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

# MISSISSIPPI VALLEY REGIONAL SPRING BARLEY NURSERY
## 2010 Crop

Preliminary Quality Report

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Detailed Data:

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|---|---|
| Crookston, MN | Morris, MN |
| Sidney, MT | Bottineau, ND |
| Fargo, ND | Osnabrock, ND |

Appendix:
Methods
Criteria for Quality Score

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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.

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

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**Mississippi Valley Regional Spring Barley Nursery – 2010 Crop**

Nursery samples were received for malting quality evaluation from six experimental stations located in Minnesota, Montana or North Dakota. The parentages of the nursery entries are listed in Table 1. Twelve of the thirty-three 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 used to calculate quality scores are based upon "Ideal commercial malt criteria" developed by the American Malting Barley Association (AMBA) (http://www.ambainc.org/media/AMBA_PDFs/Press_Releases/GUIDELINES.pdf) and are listed in Appendix B.

The mean values for fourteen quality factors are listed over the six stations located in the Mississippi Valley Region (Table 2) and over all lines (Table 3). Individual station data are reported in Tables 4 through 9. Evaluations of data from individual locations and overall performance (derived primarily from Tables 2 and 3) are also presented.

The barleys from Crookston, MN (Table 4) were plump and most had good total protein levels. Most extract values were good, but soluble protein levels were generally high and most S/T ratios exceeded the upper limit. The enzyme profiles and free amino nitrogen (FAN) levels were good, and most β-glucan, viscosity and turbidity values fell within the desired ranges. The best performers were M139, 2ND25276, 6B07-1825, 2ND24388, 6B07-1684, 6B07-1753 and Morex. M139 showed excellent quality, with all parameters falling within AMBA's "ideal" range, except for a slightly elevated soluble protein value. 2ND25276 also performed very well, with an extract value of 83.7%. This line contains a "low protein" gene and the "good" lower total protein combined with a good wort protein value resulted in an elevated S/T ratio. All quality parameters

for 6B07-1825 were in the “ideal” range, except for an elevated β-glucan value. The wort from 2ND24388 was turbid and its β-glucan value was a bit high. 6B07-1684, 6B07-1753 and Morex exhibited similar good quality, except for slightly elevated soluble protein levels that contributed to unacceptably high S/T ratios.

Most of the plump barleys from Morris, MN (Table 5) had excellent protein contents, but over half of the extract values were below AMBA’s “ideal” limit. The soluble protein levels were excellent, however two thirds of the S/T ratios were too high. Amylolitic values were good and nearly all β-glucan, FAN and viscosity values were excellent. Six turbidity values were too high, exceeding 15 Hach units. The best performers were M143, 2ND24388, M139, M140, M141, 6B05-0572, Lacey, M145, 6B07-1753, Tradition, 6B05-0717 and 2ND26333. All quality parameters for M143 fell within AMBA’s “ideal” guideline ranges. 2ND24388 showed excellent quality, except for excessive haze. M139, M140, M141, 6B05-0572 and Lacey had similar excellent quality, with only slightly depressed extract values falling below “ideal”. M145 and 6B07-1753 performed well, but had elevated S/T ratios. Note that 6B07-1753 had total protein contents similar to the experimental controls, but had 1% more extract. Tradition is an experimental control that missed a maximum score by being low by 0.3% on extract and by 0.03% for soluble protein. 6B05-0717 had an elevated S/T ratio. 2ND26333 had a slightly depressed extract value and an elevated S/T ratio.

The barleys from Sidney, MT (Table 6) were plump and had good protein contents. Extract values were very good, while soluble protein levels ranged from very good to eight that were too high. Two thirds of the S/T ratios were too high. Amylolitic, FAN and turbidity values were generally very good. Over half of the β-glucan levels were too high, but only eight viscosity values exceeded the upper desired limit. The best performers were 2ND26328, Tradition, Morex, Lacey, ND22421, 6B05-0572 and 6B07-1753. 2ND26328 performed well, except for an elevated S/T ratio. Morex and Tradition were experimental controls that had good quality, except that cell wall modification was slow, with our standardized malting protocol, resulting in elevated β-glucan levels. Lacey,

another experimental control, missed a maximum quality score due to very slightly elevated soluble protein and β-glucan contents. ND22421 and 6B05-0752 had elevated S/T ratios and slightly elevated β-glucan values. 6B07-1753 had low total protein contents, with a good soluble protein value that contributed to an unacceptably high S/T value.

The barleys from Bottineau, ND (Table 7) were extremely plump and had good protein contents. Extract values were generally good, while soluble protein levels ranged from good to six that were too high. Over a third of the S/T ratios were too high. Most of the amylolytic, β-glucan, FAN, viscosity and turbidity values were good. The best performers were 2ND25276, 6B05-0572, ND26249, 6B07-1825, Lacey (all with the maximum quality score of 70), and 2ND24388, 2ND26328, 2ND24238, Robust, M139, Morex and Tradition. The lines scoring 70 had no quality deficiencies. 2ND24388 had excellent quality, except for a very high turbidity value of 30 Hach units. 2ND26328 performed extremely well, but lost a quality point for having a slightly low kernel weight. 2ND24238, Robust and M139 had "ideal" quality, except for slightly low extract values. Morex had a slightly depressed extract value and kernel weight. Tradition had a slightly depressed soluble protein value. The Bottineau location averaged a quality score of 63 and even most of those lines scoring in the bottom quarter could improve with optimized malting conditions. Lines grown at this location performed so well that quality differentiation between the highest and lowest scoring samples was minimal.

Most of the barleys from Fargo, ND (Table 8) were plump and had good protein contents. Extract values were excellent, but most soluble protein and S/T values were too high indicating excessive nitrogen modification. Twelve viscosity and 25 β-glucan values were high, indicating poor carbohydrate modification. Most amylolytic, FAN and turbidity values were good. The best performers were ND24906, 2ND24238, 6B07-1684, Lacey, 6B07-1825 and M135. ND24906 performed quite well, except for an elevated soluble protein value that raised the S/T ratio to an unacceptable level. 2ND24238 had a protein level similar to that of Pinnacle, but with 0.7% less extract. This line's wort had lower β-glucan and

more FAN contents than that of Pinnacle. 6B07-1684 was a bit thin and had elevated soluble protein and S/T values. Lacey had elevated soluble protein and S/T values. 6B07-1825 had an excellent extract value, but had elevated soluble protein and S/T values. This line's wort β-glucan content was too high, however the viscosity value was within AMBA's "ideal" range. M135 had elevated soluble protein, S/T and β-glucan values.

The barleys from Osnabrock, ND (Table 9) were plump, but total protein contents were elevated, except in some of the North Dakota "low protein" lines. Extract values were good, but nearly all soluble protein levels were too high. All S/T values exceeded the desired limit. Amylolitic, FAN, and turbidity values were excellent, while twelve β-glucan and thirteen viscosity values were too high. The best performers were SR425, 6B05-0717, 6B07-1684, SR433, SR434, 6B07-1819, 6B07-1753, 2ND24238, ND24906, M135, SR424 and 2ND24388. SR425, 6B05-0717, 6B07-1684 and SR433 had elevated soluble protein and S/T values. SR434, 6B07-1819, 6B07-1753, ND24906, M135 and SR424 had elevated soluble protein and S/T values, with slightly elevated β-glucan contents. 2ND24238 had an elevated S/T ratio, and slightly elevated soluble protein, β-glucan and viscosity values. 2ND24388 had elevated S/T, β-glucan and viscosity values and a slightly elevated soluble protein level.

The nursery performed best at the Bottineau location (Table 2). Lines grown there were plump and had excellent protein levels. Extract levels were good, although not as high as at some other locations. The averaged soluble protein levels were excellent and the S/T ratio was lower than at any other location. The average amylolytic, FAN and turbidity values were excellent, while the β-glucan and viscosity values were low, indicating very good carbohydrate modification. The nursery grew well at the Morris, Crookston and Sidney locations. The barleys were plump and had acceptable levels of total protein. All had good extract values, although the Morris location was over 1% lower than the other two. Malts generated from barleys grown at Morris had good average soluble protein and an S/T ratio only slightly above AMBA's "ideal" upper limit. Malts generated from barleys grown at Crookston and Sidney had slightly

elevated soluble protein levels and S/T values that were too high. The averaged amylolytic, FAN and viscosity values were good from these locations. Beta-glucan levels were good in the Crookston malt extracts, but high in the worts from the Sidney submissions.

The nursery grown at Fargo and Osnabrock did not perform quite as well. These barleys were plump, although less plump at Fargo, and their total protein levels were good. Extract values were good and averaged 81.2% in malts of Fargo origin. Soluble protein, S/T and β-glucan levels were generally high and viscosity levels were significantly higher at these locations. The high S/T ratios combined with the high β-glucan and viscosity values indicate unbalanced modification, with nitrogen modification occurring more rapidly than carbohydrate modification.

The best performing lines in the MVN (Table 3) were 2ND24388, 6B07-1753, 6B07-1825, Lacey, 6B05-0572, 6B05-0717, 6B07-1684 and Tradition. 2ND24388 performed consistently well at all locations. This line had the highest averaged extract value, with an excellent protein profile. Carbohydrate modification was a bit slow at a couple locations, which elevated the β-glucan average. 2ND24388 was turbid at 5 of 6 locations and the average of 42.5 Hach units is a cause for concern. 6B07-1753 showed rapid nitrogen modification with our standardized protocol and this resulted in elevated soluble protein and S/T values. Carbohydrate modification was good, so optimizing the malting protocol should allow for generation of malt superior to that tested. 6B07-1825 performed very well, but had elevated wort β-glucan levels in malts generated from five of the six nursery locations. Lacey performed well at most locations, but had very high protein contents at Osnabrock, which contributed to elevated average soluble protein and S/T values. 6B05-0572, 6B05-0717 and 6B07-1864 were quite similar in quality to Lacey, although there was a general trend of slightly higher extract values for these experimental lines. Tradition had adequate malt extract, slightly elevated soluble protein, β-glucan and viscosity values, with the highest average diastatic power levels in the nursery.

## 2010 MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY

**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. | Busch Ag. Res. | Tradition | 6B89-2126/ND10981 |
| 6. | North Dakota | Pinnacle | ND1872/ND19130 |
| 7. | North Dakota | ND22421 | ND18546/ND19656 |
| 8. | North Dakota | 2ND24388 | 2ND17274/Rawson//2ND19854 |
| 9. | Saskatchewan | SR424 | SM01262/SM01147 |
| 10. | Saskatchewan | SR425 | SM00207/SM00150 |
| 11. | Minnesota | M135 | FEG97-44/M118 |
| 12. | Minnesota | M139 | M00-33/M122 (FEG65-02) |
| 13. | Minnesota | M140 | M00-33/FEG66-08 |
| 14. | Minnesota | M141 | M122/M123 MAS |
| 15. | North Dakota | ND24906 | ND20508/ND20492 |
| 16. | North Dakota | ND25160 | ND19557/ND19491 |
| 17. | North Dakota | ND25161 | ND19557/ND19491 |
| 18. | North Dakota | 2ND25276 | ND20802/3/ND19922//ND19929/ND20177 |
| 19. | Busch Ag. Res. | 6B05-0572 | 6B95-2482-1/6B98-9852 |
| 20. | Busch Ag. Res. | 6B05-0717 | 6B98-9814/TRADITION |
| 21. | Saskatchewan | SR432 | SM01778/BT485 |
| 22. | Minnesota | M143 | |
| 23. | Minnesota | M145 | |
| 24. | North Dakota | ND26249 | |
| 25. | North Dakota | 2ND24238 | |
| 26. | North Dakota | 2ND26328 | |
| 27. | North Dakota | 2ND26333 | |
| 28. | Busch Ag. Res. | 6B07-1684 | |
| 29. | Busch Ag. Res. | 6B07-1753 | |
| 30. | Busch Ag. Res. | 6B07-1819 | |
| 31. | Busch Ag. Res. | 6B07-1825 | |
| 32. | Saskatchewan | SR433 | |
| 33 | Saskatchewan | SR434 | |

*Entries 22-33 are new for 2010.

# MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - 2010 Crop

**Table 2 - Station Means* of Barley and Malt Quality Factors for 33 Varieties or Selections****

| LOCATION | Kernel Weight (mg) | | on 6/64" (%) | | Barley Color (Agtron) | | Malt Extract (%) | | 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 | **35.7** | ab | **96.6** | a | **42.4** | c | **80.6** | b | **2.2** | b | **12.6** | c | **6.05** | c | **50.5** | bc | **158** | bc | **72.8** | bc | **125** | c | **239** | b | **1.48** | c | **11.7** | a | **54.4** |
| Morris, MN | **34.5** | c | **91.3** | c | **43.1** | c | **79.2** | d | **2.1** | b | **11.8** | d | **5.32** | e | **47.9** | d | **138** | d | **79.1** | a | **96** | d | **226** | c | **1.45** | d | **13.7** | a | **57.6** |
| Bottineau, ND | **36.0** | a | **96.6** | a | **39.2** | d | **79.7** | c | **1.9** | c | **12.5** | c | **5.59** | d | **47.1** | d | **165** | ab | **68.6** | d | **66** | e | **235** | b | **1.45** | e | **5.9** | b | **62.9** |
| Fargo, ND | **30.7** | d | **86.6** | d | **46.1** | b | **81.2** | a | **2.1** | b | **12.8** | b | **6.31** | b | **51.1** | b | **151** | c | **71.2** | cd | **213** | a | **257** | a | **1.50** | a | **11.1** | a | **46.2** |
| Osnabrock, ND | **35.2** | b | **94.2** | b | **35.2** | e | **80.6** | b | **2.5** | a | **13.2** | a | **6.60** | a | **52.0** | a | **167** | a | **74.1** | b | **168** | b | **243** | b | **1.50** | a | **6.2** | b | **49.8** |
| Sidney, MT | **36.3** | a | **94.0** | b | **52.6** | a | **80.4** | b | **1.8** | d | **12.0** | d | **5.69** | d | **49.9** | c | **160** | ab | **65.3** | e | **184** | b | **236** | b | **1.49** | b | **7.4** | b | **55.6** |

* 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, Tradition, Pinnacle, ND22421, 2ND24388, SR424, SR425, M135, M139, M140, M141, ND24906, ND25160, ND25161 6B05-0572, 6B05-0717, SR432, M143, ND26249, 2ND24238, 2ND26328, 2ND26333, 6B07-1684, 6B07-1753, 6B07-1819, 6B07-1825, SR433, SR434

## MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - 2010 CROP

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

| Variety or Selection | Kernel Weight (mg) | | on 6/64" (%) | | Barley Color (Agtron) | | Malt Extract (%) | | 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** | **31.2** | j | **84.1** | h | **43.8** | bcdefghi | **78.9** | l | **1.9** | fgh | **13.1** | bcdef | **5.92** | hijk | **47.4** | jklmn | **174** | abcd | **74.5** | bcdefg | **112** | fghi | **240** | defghi | **1.47** | efghijk | **6.3** | c | **55.7** |
| **Robust** | **34.3** | cdefg | **92.5** | abcdef | **42.3** | fghijkl | **79.3** | jkl | **1.8** | h | **13.3** | bc | **6.11** | defgh | **47.6** | jklmn | **174** | abcd | **55.9** | l | **178** | bcde | **242** | cdefghi | **1.47** | efghijk | **5.5** | c | **52.7** |
| **Legacy** | **32.0** | hij | **90.7** | defg | **45.7** | abcde | **79.6** | hijk | **2.4** | cde | **13.0** | bcdef | **6.45** | bc | **51.6** | bcdef | **170** | bcde | **74.4** | bcdefg | **162** | bcdef | **254** | cdef | **1.47** | defghijk | **8.2** | c | **50.3** |
| **Lacey** | **34.8** | cde | **94.4** | abcde | **43.7** | cdefghij | **79.9** | fghij | **1.9** | fgh | **13.1** | bcd | **5.95** | ghij | **47.4** | jklmn | **175** | abcd | **65.6** | hijk | **101** | ghi | **236** | efghi | **1.46** | jk | **9.3** | c | **58.8** |
| **Tradition** | **33.5** | defgh | **94.0** | abcde | **47.3** | a | **79.9** | fghij | **1.8** | gh | **12.8** | bcdefg | **5.72** | jklm | **46.2** | mn | **193** | a | **68.8** | efghijk | **132** | defghi | **232** | fghi | **1.50** | bcd | **7.9** | c | **57.8** |
| **Pinnacle** | **42.2** | a | **96.7** | a | **38.3** | m | **81.8** | b | **2.1** | defgh | **11.4** | nop | **5.27** | no | **48.6** | hijkl | **115** | n | **61.4** | kl | **203** | ab | **194** | k | **1.53** | a | **12.0** | c | **51.8** |
| **ND22421** | **35.5** | c | **95.8** | ab | **42.8** | efghijk | **79.6** | ghijk | **2.0** | efgh | **12.8** | cdefgh | **5.90** | hijk | **48.2** | ijklm | **151** | efghij | **67.6** | ghijk | **136** | defghi | **219** | ij | **1.49** | bcdef | **9.2** | c | **56.7** |
| **2ND24388** | **41.7** | a | **96.5** | a | **40.3** | klm | **82.4** | a | **2.8** | ab | **11.7** | lmn | **5.25** | no | **46.5** | lmn | **135** | jklmn | **64.6** | ijk | **149** | bcdefgh | **208** | jk | **1.49** | cdefgh | **42.5** | a | **59.8** |
| **SR424** | **32.6** | ghij | **90.6** | defg | **41.2** | ijklm | **80.1** | efghi | **2.4** | cde | **11.9** | klm | **5.92** | hijk | **51.9** | bcde | **144** | ghijkl | **72.6** | bcdefgh | **139** | defghi | **259** | bcde | **1.47** | defghijk | **9.7** | c | **52.7** |
| **SR425** | **32.4** | hij | **87.7** | gh | **45.3** | abcdef | **80.2** | efg | **2.2** | defg | **12.4** | ghijk | **6.02** | efghi | **50.0** | efghi | **147** | fghijkl | **67.7** | fghijk | **96** | hi | **245** | cdefgh | **1.46** | jk | **9.5** | c | **52.3** |
| **M135** | **34.7** | cde | **94.5** | abcde | **44.7** | abcdefgh | **79.9** | fghij | **2.2** | defgh | **12.7** | defghi | **5.98** | fghij | **49.0** | ghijk | **162** | defgh | **69.5** | efghij | **134** | defghi | **240** | defghi | **1.46** | ijk | **10.8** | c | **56.5** |
| **M139** | **33.2** | efghi | **91.1** | cdefg | **44.2** | bcdefghi | **79.6** | hijk | **1.8** | h | **13.0** | bcdef | **5.92** | hijk | **47.5** | jklmn | **165** | bcdef | **75.6** | bcdef | **130** | defghi | **225** | hij | **1.46** | k | **5.9** | c | **57.7** |
| **M140** | **34.3** | cdefg | **94.2** | abcde | **44.8** | abcdefg | **79.4** | jkl | **1.8** | h | **13.3** | bc | **6.00** | fghij | **47.2** | jklmn | **169** | bcde | **68.7** | efghijk | **181** | bcd | **232** | fghi | **1.47** | fghijk | **8.3** | c | **54.3** |
| **M141** | **34.3** | cdefg | **94.5** | abcde | **44.3** | abcdefghi | **79.2** | kl | **1.8** | h | **13.8** | a | **6.33** | cd | **47.6** | jklmn | **194** | a | **71.1** | cdefghi | **157** | bcdef | **255** | cdef | **1.48** | defghijk | **5.8** | c | **49.3** |
| **ND24906** | **32.9** | ghij | **96.5** | a | **46.5** | abcd | **79.5** | ijk | **2.0** | efgh | **12.7** | defgh | **6.09** | defgh | **50.0** | efghi | **186** | ab | **72.0** | bcdefghi | **98** | hi | **247** | cdefgh | **1.48** | cdefghik | **7.1** | c | **56.7** |
| **ND25160** | **33.6** | defgh | **92.9** | abcdef | **41.5** | hijkl | **81.0** | cd | **2.3** | def | **11.0** | p | **5.47** | mn | **53.2** | abc | **129** | klmn | **71.1** | cdefghi | **181** | bcd | **218** | ij | **1.50** | bc | **8.7** | c | **47.8** |
| **ND25161** | **33.3** | defghi | **93.1** | abcdef | **41.8** | ghijkl | **81.0** | cd | **2.2** | defgh | **11.2** | op | **5.51** | lmn | **52.2** | bcd | **126** | lmn | **71.9** | bcdefghi | **232** | a | **221** | ij | **1.51** | ab | **9.6** | c | **47.5** |
| **2ND25276** | **40.7** | a | **97.0** | a | **39.7** | lm | **82.4** | a | **2.3** | def | **11.5** | mno | **5.66** | lmn | **52.2** | bcdef | **118** | n | **79.4** | b | **147** | cdefghi | **220** | ij | **1.48** | defghijk | **6.6** | c | **54.8** |
| **6B05-0572** | **33.6** | defgh | **94.4** | abcde | **43.7** | cdefghij | **80.1** | efghi | **1.9** | fgh | **13.1** | bcdef | **5.99** | fghij | **47.8** | ijklmn | **191** | a | **77.6** | bcd | **132** | defghi | **247** | cdefgh | **1.49** | bcdefg | **6.6** | c | **58.3** |
| **6B05-0717** | **33.2** | efghi | **94.8** | abcd | **41.7** | ghijkl | **80.2** | efgh | **2.1** | defgh | **12.6** | efghij | **6.21** | cdefg | **51.1** | cdefg | **175** | abcd | **78.6** | bc | **94** | hi | **250** | cdefg | **1.47** | ghijk | **7.3** | c | **58.2** |
| **SR432** | **34.6** | cdef | **95.4** | abc | **41.5** | hijkl | **80.1** | fghi | **2.5** | bcd | **13.1** | bcde | **6.61** | ab | **53.0** | abc | **164** | cdefg | **76.3** | bcde | **169** | bcde | **262** | bcd | **1.48** | cdefghi | **8.9** | c | **52.0** |
| **M143** | **34.2** | cdefg | **93.5** | abcdef | **45.3** | abcdef | **79.9** | ghij | **2.2** | defgh | **13.2** | bcd | **6.24** | cdef | **49.1** | ghijk | **156** | defghi | **74.4** | bcdefg | **172** | bcde | **266** | bc | **1.47** | defghijk | **7.1** | c | **55.5** |
| **M145** | **35.0** | cd | **93.6** | abcdef | **44.8** | abcdefg | **79.7** | ghijk | **1.9** | fgh | **13.4** | ab | **6.28** | cde | **49.5** | fghij | **185** | abc | **62.8** | jk | **147** | cdefghi | **252** | cdef | **1.46** | jk | **6.3** | c | **54.0** |
| **ND26249** | **32.9** | fghi | **95.6** | abc | **35.7** | n | **80.2** | efgh | **2.0** | efgh | **11.5** | mno | **5.73** | jklm | **52.4** | bcd | **121** | mn | **67.6** | ghijk | **196** | abc | **236** | efghi | **1.49** | cdefg | **9.6** | c | **50.2** |
| **2ND24238** | **40.7** | a | **95.9** | ab | **44.2** | bcdefghi | **81.3** | bc | **2.2** | defgh | **11.5** | mno | **5.04** | o | **46.0** | n | **133** | jklmn | **71.0** | cdefghi | **126** | defghi | **192** | k | **1.48** | cdefghi | **19.2** | b | **56.2** |
| **2ND26328** | **38.6** | b | **95.4** | abc | **42.2** | ghijkl | **81.9** | b | **1.9** | fgh | **12.0** | klm | **5.74** | ijklm | **50.7** | defgh | **132** | jklmn | **69.4** | efghij | **124** | efghi | **227** | ghij | **1.46** | hijk | **6.0** | c | **56.2** |
| **2ND26333** | **41.2** | a | **96.5** | a | **41.3** | ijkl | **80.9** | cd | **2.0** | efgh | **12.6** | fghij | **5.88** | hijk | **49.3** | ghijk | **142** | hijkl | **89.2** | a | **98** | hi | **238** | defghi | **1.46** | jk | **4.9** | c | **54.7** |
| **6B07-1684** | **33.0** | efghi | **89.1** | fg | **43.5** | defghij | **80.5** | def | **2.2** | defgh | **12.2** | ijkl | **5.78** | ijkl | **50.5** | defgh | **149** | efghijk | **79.1** | b | **98** | hi | **237** | defghi | **1.49** | bcde | **10.2** | c | **57.8** |
| **6B07-1753** | **31.6** | ij | **91.2** | cdefg | **44.0** | bcdefghi | **80.7** | de | **2.1** | defgh | **12.1** | jkl | **5.96** | fghij | **51.9** | bcde | **166** | bcdef | **78.5** | bc | **93** | i | **246** | cdefgh | **1.47** | fghijk | **6.4** | c | **58.8** |
| **6B07-1819** | **32.1** | hij | **90.2** | efg | **40.7** | jklm | **80.1** | efghi | **2.1** | defgh | **12.4** | ghijk | **5.97** | fghij | **51.0** | cdefg | **167** | bcdef | **78.7** | bc | **155** | bcdefg | **251** | cdefg | **1.46** | ijk | **5.6** | c | **54.8** |
| **6B07-1825** | **32.4** | hij | **90.6** | defg | **46.7** | abc | **80.5** | def | **1.9** | fgh | **12.4** | ghijk | **5.53** | lmn | **47.2** | klmn | **168** | bcde | **68.8** | efghijk | **174** | bcde | **234** | fghi | **1.49** | bcde | **10.2** | c | **58.8** |
| **SR433** | **31.2** | j | **91.5** | bcdefg | **46.8** | ab | **80.2** | efg | **2.6** | abc | **12.3** | hijk | **6.39** | bc | **54.6** | a | **140** | ijklm | **70.2** | defghij | **98** | hi | **279** | ab | **1.45** | k | **8.5** | c | **51.7** |
| **SR434** | **34.9** | cd | **92.5** | abcdef | **41.8** | ghijkl | **79.8** | ghijk | **2.9** | a | **13.2** | bcd | **6.80** | a | **53.5** | ab | **152** | efghij | **76.5** | bcde | **150** | bcdefgh | **295** | a | **1.47** | defghijk | **8.0** | c | **45.0** |

