49 | 47.7 | 257 | 78.0 | 192 | 301 | 1.53 | 6.3 | 36 | 36 |
| 5157 | 6B04-0007 | 6 | 34.0 | 90.2 | 39 | 80.1 | 0.7 | 1.7 | 1 | 13.2 | 5.77 | 44.7 | 235 | 73.6 | 231 | 208 | 1.53 | 5.3 | 54 | 7 |
| 5160 | 6B04-0075 | 6 | 32.9 | 88.7 | 37 | 80.1 | 0.9 | 2.1 | 1 | 14.3 | 6.74 | 50.0 | 250 | 92.6 | 175 | 281 | 1.48 | 4.1 | 36 | 36 |
| 5161 | SR424 | 6 | 33.7 | 89.8 | 38 | 80.1 | 0.8 | 2.3 | 1 | 13.3 | 6.38 | 49.0 | 193 | 78.2 | 189 | 295 | 1.49 | 6.9 | 46 | 18 |
| 5162 | SR425 | 6 | 32.0 | *80.8 | 39 | 80.0 | 1.2 | 2.6 | 1 | 13.5 | 6.49 | 49.5 | 185 | 66.6 | 71 | 276 | 1.46 | 9.5 | 52 | 9 |
| 5126 | HARRINGTON MALT CHECK | 2 | 35.5 | 88.8 | 80 | 79.4 | 1.1 | 1.8 | 1 | 12.4 | 5.43 | 44.0 | 154 | 77.6 | 62 | 238 | 1.44 | 5.3 | 52 | |
| 5127 | MOREX MALT CHECK | 6 | 34.2 | 94.9 | 77 | 80.8 | 1.3 | 2.1 | 1 | 12.1 | 6.03 | 50.7 | 154 | 81.2 | 60 | 268 | 1.47 | 6.6 | 53 | |
| 5158 | HARRINGTON MALT CHECK | 2 | 36.3 | 91.2 | 80 | 79.7 | 1.0 | 1.6 | 1 | 12.8 | 5.39 | 43.7 | 137 | 77.6 | 87 | 223 | 1.44 | 4.8 | 57 | |
| 5159 | MOREX MALT CHECK | 6 | 35.7 | 95.7 | 77 | 80.2 | 0.6 | 2.3 | 1 | 12.6 | 5.97 | 50.8 | 140 | 79.3 | 59 | 249 | 1.47 | 8.4 | 56 | |
| Minima | | | 28.8 | 87.0 | 28 | 77.7 | 0.3 | 1.7 | | 11.4 | 5.15 | 41.0 | 91 | 54.5 | 71 | 188 | 1.45 | 4.1 | 30 | |
| Maxima | | | 44.6 | 97.2 | 42 | 83.9 | 1.8 | 2.8 | | 15.4 | 6.86 | 50.5 | 257 | 92.6 | 340 | 344 | 1.55 | 13.1 | 61 | |
| Means | | | 36.1 | 92.7 | 37 | 80.6 | 1.0 | 2.1 | | 13.5 | 6.08 | 46.6 | 193 | 70.9 | 210 | 267 | 1.51 | 7.3 | 47 | |
| Standard Deviations | | | 3.9 | 2.8 | 3 | 1.2 | 0.3 | 0.3 | | 0.8 | 0.47 | 2.5 | 42 | 7.7 | 70 | 38 | 0.02 | 2.0 | 7 | |
| Coefficients of Variation | | | 10.7 | 3.1 | 9 | 1.4 | 32.9 | 13.9 | | 6.1 | 7.67 | 5.4 | 21 | 10.8 | 33 | 14 | 1.58 | 26.9 | 15 | |

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics

For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by R. D. Horsley, North Dakota State University - Fargo

| | | | | | | | | | | | | | | | | | | | | |
|-------------|------|-------|----|------|-----|-----|--|--|--|------|------|------|-----|------|-----|-----|------|------|----|--|
| Neg Std Dev | 24.5 | 84.2 | 28 | 77.2 | 0.0 | 1.2 | | | | 11.0 | 4.68 | 39.0 | 69 | 47.9 | -1 | 152 | 1.44 | 1.4 | 26 | |
| Pos Std Dev | 47.8 | 101.2 | 47 | 84.1 | 1.9 | 3.0 | | | | 16.0 | 7.49 | 54.2 | 318 | 94.0 | 421 | 382 | 1.58 | 13.1 | 68 | |

