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

MISSISSIPPI VALLEY REGIONAL SPRING BARLEY NURSERY
2006 Crop

Preliminary Quality Report

A. D. Budde, C. Martens, M. Schmitt and Staff

Detailed Data:

Aberdeen, ID
Sidney, MT
Osnabrock, ND
Morris, MN
Fargo, ND

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

July 2006
CCRU-MWA-125

Mississippi Valley Regional Spring Barley Nursery – 2006 Crop

Nursery samples were received for malting quality evaluation from five experimental stations located in Idaho, Minnesota, Montana and North Dakota. The parentages of the nursery entries are listed in Table 1. Seventeen of the thirty-six entries were new in this year's nursery.

These samples were germinated for 4 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 listed in Appendix B.

The mean values for sixteen quality factors are listed over the four stations located in the Mississippi valley region (Table 2) and over all varieties (Table 3). Tables 9 and 10 include the station data used for Tables 2 and 3, in addition to data from the Aberdeen, ID location, which lies outside of the Mississippi valley. Individual station data are reported in Tables 4 through 8. Evaluations of data from individual locations and overall performance evaluations (derived primarily from Tables 2, 3, 9 and 10) are presented below.

The Aberdeen, ID location is located outside of the Mississippi Valley Region. This location provided insight into those six-rowed lines more broadly adapted to a drier environment, with those barleys of sufficient plumpness achieving the best quality scores. Nearly three quarters of the barleys grown at Aberdeen, ID (Table 4) were too thin, and surprisingly, over three quarters of their protein contents were too low. Most extract and F – C values were good. Over half of the soluble protein levels were below the desired limit, as might be expected given the low total protein contents. A quarter of the diastatic power values were too low, influenced by the low total protein. All α–amylase levels were within desired limits, as were most of the β-glucan, free amino nitrogen (FAN), turbidity and viscosity values. The best performers were Tradition, Conlon, SR410, Stellar, SR412 and BT493. Tradition was plump and had good protein contents. Its extract value was good, but the soluble protein content was

a bit low, while the β-glucan, turbidity and viscosity values were a bit high. Conlon was very plump, with good protein contents and a good extract value. High β-glucan and viscosity values should be noted and turbidity was a bit elevated, which may have contributed to a slightly elevated wort color. SR410 and SR412 showed generally good malting quality, except for low total protein contents and unacceptably high S/T ratios, suggesting that protein modification had proceeded more rapidly than carbohydrate modification with our malting protocol. Stellar was plump, but its total protein contents were too low. Other areas of concern were elevated color, viscosity and turbidity. BT493 had low total protein contents and conflicting indicators of carbohydrate modification, with an elevated F – C value and a "good" low β-glucan level. Its S/T value was too high, negatively affected by the low total protein contents.

Half of the very plump barleys grown in Morris, MN (Table 5) had unacceptably low total protein contents. Extract values were very good, with the location averaging 80.9%. Soluble protein levels were generally good, but, when combined with the low total protein contents, resulted in over half of the S/T ratios exceeding desired limits. A third of the diastatic power values were too low, while a third of the β-glucan contents exceeded upper limits. The best performers were ND20508, 2ND22996, Tradition, M123 and 6B01-2157. Many other lines performed well as this location averaged a very respectable quality score of 50. ND20508 achieved the maximum quality score, meaning all quality parameters assessed fell within the "ideal" range established by AMBA (http://www.ambainc.org/ni/Guidelines%202004.pdf). 2ND22996 was extremely plump and had excellent malt quality, only missing the "ideal" with a diastatic power value that was a bit too low. Tradition was very plump, with a good extract value and balanced modification. M123 had an excellent quality profile, but the elevated turbidity should be noted. 6B01-2157 had a strong quality profile, with only its S/T ratio exceeding the upper limit.