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

** Crookston and Morris, MN, Bottineau, Fargo and Osnabrock, ND and Sidney, MT

2010 MISSISSIPPI VALLEY UNIFORM SPING BARLEY NURSERY - CROOKSTON, MN

Table 4

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5326 | Morex | 6 | 32.7 | 93.4 | 44 | 79.6 | 1.9 | 1 | 13.2 | 5.98 | 48.2 | 177 | 73.9 | 88 | 235 | 1.48 | 8.8 | 61 | 5 |
| 5327 | Robust | 6 | 36.4 | 97.5 | 43 | 79.4 | 2.0 | 1 | 13.8 | 6.40 | 47.5 | 183 | 57.8 | 146 | 250 | 1.47 | 7.0 | 49 | 25 |
| 5328 | Legacy(6B93-2978) | 6 | 34.1 | 94.7 | 45 | 80.0 | 2.3 | 1 | 13.6 | 6.63 | 50.4 | 185 | 74.2 | 181 | 264 | 1.48 | 7.4 | 46 | 29 |
| 5329 | Lacey (M98) | 6 | 36.1 | 98.3 | 41 | 80.1 | 2.3 | 1 | 13.4 | 6.15 | 49.4 | 182 | 58.4 | 91 | 235 | 1.47 | 15.2 | 58 | 9 |
| 5330 | Tradition(6B95-2482) | 6 | 34.6 | 96.7 | 50 | 79.7 | 2.0 | 1 | 13.8 | 6.07 | 46.8 | 233 | 72.1 | 81 | 239 | 1.48 | 7.8 | 58 | 9 |
| 5331 | Pinnacle (2ND21863) | 2 | *45.2 | 98.2 | 39 | 81.7 | 2.0 | 1 | 11.6 | 5.32 | 48.9 | 112 | 56.6 | 184 | 194 | 1.51 | 7.9 | 55 | 18 |
| 5332 | ND22421 | 6 | 37.3 | 99.4 | 45 | 80.3 | 2.3 | 1 | 12.8 | 6.05 | 49.5 | 161 | 64.0 | 114 | 227 | 1.49 | 13.3 | 58 | 9 |
| 5333 | 2ND24388 | 2 | 42.6 | 98.6 | 41 | 82.5 | n.d. | 3 | 11.7 | 5.03 | 43.8 | 129 | 58.9 | 144 | 189 | 1.49 | 74.0 | 62 | 4 |
| 5334 | SR424 (SM05109) | 2 | 33.9 | 94.3 | 38 | 80.7 | 2.5 | 1 | 12.1 | 5.86 | 52.5 | 147 | 74.4 | 182 | 260 | 1.47 | 9.7 | 46 | 29 |
| 5335 | SR425 (SM05198) | 2 | 34.5 | 96.1 | 44 | 80.7 | 2.2 | 1 | 12.8 | 6.33 | 50.7 | 170 | 73.4 | 100 | 255 | 1.44 | 5.5 | 50 | 24 |
| 5336 | M135 | 6 | 37.0 | 99.2 | 45 | 80.5 | 2.3 | 1 | 12.5 | 6.24 | 51.2 | 171 | 74.6 | 105 | 251 | 1.44 | 7.1 | 58 | 9 |
| 5337 | M139 | 6 | 32.1 | *87.9 | 48 | 79.8 | 1.8 | 1 | 13.1 | 5.82 | 45.9 | 159 | 72.6 | 116 | 214 | 1.46 | 7.1 | 66 | 1 |
| 5338 | M140 | 6 | 35.0 | 96.7 | 45 | 80.0 | 2.1 | 1 | 13.5 | 6.19 | 49.5 | 178 | 65.7 | 143 | 234 | 1.46 | 11.9 | 49 | 25 |
| 5339 | M141 | 6 | 35.6 | 98.8 | 44 | 79.6 | 1.8 | 1 | 14.0 | 6.60 | 48.5 | 207 | 73.9 | 113 | 246 | 1.48 | 6.7 | 48 | 27 |
| 5340 | ND24906 | 6 | 33.2 | 99.1 | 48 | 79.5 | 2.1 | 1 | 12.8 | 6.36 | 50.7 | 187 | 67.2 | 49 | 256 | 1.47 | 8.8 | 58 | 9 |
| 5341 | ND25160 | 6 | 33.7 | 95.6 | 36 | 80.7 | 2.4 | 1 | 11.1 | 5.42 | 52.8 | 127 | 66.6 | 155 | 199 | 1.50 | 15.7 | 51 | 22 |
| 5342 | ND25161 | 6 | 33.6 | 96.6 | 38 | 81.3 | 2.3 | 1 | 11.3 | 5.71 | 53.3 | 126 | 70.0 | 166 | 195 | 1.51 | 15.7 | 47 | 28 |
| 5343 | 2ND25276 | 2 | 41.0 | 97.7 | 38 | *83.7 | 2.1 | 1 | 11.2 | 5.56 | 53.8 | 124 | 81.1 | 76 | 213 | 1.46 | 5.4 | 64 | 2 |
| 5344 | 6B05-0572 | 6 | 34.8 | 98.5 | 42 | 80.3 | 2.0 | 1 | 13.3 | 6.22 | 49.6 | 200 | 81.1 | 93 | 241 | 1.50 | 8.7 | 58 | 9 |
| 5345 | 6B05-0717 | 6 | 33.6 | 97.6 | 42 | 80.1 | 2.2 | 1 | 13.0 | 6.41 | 52.0 | 182 | 80.6 | 75 | 248 | 1.48 | 10.4 | 58 | 9 |
| 5346 | SR432 (SM061377) | 6 | 36.1 | 98.0 | 39 | 80.8 | 2.6 | 1 | 13.4 | 7.02 | 55.4 | 168 | 80.7 | 161 | 272 | 1.47 | 8.4 | 54 | 19 |
| 5347 | M143 | 6 | 35.0 | 96.8 | 46 | 80.9 | 2.2 | 1 | 13.1 | 6.51 | 50.7 | 143 | 84.7 | 98 | 266 | 1.46 | 6.9 | 58 | 9 |
| 5348 | M145 | 6 | 34.8 | 97.2 | 46 | 80.0 | 2.0 | 1 | 13.4 | 6.46 | 50.6 | 192 | 64.3 | 98 | 259 | 1.46 | 9.3 | 58 | 9 |
| 5350 | ND26249 | 6 | 34.5 | 99.3 | 34 | 80.1 | 2.2 | 1 | 11.4 | 5.85 | 53.9 | 115 | 68.3 | 253 | 244 | 1.49 | 14.4 | 42 | 32 |
| 5352 | 2ND24238 | 2 | 38.7 | 94.6 | 44 | 81.4 | 2.1 | 2 | 11.5 | 5.07 | 47.6 | 123 | 70.5 | 89 | 181 | 1.51 | 21.0 | 59 | 8 |
| 5353 | 2ND26328 | 2 | 38.4 | 96.5 | 39 | 82.2 | 1.9 | 1 | 11.3 | 5.61 | 51.5 | 117 | 71.4 | 138 | 215 | 1.48 | 7.7 | 51 | 22 |
| 5354 | 2ND26333 | 2 | 40.1 | 96.3 | 37 | 80.9 | 2.2 | 1 | 12.2 | 5.76 | 50.5 | 115 | 90.6 | 87 | 227 | 1.46 | 5.8 | 54 | 19 |
| 5355 | 6B07-1684 | 6 | 34.1 | *90.9 | 42 | 80.1 | 2.3 | 1 | 12.4 | 5.78 | 50.4 | 144 | 81.1 | 85 | 249 | 1.50 | 16.8 | 61 | 5 |
| 5356 | 6B07-1753 | 6 | 33.3 | 96.0 | 45 | 80.8 | 2.0 | 1 | 11.8 | 5.96 | 51.6 | 158 | 74.3 | 78 | 241 | 1.48 | 7.7 | 61 | 5 |
| 5357 | 6B07-1819 | 6 | 32.5 | 96.5 | 39 | 80.1 | 2.1 | 1 | 12.4 | 6.04 | 52.9 | 157 | 87.3 | 160 | 277 | 1.47 | 6.5 | 54 | 19 |