2008 MISSISSIPPI VALLEY UNIFORM SPRING BARLEY NURSERY - FARGO, ND

Table 8

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F-C (%) | Wort Color | Wort Clarity | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (Hach) | Quality Score | Overall Rank |
|---------|----------------------|-------|--------------------|--------------|-----------------------|------------------|---------|------------|--------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|--------------|
| 5163 | Morex | 6 | 32.1 | 91.0 | 38 | 78.2 | 0.6 | 2.5 | 1 | 16.3 | 7.21 | 44.9 | 245 | 83.4 | 81 | 296 | 1.45 | 9.0 | 42 | 21 |
| 5164 | Robust | 6 | 34.7 | 94.9 | 43 | 80.2 | 0.9 | 2.1 | 1 | 14.6 | 6.98 | 51.4 | 205 | 61.5 | 226 | 279 | 1.48 | 4.8 | 36 | 33 |
| 5165 | Legacy | 6 | 34.2 | 95.9 | 44 | 80.0 | 0.6 | 3.0 | 1 | 15.3 | 7.48 | 50.2 | 195 | 80.1 | 128 | 323 | 1.49 | 8.1 | 39 | 26 |
| 5166 | Lacey | 6 | 36.8 | 96.7 | 41 | 80.7 | 0.8 | 2.2 | 1 | 14.1 | 6.91 | 49.5 | 198 | 74.2 | 113 | 291 | 1.46 | 6.6 | 43 | 12 |
| 5167 | Conlon | 2 | 41.9 | 95.7 | 39 | 82.1 | 1.1 | 2.0 | 1 | 13.3 | 5.97 | 45.5 | 152 | 79.0 | 224 | 223 | 1.47 | 5.4 | 48 | 4 |
| 5168 | Tradition | 6 | 35.8 | 98.0 | 40 | 81.1 | 0.8 | 2.1 | 1 | 14.4 | 6.52 | 46.1 | 223 | 79.5 | 183 | 261 | 1.53 | 6.8 | 41 | 23 |
| 5169 | Stellar | 6 | 35.2 | 95.7 | 42 | 81.1 | 0.7 | 2.4 | 1 | 14.5 | 6.92 | 50.3 | 214 | 71.2 | 107 | 275 | 1.51 | 7.7 | 43 | 12 |
| 5170 | ND20448 | 6 | 35.4 | 96.7 | 43 | 80.7 | 0.7 | 2.1 | 1 | 14.3 | 6.88 | 51.0 | 181 | 75.8 | 117 | 291 | 1.51 | 6.4 | 43 | 12 |
| 5171 | Pinnacle | 2 | 41.9 | 96.1 | 36 | 83.0 | 0.8 | 1.9 | 1 | 11.9 | 5.34 | 45.9 | 122 | 67.6 | 217 | 213 | 1.50 | 5.7 | 57 | 1 |
| 5172 | M128 | 6 | 35.5 | 95.0 | 44 | 80.7 | 0.3 | 2.6 | 1 | 14.4 | 7.04 | 51.3 | 186 | 68.4 | 159 | 285 | 1.51 | 8.3 | 39 | 26 |
| 5173 | M129 | 6 | 35.0 | 94.7 | 40 | 80.7 | 0.4 | 3.1 | 1 | 14.2 | 7.07 | 50.7 | 167 | 63.0 | 146 | 295 | 1.50 | 13.2 | 39 | 26 |
| 5174 | 2ND21867 | 2 | 41.0 | 95.0 | 39 | 82.5 | 1.1 | 1.9 | 1 | 13.7 | 5.70 | 42.6 | 123 | 64.0 | 237 | 225 | 1.49 | 4.1 | 43 | 12 |
| 5175 | 2ND22927 | 2 | 43.6 | 96.3 | 44 | 84.7 | 0.9 | 2.2 | 1 | 12.0 | 6.10 | 53.9 | 104 | 77.7 | 169 | 268 | 1.51 | 7.1 | 43 | 12 |
| 5176 | SR412 | 6 | 35.8 | 96.8 | 42 | 80.8 | 0.6 | 3.0 | 1 | 14.2 | 6.72 | 48.8 | 176 | 68.4 | 104 | 284 | 1.49 | 8.4 | 43 | 12 |
| 5177 | M130 | 6 | 36.5 | 97.1 | 43 | 80.4 | 0.7 | 2.8 | 1 | 14.4 | 7.19 | 51.8 | 180 | 66.4 | 239 | 282 | 1.51 | 8.0 | 36 | 33 |
| 5178 | M132 | 6 | 37.2 | 97.6 | 43 | 80.1 | 0.8 | 2.4 | 1 | 14.9 | 6.69 | 46.3 | 161 | 61.5 | 214 | 271 | 1.52 | 8.9 | 41 | 23 |
| 5179 | ND22421 | 6 | 35.7 | 97.3 | 40 | 80.3 | 0.7 | 2.3 | 1 | 14.2 | 6.49 | 47.9 | 156 | 69.9 | 163 | 259 | 1.52 | 8.7 | 39 | 26 |
| 5180 | ND23311 | 6 | 35.0 | 96.0 | *29 | 82.2 | 1.1 | 2.4 | 1 | 11.3 | 5.59 | 53.8 | 82 | 68.6 | *401 | 230 | 1.54 | 7.2 | 41 | 23 |
| 5181 | 2ND22182 | 2 | 43.9 | 96.1 | 36 | 82.4 | 0.6 | 2.4 | 1 | 12.6 | 5.93 | 49.2 | 83 | 70.5 | 274 | 240 | 1.51 | 7.1 | 42 | 21 |
| 5182 | 6B02-3120 | 6 | 35.0 | 95.8 | 41 | 79.5 | 0.4 | 2.7 | 1 | 14.7 | 6.78 | 47.9 | 176 | 79.8 | 187 | 263 | 1.50 | 8.6 | 36 | 33 |
| 5183 | 6B02-3435 | 6 | 33.8 | 95.2 | 36 | 79.5 | 0.3 | 2.4 | 1 | 14.8 | 6.82 | 47.0 | 240 | 82.8 | 111 | 241 | 1.50 | 7.3 | 48 | 4 |
| 5184 | 6B03-4478 | 6 | 35.9 | 94.8 | 38 | 81.3 | 0.6 | 2.1 | 1 | 14.1 | 6.81 | 48.6 | 201 | 78.5 | 210 | 276 | 1.51 | 6.4 | 36 | 33 |
| 5185 | SR417 | 6 | 38.9 | 95.8 | 37 | 78.5 | 1.2 | 3.4 | 1 | 14.6 | 7.25 | 51.2 | 170 | 71.1 | 201 | 316 | 1.47 | 11.4 | 33 | 38 |
| 5186 | SR420 | 6 | 36.7 | 95.8 | 41 | 80.4 | 0.8 | 2.9 | 1 | 14.4 | 6.77 | 48.8 | 147 | 65.5 | 261 | 282 | 1.51 | 12.7 | 36 | 33 |
| 5187 | M134 | 6 | 38.5 | 96.9 | 39 | 79.6 | 0.8 | 2.3 | 1 | 13.9 | 6.16 | 45.4 | 203 | 66.2 | 259 | 201 | 1.52 | 12.8 | 46 | 9 |
| 5188 | M137 | 6 | 34.5 | 96.6 | 41 | 79.5 | 1.2 | 2.0 | 1 | 15.2 | 7.15 | 49.3 | 243 | 69.1 | 153 | 266 | 1.47 | 10.1 | 39 | 26 |
| 5189 | ND23422 | 6 | 33.2 | 95.0 | 33 | 79.4 | 0.2 | 2.1 | 1 | 14.0 | 6.07 | 44.8 | 174 | 70.0 | 214 | 266 | 1.49 | 11.0 | 46 | 9 |
| 5192 | ND23497 | 6 | 35.1 | 97.2 | 39 | 79.2 | 1.1 | 2.1 | 1 | 15.6 | 6.63 | 43.9 | 219 | 60.0 | 137 | 224 | 1.50 | 10.5 | 44 | 11 |
| 5193 | ND23753 | 6 | 34.2 | 95.7 | 42 | 78.8 | 1.2 | 2.3 | 1 | 15.1 | 6.79 | 45.0 | 211 | 66.2 | 233 | 269 | 1.52 | 9.8 | 38 | 32 |
| 5194 | ND23898 | 6 | 33.0 | 94.1 | 39 | 79.9 | 0.4 | 2.0 | 1 | 14.4 | 6.70 | 48.8 | 201 | 75.8 | 96 | 302 | 1.49 | 7.3 | 43 | 12 |

Table 8

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F-C (%) | Wort Color | Wort Clarity | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (Hach) | Quality Score | Overall Rank |
|---------------------------|-----------------------|-------|--------------------|--------------|-----------------------|------------------|---------|------------|--------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|--------------|
| 5195 | 2ND24263 | 2 | 39.5 | 94.8 | 40 | 82.2 | 0.9 | 2.1 | 1 | 13.4 | 6.00 | 45.4 | 149 | 83.8 | 302 | 254 | 1.51 | 5.6 | 43 | 12 |
| 5196 | 2ND24388 | 2 | 40.6 | 94.1 | 39 | 83.7 | 0.8 | n.d. | 3 | 12.9 | 5.62 | 44.8 | 144 | 66.5 | 175 | 210 | 1.49 | *45 | 51 | 3 |
| 5197 | 2ND24393 | 2 | 40.5 | 92.5 | 38 | 82.5 | 0.7 | 2.3 | 1 | 13.1 | 5.81 | 45.3 | 144 | 66.8 | 272 | 227 | 1.49 | 9.3 | 48 | 4 |
| 5198 | 6B03-4301 | 6 | 35.2 | 94.8 | 38 | 79.4 | 0.6 | 2.2 | 1 | 14.3 | 6.83 | 49.3 | 224 | 75.4 | 124 | 322 | 1.47 | 5.8 | 39 | 26 |
| 5199 | 6B04-0007 | 6 | 35.8 | 95.5 | 42 | 80.8 | 1.2 | 2.0 | 1 | 13.5 | 6.27 | 46.6 | 216 | 75.8 | 158 | 281 | 1.51 | 7.5 | 54 | 2 |
| 5200 | 6B04-0075 | 6 | 34.4 | 96.3 | 40 | 80.6 | 0.7 | 2.8 | 1 | 14.2 | 6.89 | 50.2 | 204 | 85.3 | 105 | 256 | 1.46 | 7.3 | 43 | 12 |
| 5201 | SR424 | 6 | 31.8 | 90.6 | 40 | 80.3 | 1.0 | 3.2 | 1 | 13.7 | 6.82 | 50.1 | 177 | 75.0 | 81 | 281 | 1.46 | 12.5 | 47 | 7 |
| 5202 | SR425 | 6 | 33.1 | 92.0 | 44 | 80.8 | 0.8 | 3.3 | 2 | 14.0 | 6.37 | 45.8 | 144 | 57.9 | 76 | 241 | 1.48 | *16.9 | 47 | 7 |
| 5190 | HARRINGTON MALT CHECK | 2 | 35.3 | 89.2 | 80 | 79.7 | 1.5 | 1.6 | 1 | 13.2 | 5.55 | 43.7 | 140 | 77.6 | 74 | 232 | 1.43 | 7.2 | 50 | |
| 5191 | MOREX MALT CHECK | 6 | 35.5 | 95.9 | 78 | 79.6 | 0.3 | 2.8 | 1 | 12.8 | 6.15 | 51.8 | 140 | 74.9 | 58 | 240 | 1.46 | 9.5 | 50 | |
| Minima | | | 31.8 | 90.6 | 33 | 78.2 | 0.2 | 1.9 | | 11.3 | 5.34 | 42.6 | 82 | 57.9 | 76 | 201 | 1.45 | 4.1 | 33 | |
| Maxima | | | 43.9 | 98.0 | 44 | 84.7 | 1.2 | 3.4 | | 16.3 | 7.48 | 53.9 | 245 | 85.3 | 302 | 323 | 1.54 | 13.2 | 57 | |
| Means | | | 36.5 | 95.4 | 40 | 80.7 | 0.8 | 2.4 | | 14.1 | 6.56 | 48.1 | 177 | 71.6 | 174 | 265 | 1.50 | 8.3 | 43 | |
| Standard Deviations | | | 3.1 | 1.7 | 3 | 1.4 | 0.3 | 0.4 | | 1.0 | 0.53 | 2.8 | 41 | 7.2 | 63 | 31 | 0.02 | 2.3 | 5 | |
| Coefficients of Variation | | | 8.5 | 1.7 | 7 | 1.8 | 34.6 | 17.5 | | 7.2 | 8.12 | 5.8 | 23 | 10.0 | 36 | 12 | 1.42 | 28.2 | 12 | |