Table 4

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5358 | 6B07-1825 | 6 | 33.9 | 96.4 | 47 | 80.9 | 2.0 | 1 | 12.5 | 5.50 | 46.4 | 164 | 74.2 | 189 | 245 | 1.50 | 12.0 | 63 | 3 |
| 5359 | SR433 (SM071392) | 2 | 33.8 | 95.9 | 46 | 80.8 | 2.5 | 1 | 12.6 | 6.65 | 56.4 | 142 | 79.3 | 119 | 294 | 1.45 | 6.1 | 46 | 29 |
| 5360 | SR434 (SM071487) | 2 | 37.5 | 98.0 | 39 | 79.8 | *2.9 | 1 | 14.2 | 7.04 | 52.1 | 148 | 79.1 | 169 | 288 | 1.48 | 7.9 | 33 | 33 |
| 5349 | LACEY MALT CHECK | 6 | 36.3 | 93.2 | 50 | 79.7 | 2.0 | 1 | 12.5 | 5.57 | 47.9 | 138 | 72.4 | 65 | 216 | 1.48 | 12.8 | 62 | |
| 5351 | HARRINGTON MALT CHECK | 2 | 40.1 | 97.1 | 75 | 82.0 | 1.5 | 1 | 11.8 | 5.12 | 47.5 | 129 | 82.1 | 56 | 181 | 1.46 | 6.1 | 62 | |
| Minima | | | 32.1 | 93.4 | 34 | 79.4 | 1.8 | | 11.1 | 5.03 | 43.8 | 112 | 56.6 | 49 | 181 | 1.44 | 5.4 | | |
| Maxima | | | 42.6 | 99.4 | 50 | 82.5 | 2.6 | | 14.2 | 7.04 | 56.4 | 233 | 90.6 | 253 | 294 | 1.51 | 74.0 | | |
| Means | | | 35.5 | 97.0 | 42 | 80.5 | 2.1 | | 12.6 | 6.05 | 50.5 | 158 | 72.8 | 125 | 239 | 1.48 | 11.7 | | |
| Standard Deviations | | | 2.5 | 1.6 | 4 | 0.8 | 0.2 | | 0.9 | 0.50 | 2.7 | 30 | 8.5 | 45 | 28 | 0.02 | 11.8 | | |
| Coefficients of Variation | | | 7.1 | 1.6 | 9 | 0.9 | 9.5 | | 7.2 | 8.23 | 5.4 | 19 | 11.6 | 36 | 12 | 1.28 | 101.5 | | |

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

2010 MISSISSIPPI VALLEY UNIFORM SPING BARLEY NURSERY - MORRIS, MN

Table 5

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5361 | Morex | 6 | 32.4 | 88.0 | 45 | 78.2 | 2.1 | 1 | 12.5 | 5.43 | 47.3 | 139 | 79.3 | 74 | 221 | 1.45 | 6.9 | 56 | 22 |
| 5362 | Robust | 6 | 36.7 | 92.0 | 39 | 78.3 | 1.9 | 1 | 12.7 | 5.40 | 45.8 | 132 | 52.1 | 128 | 211 | 1.45 | 6.9 | 60 | 13 |
| 5363 | Legacy(6B93-2978) | 6 | 32.2 | 89.3 | 46 | 78.5 | 2.4 | 1 | 11.9 | 5.56 | 48.6 | 130 | 75.2 | 107 | 218 | 1.46 | 13.1 | 59 | 16 |
| 5364 | Lacey (M98) | 6 | 34.6 | 93.3 | 43 | 78.7 | 2.0 | 1 | 12.6 | 5.27 | 43.8 | 143 | 61.5 | 64 | 218 | 1.44 | 10.3 | 67 | 3 |
| 5365 | Tradition(6B95-2482) | 6 | 32.6 | 91.1 | 49 | 78.7 | 1.9 | 1 | 11.9 | 5.17 | 44.0 | 154 | 69.4 | 55 | 202 | 1.46 | 8.4 | 63 | 10 |
| 5366 | Pinnacle (2ND21863) | 2 | 39.1 | 96.2 | 41 | 80.3 | 2.0 | 1 | 11.2 | 5.02 | 49.0 | 174 | 74.8 | 86 | 189 | 1.46 | 8.0 | 57 | 21 |
| 5367 | ND22421 | 6 | 34.2 | 91.1 | 42 | 78.3 | 2.1 | 1 | 12.6 | 5.50 | 47.3 | 132 | 78.3 | 57 | 205 | 1.46 | 8.6 | 59 | 16 |
| 5368 | 2ND24388 | 2 | 42.5 | 95.6 | 37 | 81.2 | n.d. | 3 | 11.6 | 4.93 | 43.5 | 131 | 72.2 | 87 | 215 | 1.46 | 45.0 | 68 | 2 |
| 5369 | SR424 (SM05109) | 2 | 31.9 | 84.0 | 40 | 78.7 | 2.4 | 1 | 11.5 | 5.52 | 52.3 | 124 | 77.3 | 88 | 272 | 1.45 | 12.1 | 49 | 26 |
| 5370 | SR425 (SM05198) | 2 | 33.7 | 89.7 | 50 | 78.6 | 2.2 | 1 | 12.1 | 5.36 | 47.3 | 113 | 71.6 | 91 | 229 | 1.47 | 14.3 | 49 | 26 |
| 5371 | M135 | 6 | 34.5 | 93.8 | 44 | 78.6 | 2.6 | 2 | 11.9 | 5.34 | 47.7 | 132 | 75.0 | 110 | 237 | 1.45 | 25.0 | 58 | 19 |
| 5372 | M139 | 6 | 33.2 | 92.9 | 43 | 78.4 | 1.8 | 1 | 12.1 | 5.24 | 46.3 | 148 | 91.8 | 69 | 221 | 1.43 | 7.3 | 67 | 3 |
| 5373 | M140 | 6 | 33.5 | 92.6 | 43 | 78.8 | 1.8 | 1 | 12.4 | 5.36 | 46.5 | 144 | 88.1 | 95 | 215 | 1.43 | 7.7 | 67 | 3 |
| 5374 | M141 | 6 | 34.9 | 93.1 | 43 | 78.3 | 1.7 | 1 | 12.8 | 5.54 | 45.1 | 161 | 77.6 | 70 | 237 | 1.44 | 6.6 | 67 | 3 |
| 5375 | ND24906 | 6 | 32.6 | 94.1 | 48 | 78.4 | 2.0 | 1 | 11.6 | 5.18 | 47.8 | 150 | 83.6 | 56 | 243 | 1.45 | 11.3 | 58 | 19 |
| 5376 | ND25160 | 6 | 33.8 | 95.3 | 43 | 80.1 | 2.0 | 1 | 10.2 | 4.94 | 51.1 | 111 | 86.0 | 84 | 225 | 1.46 | 7.7 | 49 | 26 |
| 5377 | ND25161 | 6 | 33.8 | 94.7 | 38 | 80.5 | 2.4 | 1 | 10.6 | 5.02 | 50.3 | 105 | 90.0 | 129 | 231 | 1.47 | 17.1 | 45 | 31 |
| 5378 | 2ND25276 | 2 | 40.3 | 97.6 | 41 | 81.0 | 2.2 | 1 | 10.7 | 5.15 | 49.6 | 98 | 87.9 | 154 | 208 | 1.47 | 10.2 | 45 | 31 |
| 5379 | 6B05-0572 | 6 | 32.3 | 88.3 | 42 | 78.2 | 1.9 | 1 | 12.4 | 5.35 | 44.5 | 159 | 88.6 | 90 | 221 | 1.44 | 6.6 | 67 | 3 |
| 5380 | 6B05-0717 | 6 | 32.8 | 91.9 | 40 | 78.9 | 2.0 | 1 | 11.9 | 5.59 | 48.2 | 151 | 92.6 | 67 | 223 | 1.44 | 8.3 | 62 | 11 |
| 5382 | SR432 (SM061377) | 6 | 33.0 | 92.2 | 45 | 78.8 | 2.2 | 1 | 11.7 | 5.56 | 50.5 | 131 | 86.3 | 134 | 261 | 1.47 | 16.5 | 55 | 23 |
| 5384 | M143 | 6 | 33.1 | 90.7 | 42 | 79.1 | 1.9 | 1 | 11.9 | 5.24 | 46.8 | 159 | 86.6 | 84 | 239 | 1.45 | 9.8 | 70 | 1 |
| 5385 | M145 | 6 | 35.4 | 90.6 | 46 | 79.1 | 1.8 | 1 | 12.3 | 5.66 | 48.4 | 169 | 75.5 | 114 | 207 | 1.44 | 7.3 | 65 | 8 |
| 5386 | ND26249 | 6 | 33.6 | 94.6 | 35 | 79.5 | 2.2 | 1 | 10.7 | 5.37 | 54.0 | 115 | 75.8 | 130 | 223 | 1.46 | 13.2 | 49 | 26 |
| 5387 | 2ND24238 | 2 | 41.9 | 97.3 | 46 | 80.5 | n.d. | 3 | 10.9 | *4.53 | 43.6 | 121 | 72.7 | 107 | 180 | 1.49 | 60.0 | 50 | 25 |
| 5388 | 2ND26328 | 2 | 39.2 | 94.8 | 44 | 81.2 | 1.6 | 1 | 11.1 | 5.15 | 50.5 | 116 | 68.6 | 92 | 218 | 1.45 | 5.8 | 59 | 16 |
| 5389 | 2ND26333 | 2 | 40.4 | 95.0 | 41 | 80.4 | 1.8 | 1 | 11.9 | 5.25 | 47.4 | 135 | 98.2 | 55 | 224 | 1.44 | 6.0 | 61 | 12 |
| 5390 | 6B07-1684 | 6 | 33.7 | 92.5 | 45 | 80.0 | 2.2 | 2 | 11.3 | 5.15 | 49.1 | 149 | 79.3 | 83 | 216 | 1.48 | 19.8 | 55 | 23 |
| 5391 | 6B07-1753 | 6 | 30.8 | 87.7 | 41 | 79.6 | 1.9 | 1 | 11.9 | 5.36 | 48.2 | 157 | 93.6 | 76 | 225 | 1.46 | 9.9 | 64 | 9 |
| 5392 | 6B07-1819 | 6 | 31.8 | 85.3 | 38 | 79.2 | 2.1 | 1 | 12.3 | 5.53 | 47.5 | 163 | 84.9 | 146 | 224 | 1.45 | 8.4 | 60 | 13 |

Table 5

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5393 | 6B07-1825 | 6 | 31.0 | 81.2 | 47 | 79.1 | 2.4 | 2 | 12.4 | 5.13 | 44.6 | 164 | 76.9 | 157 | 232 | 1.48 | 25.0 | 60 | 13 |
| 5394 | SR433 (SM071392) | 2 | 30.3 | 88.2 | 49 | 79.5 | 2.5 | 1 | 11.0 | 5.45 | 51.6 | 108 | 62.6 | 99 | 255 | 1.46 | 17.0 | 47 | 30 |
| 5395 | SR434 (SM071487) | 2 | 31.7 | 78.9 | 46 | 78.4 | 2.8 | 1 | 13.5 | *6.45 | 51.4 | 152 | 76.4 | 136 | *308 | 1.46 | 12.3 | 33 | 33 |
| 5381 | LACEY MALT CHECK | 6 | 36.0 | 92.4 | 52 | 79.3 | 2.1 | 1 | 13.0 | 5.65 | 44.7 | 133 | 83.1 | 77 | 233 | 1.48 | 11.2 | 67 | |
| 5383 | HARRINGTON MALT CHECK | 2 | 40.5 | 97.1 | 74 | 82.8 | 1.4 | 1 | 11.8 | 5.12 | 45.6 | 136 | 102.1 | 69 | 217 | 1.47 | 3.9 | 69 | |
| Minima | | | 30.3 | 78.9 | 35 | 78.2 | 1.6 | | 10.2 | 4.93 | 43.5 | 98 | 52.1 | 55 | 180 | 1.43 | 5.8 | | |
| Maxima | | | 42.5 | 97.6 | 50 | 81.2 | 2.8 | | 13.5 | 5.66 | 54.0 | 174 | 98.2 | 157 | 272 | 1.49 | 60.0 | | |
| Means | | | 34.5 | 91.3 | 43 | 79.2 | 2.1 | | 11.8 | 5.31 | 47.9 | 138 | 79.1 | 96 | 223 | 1.45 | 13.7 | | |
| Standard Deviations | | | 3.3 | 4.4 | 4 | 0.9 | 0.3 | | 0.7 | 0.20 | 2.7 | 20 | 10.1 | 30 | 19 | 0.01 | 11.4 | | |
| Coefficients of Variation | | | 9.4 | 4.8 | 8 | 1.2 | 13.5 | | 6.2 | 3.73 | 5.6 | 15 | 12.7 | 31 | 8 | 0.93 | 82.8 | | |

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

2010 MISSISSIPPI VALLEY UNIFORM SPING BARLEY NURSERY - SIDNEY, MT

Table 6

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5000 | Morex | 6 | 33.8 | 87.6 | 52 | 79.1 | 1.5 | 1 | 12.8 | 5.46 | 45.8 | 162 | 62.1 | 207 | 220 | 1.49 | 5.2 | 63 | 2 |
| 5001 | Robust | 6 | 34.9 | 91.5 | 54 | 79.4 | 1.4 | 1 | 12.8 | 5.71 | 45.4 | 163 | 49.6 | 276 | 229 | 1.50 | 4.1 | 56 | 14 |
| 5002 | Legacy | 6 | 33.3 | 91.6 | 55 | 80.1 | 1.6 | 1 | 12.7 | 6.12 | 51.2 | 189 | 78.5 | 241 | 245 | 1.48 | 4.7 | 51 | 26 |
| 5003 | Lacey | 6 | 36.4 | 93.9 | 53 | 80.2 | 1.6 | 1 | 12.7 | 5.70 | 46.9 | 181 | 61.2 | 121 | 218 | 1.46 | 7.4 | 62 | 4 |
| 5004 | Tradition | 6 | 35.5 | 95.0 | 56 | 80.1 | 1.7 | 1 | 12.2 | 5.42 | 45.3 | 197 | 63.1 | 224 | 211 | 1.52 | 10.1 | 63 | 2 |
| 5005 | Pinnacle | 2 | 44.3 | 96.5 | 48 | 81.7 | 1.9 | 2 | 10.8 | 5.20 | 50.6 | 106 | 54.9 | 205 | 197 | 1.51 | 13.9 | 49 | 30 |
| 5006 | ND22421 | 6 | 36.7 | 95.7 | 54 | 80.1 | 1.7 | 1 | 12.0 | 5.54 | 48.4 | 152 | 64.4 | 141 | 216 | 1.49 | 7.5 | 61 | 5 |
| 5007 | 2ND24388 | 2 | 43.4 | 96.8 | 51 | 82.1 | n.d. | 3 | 11.1 | 5.18 | 47.8 | 144 | 61.1 | 146 | 202 | 1.47 | 41.0 | 59 | 8 |
| 5008 | SR424 | 6 | 32.7 | 89.2 | 52 | 80.6 | 1.9 | 1 | 11.1 | 5.51 | 52.8 | 146 | 76.5 | 130 | 242 | 1.46 | 4.5 | 56 | 14 |
| 5009 | SR425 | 6 | 33.0 | 87.9 | 58 | 81.4 | 1.7 | 1 | 11.4 | 5.82 | 53.4 | 165 | 71.0 | 72 | 246 | 1.44 | 4.6 | 56 | 14 |
| 5010 | M135 | 6 | 35.0 | 91.3 | 54 | 79.5 | 1.7 | 2 | 12.7 | 5.74 | 46.0 | 166 | 65.7 | 202 | 227 | 1.47 | 5.1 | 58 | 11 |
| 5011 | M139 | 6 | 37.1 | 95.9 | 55 | 80.7 | 1.8 | 1 | 12.5 | 6.23 | 51.0 | 187 | 70.8 | 127 | 258 | 1.45 | 4.4 | 54 | 19 |
| 5012 | M140 | 6 | 36.8 | 94.7 | 53 | 79.2 | 1.8 | 1 | 13.3 | 5.94 | 46.7 | 162 | 60.7 | 277 | 226 | 1.48 | 7.3 | 59 | 8 |
| 5013 | M141 | 6 | 36.3 | 94.8 | 55 | 79.6 | 1.5 | 1 | 13.8 | 6.14 | 47.7 | 194 | 64.3 | 278 | 269 | 1.51 | 4.0 | 46 | 32 |
| 5014 | ND24906 | 6 | 33.9 | 97.4 | 56 | 79.9 | 1.7 | 1 | 12.4 | 6.05 | 52.6 | 189 | 63.7 | 170 | 242 | 1.51 | 5.0 | 54 | 19 |
| 5015 | ND25160 | 6 | 36.5 | 96.1 | 51 | 80.9 | 2.6 | 2 | 10.8 | 5.28 | 52.5 | 126 | 59.6 | 305 | 213 | 1.53 | 12.4 | 49 | 30 |
| 5016 | ND25161 | 6 | 35.9 | 96.0 | 52 | 80.9 | 2.0 | 1 | 11.0 | 5.39 | 52.7 | 126 | 59.2 | *424.7 | 231 | 1.57 | 8.5 | 50 | 29 |
| 5017 | 2ND25276 | 2 | 42.6 | 97.0 | 45 | 81.5 | 1.9 | 1 | 11.3 | 5.64 | 52.6 | 126 | 71.6 | 187 | 240 | 1.48 | 6.0 | 54 | 19 |
| 5018 | 6B05-0572 | 6 | 35.1 | 95.5 | 52 | 80.4 | 1.6 | 1 | 12.2 | 5.68 | 48.4 | 193 | 70.2 | 138 | 256 | 1.50 | 5.1 | 61 | 5 |
| 5019 | 6B05-0717 | 6 | 35.0 | 95.5 | 48 | 80.5 | 1.7 | 1 | 12.1 | 6.04 | 51.5 | 185 | 66.3 | 96 | 252 | 1.50 | 6.5 | 58 | 11 |
| 5020 | SR432 | 6 | 35.4 | 94.4 | 52 | 80.1 | 1.9 | 1 | 13.0 | 6.37 | 53.1 | 172 | 72.6 | 211 | 249 | 1.50 | 5.2 | 51 | 26 |
| 5021 | M143 | 6 | 36.2 | 94.6 | 56 | 79.7 | 1.8 | 1 | 12.5 | 6.09 | 50.2 | 143 | 66.9 | 239 | 270 | 1.48 | 4.1 | 51 | 26 |
| 5022 | M145 | 6 | 36.0 | 94.5 | 54 | 79.3 | 1.6 | 1 | 12.8 | 5.96 | 50.3 | 176 | 52.2 | 209 | 252 | 1.47 | 4.7 | 54 | 19 |
| 5023 | ND26249 | 6 | 33.2 | 96.6 | 44 | 80.9 | 1.8 | 1 | 11.2 | 5.67 | 51.9 | 115 | 57.7 | 206 | 240 | 1.50 | 7.9 | 46 | 32 |
| 5024 | 2ND24238 | 2 | 43.5 | 95.7 | 54 | 80.7 | 1.9 | 2 | 11.4 | 4.79 | 44.3 | 137 | 57.8 | 151 | 176 | 1.49 | 13.5 | 54 | 19 |
| 5025 | 2ND26328 | 2 | 40.7 | 97.1 | 52 | 81.6 | 1.6 | 1 | 11.8 | 5.51 | 50.7 | 125 | 58.6 | 95 | 236 | 1.46 | 6.0 | 64 | 1 |
| 5026 | 2ND26333 | 2 | 44.7 | 96.8 | 49 | 80.6 | 1.6 | 1 | 12.5 | 5.78 | 48.2 | 153 | 81.1 | 90 | 244 | 1.45 | 3.9 | 58 | 11 |
| 5027 | 6B07-1684 | 6 | 31.7 | 86.4 | 51 | 80.2 | 1.8 | 1 | 11.5 | 5.39 | 51.0 | 143 | 69.2 | 145 | 232 | 1.53 | 6.8 | 55 | 18 |
| 5028 | 6B07-1753 | 6 | 33.6 | 94.3 | 55 | 81.0 | 1.5 | 1 | 11.5 | 5.61 | 53.1 | 171 | 66.5 | 94 | 228 | 1.48 | 4.6 | 60 | 7 |
| 5030 | 6B07-1819 | 6 | 32.8 | 90.0 | 51 | 80.8 | 1.6 | 1 | 11.3 | 5.53 | 52.9 | 172 | 69.5 | 191 | 258 | 1.49 | 3.7 | 53 | 25 |

Table 6

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5032 | 6B07-1825 | 6 | 32.8 | 89.8 | 56 | 80.1 | 1.5 | 1 | 11.6 | 5.17 | 45.9 | 171 | 57.8 | 240 | 216 | 1.52 | 7.9 | 59 | 8 |
| 5033 | SR433 | 6 | 32.0 | 93.9 | 58 | 80.8 | 1.8 | 1 | 11.4 | 5.85 | 54.0 | 155 | 72.9 | 110 | 263 | 1.46 | 4.1 | 56 | 14 |
| 5034 | SR434 | 6 | 36.7 | 96.9 | 49 | 80.4 | 1.9 | 1 | 12.2 | 6.22 | 52.7 | 177 | 78.2 | 129 | 280 | 1.47 | 5.5 | 54 | 19 |
| 5029 | LACEY MALT CHECK | 6 | 37.0 | 96.4 | 51 | 79.7 | 1.7 | 1 | 12.8 | 5.49 | 45.5 | 157 | 63.7 | 73 | 191 | 1.48 | 9.2 | 68 | |
| 5031 | HARRINGTON MALT CHECK | 2 | 41.0 | 96.8 | 78 | 82.5 | 1.3 | 1 | 11.9 | 5.02 | 46.2 | 152 | 83.7 | 65 | 203 | 1.46 | 3.8 | 69 | |
| Minima | | | 31.7 | 86.4 | 44 | 79.1 | 1.4 | | 10.8 | 4.79 | 44.3 | 106 | 49.6 | 72 | 176 | 1.44 | 3.7 | 46 | |
| Maxima | | | 44.7 | 97.4 | 58 | 82.1 | 2.6 | | 13.8 | 6.37 | 54.0 | 197 | 81.1 | 305 | 280 | 1.57 | 41.0 | 64 | |
| Means | | | 36.3 | 94.0 | 53 | 80.4 | 1.7 | | 12.0 | 5.69 | 49.9 | 160 | 65.3 | 177 | 236 | 1.49 | 7.4 | 56 | |
| Standard Deviations | | | 3.7 | 3.1 | 3 | 0.8 | 0.2 | | 0.8 | 0.36 | 2.9 | 25 | 7.7 | 64 | 23 | 0.03 | 6.6 | 5 | |
| Coefficients of Variation | | | 10.1 | 3.3 | 6 | 0.9 | 12.9 | | 6.4 | 6.38 | 5.8 | 16 | 11.7 | 36 | 10 | 1.90 | 88.9 | 9 | |