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics

For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by R. D. Horsley, North Dakota State University - Fargo

MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - 2008 Crop

Table 9 - Station Means* of Barley and Malt Quality Factors for 38 Varieties or Selections.**

| LOCATION | Kernel Weight (mg) | Kernel on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | F - C (%) | Wort Color | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (HACH) | Quality Score |
|----------------|--------------------|---------------------|-----------------------|------------------|----------------|---------------|--------------------|------------------|---------------|--------------|-----------------------|-------------------|--------------|----------------------|------------------|---------------|
| Aberdeen, ID | 40.5 A | 98.6 A | 75 A | 80.8 A | 0.9 ABC | 1.8 D | 12.5 D | 5.45 C | 45.5 C | 144 C | 59.5 B | 144 C | 202 C | 1.49 B | 9.3 B | 54 |
| Crookston, MN | 38.5 B | 98.3 A | 41 C | 80.6 A | 0.8 BC | 3.4 A | 11.8 E | 5.14 D | 45.0 C | 122 D | 46.8 C | 165 BC | 196 C | 1.52 A | 33.6 A | 47 |
| Bottineau, ND | 35.0 D | 91.8 C | 56 B | 78.3 B | 0.9 AB | 2.3 BC | 13.2 C | 5.55 C | 43.4 D | 171 B | 59.8 B | 55 D | 216 B | 1.45 C | 8.6 B | 48 |
| Carrington, ND | 36.1 C | 91.8 C | 37 D | 80.6 A | 1.0 A | 2.1 C | 13.5 B | 6.08 B | 46.6 B | 193 A | 70.9 A | 217 A | 267 A | 1.51 A | 7.3 B | 47 |
| Fargo, ND | 36.5 C | 95.4 B | 40 C | 80.7 A | 0.8 C | 2.4 B | 14.1 A | 6.56 A | 48.1 A | 177 B | 71.6 A | 180 B | 265 A | 1.50 B | 9.5 B | 43 |

* Within each column, means followed by the same letter are not significantly different (alpha=0.05), according to Duncan's Multiple Range test.

** Morex, Robust, Legacy, Lacey, Conlon, Tradition, Stellar, ND20448, Pinnacle, M128, M129, 2ND21867, 2ND22927, SR412, M130, M132, ND22421, ND23311, ND22182, 6B02-3120, 6B02-3435, 6B03-4478, SR 417, SR 420, M134, M137, ND23422, ND23497, ND23753, ND23898, 2ND24263, 2ND24388, 2ND24393, 6B03-4301, 6B04-0007, 6B04-0075, SR424, SR425

MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - 2008 CROP

Table 10 - Varietal Means of Barley and Malt Quality Factor for all Stations** including Aberdeen, ID