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 C. Allen, Busch Agricultural Resources, LLC - Fort Collins, CO

2010 MISSISSIPPI VALLEY UNIFORM SPING BARLEY NURSERY - BOTTINEAU, ND
Table 7

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5035 | Morex | 6 | 31.6 | *84.1 | 39 | 78.4 | 1.7 | 1 | 12.6 | 5.44 | 44.9 | 180 | 72.4 | 64 | 221 | 1.44 | 4.4 | 66 | 11 |
| 5036 | Robust | 6 | 34.2 | 95.0 | 39 | 78.8 | 1.4 | 1 | 12.5 | 5.58 | 44.7 | 181 | 54.0 | 95 | 222 | 1.45 | 4.0 | 67 | 8 |
| 5037 | Legacy | 6 | 31.6 | 95.6 | 40 | 78.9 | 2.0 | 1 | 13.3 | 6.22 | 50.1 | 186 | 73.1 | 60 | 246 | 1.45 | 6.3 | 54 | 30 |
| 5038 | Lacey | 6 | 35.5 | 97.2 | 39 | 79.9 | 1.5 | 1 | 12.8 | 5.60 | 46.8 | 179 | 68.8 | 55 | 220 | 1.44 | 4.5 | 70 | 1 |
| 5039 | Tradition | 6 | 33.7 | 96.9 | 40 | 79.4 | 1.3 | 1 | 12.2 | 5.02 | 42.8 | 184 | 74.9 | 53 | 216 | 1.46 | 4.4 | 66 | 11 |
| 5040 | Pinnacle | 2 | 45.0 | 99.1 | 36 | 81.2 | 1.4 | 1 | 11.0 | 4.70 | 42.9 | 115 | 58.6 | 108 | 173 | 1.50 | 10.0 | 58 | 24 |
| 5041 | ND22421 | 6 | 36.1 | 98.7 | 38 | 79.0 | 1.4 | 1 | 12.6 | 5.43 | 45.5 | 161 | 67.8 | 75 | 188 | 1.47 | 5.8 | 65 | 13 |
| 5042 | 2ND24388 | 2 | 42.7 | 98.3 | 38 | 81.4 | 2.0 | 2 | 12.0 | 4.95 | 43.9 | 137 | 60.7 | 62 | 194 | 1.45 | 30.0 | 69 | 6 |
| 5043 | SR424 | 6 | 33.2 | 96.9 | 38 | 79.4 | 2.0 | 1 | 11.7 | 5.65 | 48.6 | 147 | 69.4 | 54 | 237 | 1.45 | 6.8 | 65 | 13 |
| 5044 | SR425 | 6 | 33.7 | 96.2 | 41 | 80.0 | 1.8 | 1 | 11.8 | 5.71 | 48.5 | 145 | 62.9 | 51 | 244 | 1.44 | 8.3 | 61 | 21 |
| 5045 | M135 | 6 | 35.4 | 97.8 | 41 | 79.5 | 1.8 | 1 | 12.7 | 5.75 | 49.1 | 172 | 64.1 | 59 | 244 | 1.44 | 9.3 | 61 | 21 |
| 5046 | M139 | 6 | 34.2 | 95.8 | 36 | 78.8 | 1.3 | 1 | 13.0 | 5.37 | 44.4 | 161 | 70.2 | 114 | 217 | 1.45 | 4.6 | 67 | 8 |
| 5047 | M140 | 6 | 35.2 | 97.3 | 40 | 78.0 | 1.4 | 1 | 13.3 | 5.64 | 43.3 | 184 | 67.7 | 144 | 231 | 1.45 | 6.1 | 60 | 23 |
| 5048 | M141 | 6 | 35.8 | 97.1 | 38 | 77.6 | 1.6 | 1 | 13.8 | 5.98 | 43.9 | 204 | 70.6 | 111 | 244 | 1.45 | 4.8 | 51 | 33 |
| 5049 | ND24906 | 6 | 33.3 | 97.3 | 41 | 78.6 | 1.9 | 1 | 13.2 | 5.74 | 46.5 | 214 | 70.6 | 47 | 236 | 1.45 | 4.2 | 63 | 19 |
| 5050 | ND25160 | 6 | 35.3 | 97.5 | 41 | 80.7 | 1.9 | 1 | 11.0 | 5.07 | 48.9 | 140 | 67.8 | 90 | 217 | 1.47 | 4.4 | 53 | 31 |
| 5051 | ND25161 | 6 | 34.6 | 98.4 | 42 | 80.3 | 2.0 | 1 | 11.2 | 5.15 | 48.7 | 147 | 70.3 | 94 | 218 | 1.47 | 5.0 | 56 | 29 |
| 5052 | 2ND25276 | 2 | 43.1 | 98.5 | 43 | 81.2 | 2.0 | 1 | 12.4 | 5.37 | 47.0 | 135 | 75.5 | 60 | 212 | 1.45 | 4.3 | 70 | 1 |
| 5053 | 6B05-0572 | 6 | 34.4 | 96.3 | 39 | 79.5 | 1.8 | 1 | 13.1 | 5.47 | 42.9 | 211 | 73.4 | 53 | 238 | 1.45 | 3.5 | 70 | 1 |
| 5054 | 6B05-0717 | 6 | 34.8 | 98.7 | 37 | 80.1 | 1.8 | 1 | 12.2 | 5.46 | 48.5 | 176 | 75.2 | 47 | 238 | 1.44 | 4.1 | 65 | 13 |
| 5055 | SR432 | 6 | 35.8 | 98.6 | 36 | 79.3 | 2.7 | 1 | 13.0 | 6.41 | 51.3 | 179 | 69.5 | 48 | 252 | 1.45 | 7.9 | 58 | 24 |
| 5056 | M143 | 6 | 36.3 | 95.4 | 40 | 79.1 | 2.5 | 1 | 13.4 | 6.01 | 46.4 | 162 | 60.5 | 82 | 290 | 1.45 | 6.3 | 63 | 19 |
| 5057 | M145 | 6 | 37.4 | 97.6 | 40 | 79.2 | 2.0 | 1 | 13.8 | 6.10 | 46.8 | 203 | 55.9 | 97 | 272 | 1.43 | 3.4 | 58 | 24 |
| 5058 | ND26249 | 6 | 33.0 | 97.0 | 33 | 79.3 | 1.8 | 1 | 12.0 | 5.35 | 46.6 | 145 | 60.2 | 71 | 230 | 1.44 | 4.8 | 70 | 1 |
| 5059 | 2ND24238 | 2 | 44.0 | 99.0 | 42 | 80.2 | 1.7 | 1 | 11.6 | 4.74 | 43.6 | 150 | 63.3 | 46 | 206 | 1.44 | 4.8 | 67 | 8 |
| 5060 | 2ND26328 | 2 | 41.1 | 98.4 | 40 | 81.3 | 1.5 | 1 | 12.5 | 5.41 | 45.7 | 157 | 64.0 | 55 | 202 | 1.42 | 3.1 | 69 | 6 |
| 5062 | 2ND26333 | 2 | 45.7 | 99.0 | 38 | 80.2 | 1.8 | 1 | 13.4 | 5.87 | 46.2 | 174 | 87.1 | 45 | 259 | 1.42 | 2.8 | 58 | 24 |
| 5064 | 6B07-1684 | 6 | 33.8 | 96.8 | 39 | 80.0 | 2.2 | 1 | 11.9 | 5.58 | 48.5 | 149 | 76.7 | 41 | 255 | 1.46 | 4.3 | 65 | 13 |
| 5065 | 6B07-1753 | 6 | 32.4 | 96.6 | 40 | 80.5 | 2.6 | 1 | 11.5 | 5.63 | 53.0 | 148 | 78.8 | 37 | 252 | 1.43 | 4.3 | 65 | 13 |
| 5066 | 6B07-1819 | 6 | 32.9 | *91.6 | 40 | 79.9 | 2.3 | 1 | 11.7 | 5.47 | 50.3 | 149 | 74.4 | 46 | 243 | 1.42 | 3.0 | 65 | 13 |

Table 7

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5067 | 6B07-1825 | 6 | 33.0 | *92.6 | 42 | 80.1 | 2.0 | 1 | 11.8 | 5.21 | 46.9 | 154 | 63.5 | 57 | 230 | 1.45 | 4.0 | 70 | 1 |
| 5068 | SR433 | 6 | 32.3 | 95.2 | 40 | 79.6 | 3.2 | 1 | 12.7 | 6.38 | 53.8 | 142 | 66.6 | 37 | 290 | 1.43 | 6.3 | 58 | 24 |
| 5069 | SR434 | 6 | 37.8 | 98.9 | 37 | 79.5 | 3.6 | 1 | 13.6 | 7.08 | 54.1 | 159 | 74.3 | 35 | 322 | 1.43 | 5.1 | 53 | 31 |
| 5061 | LACEY MALT CHECK | 6 | 36.2 | 96.2 | 50 | 80.2 | 1.6 | 2 | 12.8 | 5.30 | 42.7 | 156 | 59.8 | 52 | 232 | 1.48 | 12.1 | 69 | |
| 5063 | HARRINGTON MALT CHECK | 2 | 41.0 | 96.7 | 78 | 82.4 | 1.6 | 1 | 11.3 | 4.96 | 46.2 | 146 | 85.0 | 65 | 222 | 1.47 | 3.7 | 69 | |
| Minima | | | 31.6 | 95.0 | 33 | 77.6 | 1.3 | | 11.0 | 4.70 | 42.8 | 115 | 54.0 | 35 | 173 | 1.42 | 2.8 | | |
| Maxima | | | 45.7 | 99.1 | 43 | 81.4 | 3.6 | | 13.8 | 7.08 | 54.1 | 214 | 87.1 | 144 | 322 | 1.50 | 30.0 | | |
| Means | | | 36.0 | 97.4 | 39 | 79.7 | 1.9 | | 12.5 | 5.59 | 47.1 | 165 | 68.6 | 66 | 235 | 1.45 | 5.9 | | |
| Standard Deviations | | | 4.0 | 1.2 | 2 | 0.9 | 0.5 | | 0.8 | 0.49 | 3.1 | 24 | 7.0 | 26 | 30 | 0.02 | 4.7 | | |
| Coefficients of Variation | | | 11.0 | 1.3 | 5 | 1.2 | 26.9 | | 6.4 | 8.83 | 6.6 | 14 | 10.3 | 40 | 13 | 1.16 | 78.9 | | |