| Variety or Selection | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agron) | Malt Extract (%) | F - C (%) | Wort Color | Barley Protein (%) | Wort Protein (%) | S/T (%) | DP (°ASBC) | Alpha-amylase (20°DU) | Beta-glucan (ppm) | FAN (ppm) | Viscosity (Relative) | Turbidity (HACH) | Quality Score | | | | | | | | | | | | | | | |
|----------------------|--------------------|--------------|----------------------|------------------|-----------|------------|--------------------|------------------|---------|------------|-----------------------|-------------------|-----------|----------------------|------------------|---------------|------|---------|-----|---------|------|---------|-----|----------|-----|------------|------|----------|------|------|----|
| Morex | 32.6 | M | 88.4 | H | 49 | BCDEF | 78.5 | R | 0.8 | ABC | 2.2 | EFGHI | 14.0 | ABC | 5.75 | ABC | 41.9 | JKLM | 192 | ABCDE | 65.8 | BCD | 89 | JK | 231 | DEFGHIJKLM | 1.46 | GH | 13.5 | BCDE | 45 |
| Robust | 34.6 | HIJKLM | 93.2 | DEF | 51 | ABCD | 79.7 | IJKLMPON | 1.0 | ABC | 1.8 | HI | 13.2 | BCDEFGH | 5.59 | BCDEF | 44.2 | GHIJKLM | 167 | EFGHI | 49.7 | L | 187 | BCDEF | 217 | GHIJKLMNO | 1.48 | BCDEFGH | 6.0 | DE | 43 |
| Legacy | 33.9 | IJKLM | 93.9 | BCDEF | 53 | ABC | 80.3 | FGHIJKL | 0.8 | ABC | 2.7 | ABCDEF | 12.9 | EFGHI | 6.21 | FGHIJKLM | 49.2 | ABCDE | 175 | BCDEFGH | 69.3 | AB | 108 | FGHIJK | 257 | ABCDE | 1.48 | CDEFGH | 11.7 | CDE | 45 |
| Lacey | 35.8 | FGHIJ | 95.1 | ABCDEF | 52 | ABC | 80.5 | EFGHI | 0.8 | ABC | 2.2 | DEFGHI | 12.4 | HI | 5.64 | KLMN | 46.7 | CDEFG | 166 | EFGHIJ | 61.2 | DEFGHI | 96 | IJK | 222 | FGHIJKLMN | 1.46 | H | 15.3 | BCDE | 51 |
| Conlon | 43.8 | C | 97.8 | AB | 45 | FG | 80.5 | EFGHIJ | 1.3 | A | 1.9 | GHI | 13.1 | CDEFGH | 5.23 | BCDEFG | 41.1 | M | 139 | JKL | 61.6 | DEFGH | 210 | BCD | 184 | OPQ | 1.47 | EFGH | 9.4 | CDE | 45 |
| Tradition | 35.8 | FGHIJ | 95.7 | ABCDE | 53 | AB | 80.1 | GHIJKLM | 0.9 | ABC | 2.0 | EFGHI | 12.9 | EFGHI | 5.44 | CDEFGHIJ | 43.5 | HIJKLM | 195 | ABCD | 64.7 | BCDE | 136 | DEFGHIJK | 212 | HIJKLMNPO | 1.49 | ABCDEFGH | 14.6 | BCDE | 49 |
| Stellar | 35.5 | FGHIJ | 94.9 | ABCDEF | 50 | ABCDE | 80.6 | EFGHI | 0.9 | ABC | 2.6 | BCDEFG | 12.9 | EFGHI | 5.68 | FGHIJKLM | 46.0 | EFGHI | 189 | ABCDEF | 63.0 | BCDEF | 98 | HIJK | 221 | GNFKMHLIJ | 1.51 | ABC | 21.3 | ABC | 51 |
| ND20448 | 37.0 | EFG | 95.8 | ABCDE | 51 | ABC | 80.1 | GHIJKLMN | 1.0 | ABC | 2.1 | EFGHI | 13.3 | ABCDEFGH | 5.88 | BCDE | 46.3 | DEFGH | 171 | DEFGH | 63.2 | BCDEF | 109 | FGHIJK | 234 | CDEFGHIJK | 1.50 | ABCDEF | 13.3 | BCDE | 50 |
| Pinnacle | 45.6 | BC | 98.0 | AB | 43 | G | 81.6 | BC | 0.9 | ABC | 1.9 | FGHI | 11.5 | JK | 4.90 | MN | 43.4 | HIJKLM | 114 | MN | 54.8 | HIJKL | 206 | BCDE | 183 | PQ | 1.52 | A | 10.8 | CDE | 52 |
| M128 | 36.1 | FGHI | 94.4 | ABCDEF | 52 | ABC | 80.4 | EFGHIJK | 0.7 | BC | 2.6 | BCDEFG | 13.3 | ABCDEFGH | 6.23 | BCDE | 48.3 | ABCDE | 172 | CDEFGH | 61.9 | CDEFG | 126 | DEFGHIJK | 244 | CDEFGHI | 1.49 | ABCDEFGH | 10.3 | CDE | 48 |
| M129 | 35.4 | FGHIJ | 92.6 | EFG | 50 | ABCDE | 80.7 | DEFGH | 0.8 | BC | 3.3 | AB | 13.2 | ABCDEFGH | 6.62 | BCDEF | 51.0 | A | 149 | HIJK | 64.7 | BCDE | 108 | FGHIJK | 286 | A | 1.48 | ABCDEFGH | 11.5 | CDE | 47 |
| 2ND21867 | 43.9 | C | 97.3 | ABCD | 46 | DEFG | 81.2 | BCDE | 1.1 | ABC | 1.7 | I | 12.8 | EFGHI | 5.16 | GHIJKLM | 41.3 | LM | 120 | LM | 51.5 | KL | 178 | CDEFGHI | 190 | NOPQ | 1.48 | DEFGH | 5.1 | E | 50 |
| 2ND22927 | 46.5 | AB | 97.3 | ABCD | 52 | ABC | 82.7 | A | 0.9 | ABC | 2.7 | ABCDEF | 12.0 | IJ | 5.57 | MN | 48.4 | ABCDE | 94 | NO | 61.8 | DEFG | 192 | BCDEF | 233 | DEFGHIJKL | 1.51 | ABCD | 25.6 | AB | 47 |
| SR412 | 35.6 | FGHIJ | 95.7 | ABCDEF | 52 | ABC | 80.5 | EFGHI | 0.7 | BC | 2.8 | ABCDE | 13.0 | EFGHI | 6.07 | CDEFGHIJ | 47.8 | BCDEF | 169 | DEFGHI | 64.3 | BCDEF | 84 | JK | 258 | ABCDE | 1.50 | ABCDE | 11.0 | CDE | 52 |
| M130 | 35.7 | FGHIJ | 95.3 | ABCDEF | 53 | ABC | 80.1 | GHIJKLMON | 0.9 | ABC | 2.5 | CDEFGH | 12.7 | GHI | 6.07 | JKLMN | 49.2 | ABCDE | 156 | HIJK | 60.5 | DEFGHIJ | 183 | BCDEFG | 246 | BCDEFGH | 1.49 | ABCDEFGH | 10.8 | CDE | 47 |
| M132 | 36.6 | EFGH | 97.0 | ABCD | 52 | ABC | 80.0 | GHIJKLMON | 0.7 | BC | 2.5 | BCDEFGH | 13.1 | CDEFGH | 5.89 | BCDEFG | 46.3 | DEFGH | 153 | HIJK | 57.8 | EFGHIJK | 156 | DEFGHIJ | 247 | BCDEFG | 1.51 | ABC | 11.9 | CDE | 50 |
| ND22421 | 35.8 | FGHIJ | 95.6 | ABCDEF | 51 | ABCD | 79.6 | JKLMNOPQ | 0.8 | BC | 2.4 | CDEFGHI | 13.0 | DEFGHI | 5.53 | BCDEFGH | 44.5 | GHIJKL | 143 | IJKL | 61.0 | DEFGHIJ | 133 | DEFGHIJK | 216 | GHIJKLMNOP | 1.51 | ABC | 13.8 | BCDE | 46 |
| ND23311 | 35.6 | FGHIJ | 95.6 | ABCDEF | 44 | G | 81.3 | BCDE | 1.1 | AB | 2.4 | CDEFGHI | 11.1 | K | 5.29 | N | 50.5 | AB | 99 | MNO | 62.5 | BCDEF | 304 | A | 232 | DEFGHIJKL | 1.51 | AB | 12.0 | CDE | 43 |
| 2ND22182 | 47.8 | A | 97.4 | ABC | 43 | G | 81.1 | CDEF | 1.0 | ABC | 2.3 | DEFGHI | 12.6 | GHI | 5.12 | JKLMN | 42.0 | JKLM | 87 | O | 55.4 | GHIJKL | 260 | BA | 201 | KLMNOPQ | 1.50 | ABCD | 14.7 | BCDE | 42 |
| 6B02-3120 | 35.4 | FGHIJ | 94.7 | ABCDEF | 52 | ABC | 80.0 | GHIJKLMON | 0.8 | ABC | 2.6 | BCDEFG | 13.0 | EFGHI | 5.81 | BCDEFGHI | 46.3 | DEFGH | 158 | GHIJK | 66.2 | BCD | 142 | DEFGHIJK | 223 | EFGHIJKLMN | 1.50 | ABCDE | 14.4 | BCDE | 52 |
| 6B02-3435 | 34.0 | IJKLM | 94.0 | BCDEF | 52 | ABC | 79.2 | NOPQR | 0.8 | ABC | 2.5 | CDEFGH | 13.7 | ABCDEF | 5.74 | ABCD | 43.1 | IJKLM | 205 | A | 64.9 | BCDE | 89 | JK | 215 | GHIJKLMNOP | 1.49 | ABCDEF | 20.0 | ABC | 52 |
| 6B03-4478 | 35.9 | FGHIJ | 95.5 | ABCDEF | 51 | ABCD | 80.7 | CDEFGH | 0.9 | ABC | 2.4 | DEFGHI | 12.8 | FGHI | 5.97 | IJKLM | 48.7 | ABCDE | 163 | FGHIJK | 64.3 | BCDEF | 181 | BCDEFHG | 256 | ABCDEF | 1.50 | ABCDE | 12.0 | CDE | 46 |
| SR417 | 38.5 | E | 94.8 | ABCDEF | 49 | BCDEF | 79.0 | PQR | 0.8 | ABC | 3.2 | ABC | 12.8 | EFGHI | 6.28 | GHIJKLM | 50.2 | AB | 153 | HIJK | 63.0 | BCDEF | 130 | DEFGHIJK | 278 | AB | 1.48 | BCDEFGH | 13.2 | BCDE | 43 |
| SR420 | 35.8 | FGHIJ | 91.6 | FGH | 52 | ABC | 80.8 | CDEFGH | 1.0 | ABC | 3.4 | A | 13.0 | DEFGHI | 6.18 | BCDEFGH | 49.7 | ABC | 138 | KL | 62.8 | BCDEF | 178 | CDEFGHI | 248 | BCDEFG | 1.51 | ABCD | 21.7 | ABC | 44 |
| M134 | 36.9 | EFG | 94.7 | ABCDEF | 51 | ABC | 79.5 | KLMNOPQ | 1.0 | ABC | 2.0 | EFGHI | 12.5 | GHI | 5.23 | KLMN | 42.9 | IJKLM | 170 | DEFGHI | 54.6 | IJKL | 177 | CDEFGHI | 176 | Q | 1.51 | AB | 13.7 | BCDE | 50 |
| M137 | 35.1 | FGHIJK | 97.3 | ABCD | 52 | ABC | 79.2 | MNOPQR | 0.9 | ABC | 2.0 | EFGHI | 13.9 | ABCD | 6.07 | ABC | 45.1 | FGHIJ | 200 | AB | 60.3 | DEFGHIJ | 147 | DEFGHIJ | 230 | DEFGHIJKLM | 1.47 | DEFGH | 13.3 | BCDE | 49 |
| ND23422 | 34.9 | GHIJKL | 95.5 | ABCDEF | 47 | DEFG | 79.9 | GHIJKLMPON | 0.8 | ABC | 2.3 | DEFGHI | 12.9 | EFGHI | 5.59 | EFGHIJKL | 44.7 | FGHIJK | 155 | HIJK | 59.2 | DEFGHIJ | 182 | BCDEFHG | 240 | CDEFGHIJ | 1.50 | ABCDEF | 17.3 | BCDE | 51 |
| ND23497 | 36.1 | FGHI | 98.3 | A | 53 | ABC | 79.4 | LMNOPQR | 1.0 | ABC | 2.1 | EFGHI | 14.1 | A | 5.98 | A | 43.8 | GHIJKLM | 208 | A | 58.0 | EFGHIJK | 108 | FGHIJK | 225 | EFGHIJKLM | 1.50 | ABCD | 15.2 | BCDE | 49 |
| ND23753 | 35.5 | FGHIJ | 97.4 | ABCD | 54 | A | 78.7 | QR | 1.1 | ABC | 2.4 | DEFGHI | 14.0 | ABC | 6.13 | ABC | 44.4 | GHIJKL | 195 | ABCD | 60.4 | DEFGHIJ | 198 | BCDE | 234 | CDEFGHIJK | 1.52 | A | 15.7 | BCDE | 46 |
| ND23898 | 33.8 | JKLM | 93.6 | CDEF | 49 | ABCDEF | 79.4 | KLMNOPQ | 0.9 | ABC | 1.9 | GHI | 14.1 | AB | 5.98 | AB | 44.2 | GHIJKLM | 196 | ABCD | 66.2 | BCD | 89 | JK | 244 | CDEFGHIJ | 1.49 | ABCDEFGH | 6.4 | DE | 47 |
| 2ND24263 | 41.4 | D | 97.8 | AB | 45 | FG | 80.8 | CDEFG | 1.1 | ABC | 1.8 | HI | 13.5 | ABCDEFG | 5.49 | BCD | 41.8 | KLM | 165 | FGHIJK | 68.9 | ABC | 297 | A | 199 | LMNOPQ | 1.52 | A | 5.8 | DE | 45 |
| 2ND24388 | 43.9 | C | 96.9 | ABCD | 46 | EFG | 82.1 | AB | 0.8 | ABC | 2.8 | ABCDE | 12.4 | HI | 5.14 | LMN | 42.4 | JKLM | 149 | HIJK | 57.5 | FGHIJK | 151 | DEFGHIJ | 197 | MNOPQ | 1.49 | ABCDEFGH | 29.6 | A | 54 |
| 2ND24393 | 44.2 | C | 97.0 | ABCD | 45 | FG | 81.6 | BCD | 0.9 | ABC | 2.3 | DEFGHI | 12.9 | EFGHI | 5.31 | DEFGHIJK | 42.6 | JKLM | 147 | HIJK | 54.2 | JKL | 255 | BCA | 209 | JKLMNOP | 1.50 | ABCD | 18.3 | ABCD | 51 |
| 6B03-4301 | 37.2 | EF | 96.4 | ABCDE | 49 | CDEF | 79.1 | OPQR | 0.6 | C | 2.3 | DEFGHI | 13.8 | ABCDE | 6.13 | ABC | 46.5 | CDEFGH | 199 | ABC | 65.5 | BCD | 122 | EFGHIJK | 268 | ABC | 1.49 | ABCDEFGH | 9.0 | CDE | 43 |
| 6B04-0007 | 36.1 | FGHI | 94.5 | ABCDEF | 53 | ABC | 79.7 | IJKLMPON | 0.7 | BC | 1.9 | GHI | 12.8 | EFGHI | 5.38 | GHIJKLM | 42.9 | IJKLM | 195 | ABCD | 65.3 | BCD | 129 | DEFGHIJK | 211 | IJKLMNOP | 1.50 | ABCDEF | 12.6 | CDE | 53 |
| 6B04-0075 | 33.8 | JKLM | 93.3 | CDEF | 52 | ABC | 79.8 | HIJKLMPON | 0.7 | BC | 2.6 | BCDEFGH | 13.2 | CDEFGH | 6.13 | BCDEF | 48.5 | ABCDE | 185 | ABCDEF | 73.7 | A | 97 | HIJK | 232 | DEFGHIJKL | 1.46 | FGH | 9.3 | CDE | 44 |
| SR424 | 33.1 | KLM | 93.4 | CDEF | 51 | ABCD | 79.9 | GHIJKLMPON | 0.7 | BC | 3.3 | AB | 12.8 | EFGHI | 6.18 | HIJKLM | 49.5 | ABCD | 158 | GHIJK | 66.3 | BCD | 100 | GHIJK | 263 | ABCD | 1.48 | BCDEFGH | 15.5 | BCDE | 44 |
| SR425 | 33.0 | LM | 89.5 | GH | 54 | A | 80.3 | EFGHIJK | 0.9 | ABC | 3.0 | ABCD | 13.1 | CDEFGH | 6.17 | BCDEFG | 48.6 | ABCDE | 148 | HIJK | 60.0 | DEFGHIJ | 62 | K | 249 | BCDEFG | 1.47 | DEFGH | 13.4 | BCDE | 49 |