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. Horsley, North Dakota State University - Fargo

2010 MISSISSIPPI VALLEY UNIFORM SPING BARLEY NURSERY - FARGO, ND

Table 8

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5256 | MOREX | 6 | 26.1 | 66.8 | 47 | 79.6 | 2.0 | 1 | 13.6 | 6.52 | 49.3 | 204 | 84.9 | 133 | 273 | 1.52 | 8.1 | 39 | 32 |
| 5257 | ROBUST | 6 | 29.9 | 85.4 | 46 | 80.7 | 1.8 | 1 | 13.7 | 6.71 | 51.6 | 191 | 65.6 | 209 | 262 | 1.47 | 5.5 | 43 | 24 |
| 5258 | LEGACY | 6 | 27.4 | 78.9 | 49 | 79.9 | 2.7 | 2 | 13.1 | 6.81 | 53.1 | 148 | 68.2 | 220 | 274 | 1.51 | 12.8 | 43 | 24 |
| 5259 | LACEY | 6 | 31.5 | 89.1 | 49 | 81.0 | 1.9 | 2 | 13.0 | 6.23 | 48.6 | 184 | 79.2 | 139 | 251 | 1.48 | 12.0 | 52 | 4 |
| 5260 | TRADITION | 6 | 29.2 | 87.7 | 50 | 81.1 | 1.9 | 1 | 13.0 | 6.08 | 49.3 | 189 | 67.8 | 212 | 249 | 1.54 | 10.5 | 48 | 10 |
| 5261 | PINNACLE | 2 | 37.6 | 93.0 | 38 | 83.6 | 2.2 | 2 | 11.6 | 5.10 | 46.3 | 88 | 59.9 | 387 | 184 | 1.59 | 19.6 | 48 | 10 |
| 5262 | ND22421 | 6 | 32.0 | 92.3 | 45 | 80.5 | 2.1 | 2 | 13.3 | 6.29 | 48.7 | 140 | 65.6 | 241 | 233 | 1.51 | 12.4 | 46 | 14 |
| 5263 | 2ND24388 | 2 | 34.4 | 92.3 | 40 | 83.4 | n.d. | 3 | 12.1 | 5.62 | 48.6 | 129 | 69.0 | 224 | 210 | 1.53 | 53.0 | 47 | 13 |
| 5264 | SR424 | 6 | 30.0 | 86.6 | 45 | 81.0 | 2.7 | 2 | 12.1 | 6.08 | 51.3 | 128 | 63.8 | 224 | 236 | 1.52 | 18.1 | 46 | 14 |
| 5265 | SR425 | 6 | 27.5 | 70.4 | 43 | 80.5 | 2.7 | 2 | 13.0 | 6.26 | 49.4 | 130 | 58.1 | 151 | 247 | 1.49 | 18.0 | 40 | 31 |
| 5266 | M135 | 6 | 30.0 | 87.4 | 43 | 80.5 | 2.4 | 1 | 13.3 | 6.35 | 48.6 | 155 | 65.0 | 188 | 261 | 1.50 | 13.2 | 50 | 5 |
| 5267 | M139 | 6 | 29.5 | 82.5 | 45 | 80.4 | 1.8 | 1 | 13.5 | 6.36 | 48.0 | 164 | 76.0 | 198 | 224 | 1.49 | 7.3 | 43 | 24 |
| 5268 | M140 | 6 | 31.5 | 89.6 | 50 | 80.4 | 1.8 | 1 | 13.6 | 6.47 | 49.7 | 170 | 63.5 | 221 | 265 | 1.49 | 10.5 | 45 | 20 |
| 5269 | M141 | 6 | 31.1 | 90.5 | 49 | 80.6 | 1.8 | 1 | 14.0 | 6.90 | 51.5 | 200 | 71.0 | 170 | 299 | 1.48 | 7.3 | 43 | 24 |
| 5270 | ND24906 | 6 | 30.0 | 93.3 | 50 | 80.3 | 1.9 | 1 | 13.2 | 6.61 | 51.1 | 183 | 73.0 | 134 | 274 | 1.49 | 8.3 | 53 | 1 |
| 5271 | ND25160 | 6 | 27.8 | 77.6 | 44 | 81.5 | 2.0 | 1 | 11.4 | 5.96 | 55.4 | 145 | 78.0 | 214 | 240 | 1.51 | 7.2 | 42 | 30 |
| 5272 | ND25161 | 6 | 27.5 | 77.0 | 46 | 81.3 | 2.0 | 1 | 11.2 | 5.77 | 54.3 | 124 | 71.3 | 271 | 244 | 1.50 | 6.7 | 39 | 32 |
| 5273 | 2ND25276 | 2 | 36.1 | 94.9 | 41 | 83.2 | 2.1 | 1 | 11.1 | 5.62 | 51.8 | 115 | 75.9 | 261 | 215 | 1.48 | 8.3 | 46 | 14 |
| 5274 | 6B05-0572 | 6 | 30.3 | 90.5 | 49 | 81.3 | 2.1 | 1 | 13.8 | 6.79 | 51.4 | 189 | 76.9 | 254 | 281 | 1.51 | 10.4 | 45 | 20 |
| 5275 | 6B05-0717 | 6 | 29.0 | 89.7 | 48 | 81.1 | 2.2 | 1 | 12.8 | 6.89 | 53.9 | 156 | 72.6 | 182 | 305 | 1.47 | 9.2 | 48 | 10 |
| 5276 | SR432 | 6 | 30.6 | 91.5 | 42 | 81.0 | 2.4 | 1 | 13.8 | 6.92 | 52.4 | 145 | 68.1 | 306 | 287 | 1.52 | 10.3 | 45 | 20 |
| 5277 | M143 | 6 | 31.6 | 91.9 | 51 | 80.9 | 2.2 | 1 | 13.5 | 6.74 | 51.1 | 155 | 69.5 | 319 | 282 | 1.50 | 8.6 | 50 | 5 |
| 5278 | M145 | 6 | 31.3 | 89.8 | 49 | 80.6 | 1.8 | 1 | 13.6 | 6.81 | 52.2 | 176 | 66.0 | 201 | 298 | 1.48 | 6.6 | 45 | 20 |
| 5279 | ND26249 | 6 | 30.3 | 90.2 | 42 | 81.5 | 1.9 | 1 | 11.6 | 5.94 | 54.5 | 98 | 70.6 | 292 | 253 | 1.52 | 9.9 | 46 | 14 |
| 5280 | 2ND24238 | 2 | 35.4 | 93.0 | 43 | 82.9 | 1.8 | 1 | 11.6 | 5.41 | 48.5 | 142 | 78.6 | 228 | 223 | 1.48 | 8.1 | 53 | 1 |
| 5281 | 2ND26328 | 2 | 33.0 | 90.7 | 46 | 82.8 | 1.8 | 1 | 12.4 | 6.10 | 52.2 | 135 | 75.9 | 205 | 263 | 1.47 | 6.7 | 46 | 14 |
| 5282 | 2ND26333 | 2 | 37.3 | 96.3 | 46 | 82.6 | 1.8 | 1 | 12.6 | 5.91 | 49.6 | 128 | 89.6 | 185 | 221 | 1.48 | 4.8 | 49 | 8 |
| 5283 | 6B07-1684 | 6 | 28.8 | 74.6 | 49 | 81.5 | 1.9 | 1 | 13.0 | 6.28 | 50.9 | 156 | 80.0 | 114 | 255 | 1.49 | 8.0 | 53 | 1 |
| 5284 | 6B07-1753 | 6 | 27.4 | 80.2 | 47 | 81.4 | 1.7 | 1 | 13.3 | 6.51 | 50.8 | 183 | 76.4 | 145 | 287 | 1.48 | 6.7 | 49 | 8 |
| 5286 | 6B07-1819 | 6 | 29.5 | 86.1 | 43 | 80.6 | 2.1 | 1 | 13.6 | 6.66 | 50.8 | 170 | 73.0 | 217 | 271 | 1.47 | 7.2 | 43 | 24 |

Table 8

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5288 | 6B07-1825 | 6 | 30.2 | 90.4 | 49 | 82.0 | 1.8 | 1 | 12.7 | 6.12 | 51.5 | 169 | 70.1 | 198 | 257 | 1.50 | 7.4 | 50 | 5 |
| 5289 | SR433 | 6 | 27.0 | 82.2 | 50 | 79.9 | 3.0 | 1 | 12.6 | 6.79 | 56.1 | 103 | 60.5 | 115 | 287 | 1.46 | 11.7 | 46 | 14 |
| 5290 | SR434 | 6 | 30.9 | 85.5 | 47 | 80.5 | 3.2 | 1 | 12.9 | 6.68 | 53.2 | 93 | 64.6 | 282 | 286 | 1.51 | 10.8 | 43 | 24 |
| 5285 | LACEY MALT CHECK | 6 | 35.7 | 93.8 | 50 | 79.9 | 1.8 | 1 | 12.7 | 5.42 | 44.2 | 155 | 57.8 | 82 | 189 | 1.48 | 11.8 | 65 | |
| 5287 | HARRINGTON MALT CHECK | 2 | 39.7 | 96.0 | 77 | 82.6 | 1.7 | 1 | 11.3 | 5.28 | 48.1 | 146 | 79.0 | 71 | 207 | 1.45 | 5.1 | 62 | |
| Minima | | | 26.1 | 66.8 | 38 | 79.6 | 1.7 | | 11.1 | 5.10 | 46.3 | 88 | 58.1 | 114 | 184 | 1.46 | 4.8 | | |
| Maxima | | | 37.6 | 96.3 | 51 | 83.6 | 3.2 | | 14.0 | 6.92 | 56.1 | 204 | 89.6 | 387 | 305 | 1.59 | 53.0 | | |
| Means | | | 30.7 | 86.6 | 46 | 81.2 | 2.1 | | 12.8 | 6.31 | 51.1 | 151 | 71.2 | 213 | 257 | 1.50 | 11.1 | | |
| Standard Deviations | | | 2.9 | 7.1 | 3 | 1.0 | 0.4 | | 0.8 | 0.47 | 2.3 | 31 | 7.2 | 61 | 29 | 0.03 | 8.3 | | |
| Coefficients of Variation | | | 9.4 | 8.2 | 7 | 1.3 | 18.4 | | 6.4 | 7.39 | 4.4 | 21 | 10.1 | 29 | 11 | 1.74 | 75.2 | | |

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. Horsley, North Dakota State University - Fargo