* Within each column, means followed by the same letter are not significantly different (alpha=0.05), according to Duncan's Multiple Range Test

** Aberdeen ID, Crookston, MN, Bottineau, Carrington and Fargo, ND

Appendix A:

METHODS

Cleaning All samples were cleaned on a Carter Dockage Tester and only grain between 5 and 7/64" was used.

Barley Mill Ground barley was prepared with a Labconco Burr mill that was adjusted so that only 35% of the grist remained on a 525 µm sieve after 3 min of shaking and tapping.

Kernel Weight The number of kernels in a 20 g aliquot of each sample was counted electronically and the '1000 kernel weight' was calculated.

Plumpness Samples were sized on a Eureka-Niagra Barley Grader and the percentage of the seeds retained on a 6/64" screen was determined.

Barley Color The brightness of the grains was measured using an Agtron M45-D analyzer.

Barley Moisture Content (Barley 5B) Five g of ground sample was dried for 3 h at 104°C. The percentage of weight loss that occurred during this drying was calculated.

Barley Protein Content Total nitrogen values were obtained using an automated Dumas combustion procedure with a LECO FP-528 analyzer. Nitrogen values were converted to protein percentages by multiplication by 6.25.

Malting Conditions 170 g (db) aliquots of barley were processed in Joe White micro-malters. Samples were hydrated to 47% moisture via a 31 h steep at 19°C: 8 h wet, 8 h air, 4 h wet, 5 h air, 2 h wet, 2 h air, 2 h wet. (Larger barleys, > 42 mg/kernel, received a continuous, wet pre-steep (16°C) of between 2 and 7 h). The samples were germinated for 48 h (18°C), 24 h (17°C), and 24 h (16°C), with moisture adjustment to 47% at 0, 24, and 48 h. The samples received 4 full turns every 2 h. The germinated grain was kilned for 24h as follows: 49°C, 10 h; 54°C, 4 h; 60°C, 3 h; 68°C, 2 h; and 85°C, 3 h, with 30 min. ramps between stages. All stages received 40% total flow, with 0% recirculation for stages 1-3, 50% for stage 4, and 75% for stage 5.

Malt Mill Fine-grind malts were prepared with a Miag laboratory cone mill that was adjusted so that 10% of the grist remained on a 525 µm sieve after 3 min of shaking, with tapping. Coarse-grind malts were prepared with a corrugated roller mill that was adjusted so that 75% of the grist remained on a 525 µm sieve. Malts to be used for moisture, protein and amyolytic activity analyses were ground in a Labconco Burr mill (see Barley Mill).

Malt Moisture Content Determined by Malt 3 (Methods of Analysis of the ASBC, 8th ed, 1992) See Barley Moisture Content.

Malt Protein Content See Barley Protein Content.

Malt Extract Samples were extracted using the Malt-4 procedure (Methods of Analysis of the ASBC, 8th ed, 1992), except that all weights and volumes specified for the method were halved. The specific gravity of the filtrate was measured with an Anton/Parr DMA5000 density meter. The density data were used to calculate the amount of soluble material present in the filtrate, and thus the percentage that was extracted from the malt. **F-C** represents the difference in extract % between the finely ground malts and the coarsely ground malts.

Wort Color was determined on a Skalar SAN plus analyzer by measuring the absorbance at 430nm and dividing by a factor determined by collaborative testing.

Wort Clarity was assessed by visual inspection.

β-Glucan Levels were determined on a Skalar SAN plus analyzer by using the Wort-18 fluorescence flow injection analysis method with calcofluor as the fluorescent agent (Methods of Analysis of the ASBC, 8th ed, 1992).

Free Amino Nitrogen Levels were determined on a Skalar SAN plus analyzer using an automated version of the Wort-12 protocol (Methods of Analysis of the ASBC, 8th ed, 1992).

Soluble (Wort) Protein Levels were determined on a Skalar SAN plus analyzer using the Wort-17 UV-spectrophotometric method (Methods of Analysis of the ASBC, 8th ed, 1992).

S/T Ratio was calculated as Soluble Protein / Total Malt Protein

Diastatic Power Values were determined on a Skalar SAN plus analyzer by the automated ferricyanide procedure Malt-6C (Methods of Analysis of the ASBC, 8th ed, 1992).

α-Amylase activities were measured on a Skalar SAN plus analyzer by heating the extract to 73°C to inactivate any β-amylase present. The remaining (α-amylase) activity was measured as described for Diastatic Power Values.

Turbidities were determined in Nephelometric Turbidity Units (NTU) on a Hach Model 18900 Ratio Turbidimeter.

Quality Scores were calculated by using a modification of the method of Clancy and Ullrich (Cereal Chem. 65:428-430, 1988). The criteria used to quantify individual quality factors are listed in Table A1.

Overall Rank Values were ordered from low to high based on their Quality Scores. A rank of '1' was assigned to the sample with the best quality score.

Appendix B

2008 Crop Year

Quality Score Parameters for 2- and 6-rowed barleys

| Quality parameter | 2-rowed | | 6-rowed | | |
|--------------------------------------|-----------------|-------|-----------|-------|---|
| | condition | score | condition | score | |
| Kernel Weight (mg) | > 42.0 | 5 | > 32.0 | 5 | |
| | 40.1–42.0 | 4 | 30.1–32.0 | 4 | |
| | 38.1–40.0 | 2 | 28.1–30.0 | 2 | |
| | ≤ 38.0 | 0 | ≤ 28.0 | 0 | |
| on 6/64 " (%) | ≥ 90.0 | 5 | ≥ 80.0 | 5 | |
| | 85.0–89.9 | 3 | 73.0–79.9 | 3 | |
| | < 85.0 | 0 | < 73.0 | 0 | |
| Malt Extract (% db) | ≥ 81.0 | 10 | ≥ 79.0 | 10 | |
| | 79.4–81.0 | 7 | 78.2–78.9 | 7 | |
| | 78.0–79.4 | 4 | 77.7–78.2 | 4 | |
| | < 78.0 | 0 | < 77.7 | 0 | |
| Wort Clarity | = 3 | 0 | = 3 | 0 | |
| | 3=hazy | = 2 | 1 | = 2 | 1 |
| | 2=slightly hazy | = 1 | 2 | = 1 | 2 |
| | 1=clear | | | | |
| Barley Protein (% db) | ≥ 13.5 | 0 | ≥ 14.0 | 0 | |
| | 13.0–13.5 | 5 | 13.5–13.9 | 5 | |
| | 11.0–13.0 | 10 | 11.5–13.5 | 10 | |
| | ≤ 11.0 | 5 | ≤ 11.5 | 5 | |
| Wort Protein (% db) | > 6.0 | 0 | > 6.0 | 0 | |
| | 5.6–6.0 | 3 | 5.7–6.0 | 3 | |
| | 4.4–5.6 | 7 | 5.2–5.7 | 7 | |
| | 4.0–4.4 | 3 | 4.8–5.2 | 3 | |
| | < 4.0 | 0 | < 4.8 | 0 | |
| S/T (Soluble/Total Protein, % db) | > 47 | 0 | > 47 | 0 | |
| | 40–47 | 5 | 42–47 | 5 | |
| | < 40 | 0 | < 42 | 0 | |
| DP (Diastatic Power, ° ASBC) | > 120 | 7 | > 140 | 7 | |
| | 100–120 | 4 | 120–140 | 4 | |
| | < 100 | 0 | < 120 | 0 | |
| Alpha-amylase (20° DU) | > 50 | 7 | > 50 | 7 | |
| | 40–50 | 4 | 40–50 | 4 | |
| | < 40 | 0 | < 40 | 0 | |
| Beta-glucan (ppm) | < 100 | 7 | < 120 | 7 | |
| | 100–150 | 3 | 120 – 170 | 3 | |
| | > 150 | 0 | > 170 | 0 | |