2010 MISSISSIPPI VALLEY UNIFORM SPING BARLEY NURSERY - OSNABROCK, ND

Table 9

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5291 | MOREX | 6 | 30.6 | *84.4 | 36 | 78.4 | 2.1 | 1 | 13.9 | 6.67 | 49.0 | 185 | 74.3 | 104 | 270 | 1.46 | 4.6 | 49 | 16 |
| 5292 | ROBUST | 6 | 33.5 | 93.3 | 33 | 79.3 | 2.1 | 1 | 14.1 | 6.85 | 50.4 | 195 | 56.2 | 212 | 280 | 1.49 | 5.2 | 41 | 31 |
| 5293 | LEGACY | 6 | 33.2 | 93.9 | 39 | 80.0 | 3.1 | 1 | 13.6 | 7.34 | 56.4 | 182 | 77.2 | 162 | 278 | 1.45 | 5.1 | 49 | 16 |
| 5294 | LACEY | 6 | 34.5 | 94.6 | 37 | 79.5 | 2.2 | 1 | 14.3 | 6.78 | 48.7 | 180 | 64.8 | 135 | 275 | 1.47 | 6.6 | 44 | 27 |
| 5295 | TRADITION | 6 | 35.1 | 96.7 | 39 | 80.2 | 2.1 | 1 | 14.0 | 6.54 | 48.9 | 202 | 65.3 | 165 | 277 | 1.53 | 6.2 | 49 | 16 |
| 5296 | PINNACLE | 2 | 42.0 | 96.9 | 28 | 82.2 | 3.1 | 1 | 12.2 | 6.26 | 53.7 | 94 | 63.4 | 248 | 230 | 1.58 | 12.3 | 44 | 27 |
| 5297 | ND22421 | 6 | 36.8 | 97.4 | 33 | 79.4 | 2.5 | 1 | 13.5 | 6.61 | 49.9 | 159 | 65.4 | 188 | 243 | 1.52 | 7.8 | 51 | 13 |
| 5298 | 2ND24388 | 2 | 44.8 | 97.6 | 35 | 83.7 | 2.3 | 1 | 11.7 | 5.82 | 51.3 | 138 | 65.6 | 233 | 237 | 1.52 | 12.2 | 54 | 5 |
| 5299 | SR424 | 6 | 34.0 | 92.3 | 34 | 80.0 | 3.0 | 1 | 13.2 | 6.89 | 53.7 | 172 | 73.9 | 158 | 306 | 1.49 | 7.1 | 54 | 5 |
| 5300 | SR425 | 6 | 32.1 | *85.8 | 36 | 80.1 | 2.7 | 1 | 13.4 | 6.61 | 50.6 | 156 | 69.4 | 109 | 251 | 1.47 | 6.3 | 58 | 1 |
| 5301 | M135 | 6 | 36.3 | 97.5 | 41 | 80.7 | 2.3 | 1 | 13.0 | 6.44 | 51.1 | 173 | 72.7 | 137 | 223 | 1.47 | 5.0 | 54 | 5 |
| 5302 | M139 | 6 | 32.9 | 91.4 | 38 | 79.4 | 2.1 | 1 | 13.8 | 6.50 | 49.1 | 172 | 72.0 | 156 | 219 | 1.47 | 4.9 | 49 | 16 |
| 5303 | M140 | 6 | 33.8 | 94.4 | 38 | 80.1 | 1.8 | 1 | 13.8 | 6.43 | 47.7 | 174 | 66.6 | 206 | 224 | 1.50 | 6.3 | 46 | 26 |
| 5304 | M141 | 6 | 32.3 | 92.5 | 37 | 79.2 | 2.1 | 1 | 14.3 | 6.80 | 49.2 | 199 | 69.3 | 203 | 233 | 1.49 | 5.3 | 41 | 31 |
| 5305 | ND24906 | 6 | 34.0 | 97.9 | 36 | 80.2 | 2.3 | 1 | 13.2 | 6.62 | 51.1 | 194 | 73.9 | 130 | 231 | 1.50 | 5.0 | 54 | 5 |
| 5306 | ND25160 | 6 | 34.3 | 95.1 | 34 | 82.0 | 2.7 | 1 | 11.3 | 6.15 | 58.3 | 124 | 68.4 | 239 | 216 | 1.53 | 4.9 | 43 | 30 |
| 5307 | ND25161 | 6 | 34.3 | 95.9 | 35 | 81.8 | 2.4 | 1 | 11.7 | 6.01 | 54.1 | 129 | 70.9 | 310 | 204 | 1.53 | 4.3 | 48 | 22 |
| 5308 | 2ND25276 | 2 | 41.0 | 96.4 | 30 | 83.9 | 3.3 | 1 | 12.3 | 6.62 | 58.1 | 110 | 84.5 | 146 | 232 | 1.52 | 5.6 | 50 | 15 |
| 5309 | 6B05-0572 | 6 | 34.7 | 97.0 | 38 | 81.0 | 2.1 | 1 | 13.6 | 6.45 | 50.2 | 197 | 75.3 | 163 | 246 | 1.53 | 5.2 | 49 | 16 |
| 5310 | 6B05-0717 | 6 | 33.8 | 95.5 | 35 | 80.3 | 2.5 | 1 | 13.5 | 6.89 | 52.3 | 202 | 84.4 | 96 | 237 | 1.48 | 5.4 | 58 | 1 |
| 5311 | SR432 | 6 | 36.9 | 97.6 | 35 | 80.5 | 3.0 | 1 | 13.9 | 7.39 | 55.5 | 187 | 80.5 | 153 | 248 | 1.49 | 5.1 | 49 | 16 |
| 5312 | M143 | 6 | 33.1 | 91.3 | 37 | 79.5 | 2.5 | 1 | 14.5 | 6.86 | 49.1 | 175 | 78.2 | 210 | 248 | 1.49 | 6.6 | 41 | 31 |
| 5313 | M145 | 6 | 34.9 | 91.7 | 34 | 80.2 | 2.0 | 1 | 14.3 | 6.69 | 48.5 | 195 | 63.1 | 161 | 227 | 1.48 | 6.2 | 44 | 27 |
| 5314 | ND26249 | 6 | 33.0 | 95.7 | 26 | 80.0 | 2.4 | 1 | 12.3 | 6.17 | 53.8 | 135 | 73.3 | 227 | 225 | 1.51 | 7.5 | 48 | 22 |
| 5315 | 2ND24238 | 2 | 40.8 | 95.9 | 36 | 82.3 | 2.4 | 1 | 12.1 | 5.69 | 48.1 | 127 | 83.0 | 137 | 187 | 1.51 | 7.9 | 54 | 5 |
| 5316 | 2ND26328 | 2 | 39.2 | 94.9 | 32 | 82.1 | 3.1 | 1 | 13.0 | 6.66 | 53.9 | 139 | 78.1 | 156 | 229 | 1.51 | 6.9 | 48 | 22 |
| 5318 | 2ND26333 | 2 | 38.8 | 95.5 | 37 | 80.6 | 2.8 | 1 | 12.8 | 6.71 | 53.8 | 150 | 88.8 | 126 | 254 | 1.50 | 6.3 | 48 | 22 |
| 5320 | 6B07-1684 | 6 | 36.2 | 93.4 | 35 | 81.2 | 2.4 | 1 | 13.0 | 6.50 | 53.3 | 155 | 88.3 | 118 | 216 | 1.51 | 5.4 | 58 | 1 |
| 5321 | 6B07-1753 | 6 | 32.2 | 92.3 | 36 | 81.0 | 2.7 | 1 | 12.7 | 6.71 | 54.9 | 181 | 81.2 | 130 | 242 | 1.49 | 5.2 | 54 | 5 |
| 5322 | 6B07-1819 | 6 | 33.2 | 91.8 | 33 | 80.0 | 2.4 | 1 | 13.5 | 6.60 | 51.6 | 192 | 83.0 | 169 | 235 | 1.47 | 4.7 | 54 | 5 |

Table 9

| Lab No. | Variety or Selection | Rowed | Kernel Weight (mg) | on 6/64" (%) | Barley Color (Agtron) | Malt Extract (%) | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5323 | 6B07-1825 | 6 | 33.7 | 93.2 | 39 | 80.8 | 2.1 | 1 | 13.1 | 6.02 | 47.8 | 188 | 70.5 | 204 | 223 | 1.51 | 4.9 | 51 | 13 |
| 5324 | SR433 | 6 | 31.8 | 93.3 | 38 | 80.7 | 2.9 | 1 | 13.4 | 7.22 | 55.7 | 187 | 79.5 | 106 | 286 | 1.48 | 6.0 | 57 | 4 |
| 5325 | SR434 | 6 | 35.0 | 97.0 | 33 | 80.2 | 3.1 | 1 | 13.0 | 7.32 | 57.2 | 180 | 86.2 | 148 | 288 | 1.49 | 6.1 | 54 | 5 |
| 5317 | LACEY MALT CHECK | | 36.2 | 93.2 | 55 | 79.9 | 1.9 | 1 | 12.8 | 5.40 | 45.1 | 137 | 66.7 | 74 | 178 | 1.47 | 10.1 | 62 | |
| 5319 | HARRINGTON MALT CHECK | | 40.5 | 97.3 | 72 | 82.6 | 1.7 | 1 | 11.5 | 5.22 | 49.4 | 126 | 87.2 | 81 | 195 | 1.45 | 5.2 | 55 | |
| Minima | | | 30.6 | 91.3 | 26 | 78.4 | 1.8 | | 11.3 | 5.69 | 47.7 | 94 | 56.2 | 96 | 187 | 1.45 | 4.3 | | |
| Maxima | | | 44.8 | 97.9 | 41 | 83.9 | 3.3 | | 14.5 | 7.39 | 58.3 | 202 | 88.8 | 310 | 306 | 1.58 | 12.3 | | |
| Means | | | 35.2 | 94.8 | 35 | 80.6 | 2.5 | | 13.2 | 6.60 | 52.0 | 167 | 74.1 | 168 | 243 | 1.50 | 6.2 | | |
| Standard Deviations | | | 3.2 | 2.1 | 3 | 1.2 | 0.4 | | 0.8 | 0.40 | 3.1 | 29 | 8.2 | 49 | 27 | 0.03 | 1.8 | | |
| Coefficients of Variation | | | 9.2 | 2.2 | 9 | 1.5 | 15.7 | | 6.2 | 6.12 | 6.0 | 17 | 11.0 | 29 | 11 | 1.75 | 29.5 | | |

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. Horsley, North Dakota State University - Fargo

# 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 32 h steep at 19°C: 8 h wet, 8 h air, 5 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 1 and 3 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. Malts to be used for moisture, protein and amylolytic 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.

**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 2010 Crop Year

**Quality Score Parameters for 2- and 6-rowed barleys**

| | 2-rowed | | 6-rowed | |
|---|---|---|---|---|
| Quality parameter | condition | score | condition | score |
| Kernel Weight | > 42.0 | 5 | > 32.0 | 5 |
| (mg) | 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 | ≥ 81.0 | 10 | ≥ 79.0 | 10 |
| (% db) | 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 | ≥ 13.5 | 0 | ≥ 14.0 | 0 |
| (% db) | 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 | > 6.0 | 0 | > 6.0 | 0 |
| (% db) | 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 | >47 | 0 | >47 | 0 |
| Protein, % db) | 40–47 | 5 | 42–47 | 5 |
| | < 40 | 0 | < 42 | 0 |
| DP (Diastatic | >120 | 7 | >140 | 7 |
| Power, ° ASBC) | 100–120 | 4 | 120–140 | 4 |
| | < 100 | 0 | < 120 | 0 |
| Alpha-amylase | >50 | 7 | >50 | 7 |
| (20° DU) | 40–50 | 4 | 40–50 | 4 |
| | < 40 | 0 | < 40 | 0 |
| Beta-glucan | < 100 | 7 | <120 | 7 |
| (ppm) | 100–150 | 3 | 120 – 170 | 3 |
| | > 150 | 0 | > 170 | 0 |
| Free Amino Nitrogen | >190 | 5 | >200 | 5 |
| | 180 – 190 | 3 | 190 – 200 | 3 |