A third of the barleys grown in Sidney, MT (Table 6) were too thin and a quarter of the protein contents exceeded upper limits. Six extract values were too low and most F – C differences were above the desired limit. Balanced

modification of these lines was an issue. Eleven S/T ratios were below the desired limit, while five exceeded the upper limit and over half of the β-glucan values were too high. The best performers were Stellar, SR410, SR412, ND20448, Legacy and M126. Stellar had a good malting profile, except for an unacceptably high F – C difference and a slightly elevated viscosity. SR410 and SR412 exhibited similar quality profiles. SR412 had slightly higher total protein and a higher diastatic power value than SR410. Both of these lines had very good viscosity, turbidity and FAN values. ND20448 showed a good quality profile, except for an elevated F – C difference. Legacy had elevated F – C and β-glucan values, but a good viscosity. M126 was a bit thin and had a slightly elevated F – C difference, but otherwise showed good malting quality.

Most of the barleys grown in Fargo, ND (Table 7) were plump and had good protein contents. The extract values were generally good, however over a third of the F – C differences exceeded the upper limit. Soluble protein levels ranged from one that was too low to six that exceeded the upper limit. Eight S/T ratios were too low, while two were too high. Most of the amylolytic values were good, while over a third of the β-glucan and viscosity values exceeded the upper limits. Nearly all FAN and turbidity values were good. The best performers were SR412, ND21532, Stellar, BT493, ND20448, Lacey, M125 and ND21306. SR412 achieved the maximum quality score indicating that all malt quality parameters assessed fell within the “ideal” range set by AMBA. Note that this line has high amylolytic levels. ND21532 had an excellent malt quality profile, except for being a bit thin. Note that this line had the highest barley color reading. Stellar and BT493 showed excellent quality profiles, except for slightly elevated soluble protein contents. The S/T ratio for ND20448 was a bit low, while its viscosity was a bit high. ND20448 had a “hot” amylolytic package. Lacey was a bit thin and had a slightly elevated β-glucan level that prevented this line from attaining a maximum score. ND21306 and M125 had elevated β-glucan and viscosity values.

The barleys grown in Osnabrock, ND (Table 8) were plump and most had good protein contents. Extract and F – C values were very good. Protein

modification was generally a bit excessive, resulting in nearly half of the soluble protein and S/T values exceeding upper limits and generating some very high FAN values. Amylolytic values were generally good, but nine β-glucan contents and 14 viscosities were too high. The best performers were Stellar, M126, ND21532, Tradition, M125, 6B01-2513 and ND20666. Stellar, M126 and ND21532 had maximum quality scores, indicating excellent values for those parameters used in scoring. Stellar had slightly elevated turbidity and viscosity values. Tradition had slightly elevated β-glucan and viscosity values. M125 had slightly elevated β-glucan and turbidity values. The soluble protein level of 6B01-2513 exceeded the upper limit. ND20666 was very plump, but had slightly elevated total protein, β-glucan and viscosity values.

Within the Mississippi valley (Table 2), the nursery performed best at Morris, followed by Osnabrock, Fargo and Sidney. The nursery grown in Aberdeen (Table 9) was unusual in that most of the barleys were thin and had total protein levels that were too low. This was not conducive to great malt quality, having a negative affect on soluble protein and S/T values. The nursery grew plump at Morris and had good “lower” total protein. Extract and F – C values were generally good, while there were more than sufficient soluble protein and FAN contents. The averaged S/T, β-glucan and turbidity values were just a bit high. The amylolytic values were lowest at Morris, however only a third of the diastatic power levels were too low and all of the α–amylase values were good. The barleys grown at Osnabrock were also plump, but averaged nearly 2% higher total protein than at Morris. The extract values averaged 0.5% lower than those from Morris, as would be expected with the higher total protein. The β-glucan and F – C values were lowest at Osnabrock suggesting good carbohydrate modification. The soluble protein and FAN levels averaged highest at Osnabrock implying rapid protein modification. The amylolytic values were very good, but average wort color and turbidities were a bit elevated. The barleys grown at Fargo were generally thinner than those grown at Morris or Osnabrock, while protein contents were similar to those grown in Sidney and Osnabrock. Extract values were over 1% lower than those from Osnabrock, but

nearly 1% higher than found at Sidney. Wort color and turbidity values were lowest in Fargo worts, while amylolytic activities were highest. The barleys from Sidney were less plump than those from the other locations, while barley color was higher than those of other locations in the Mississippi valley and similar to those same lines when grown in Aberdeen. The average extract values were lowest at this location. Modification was generally poorer at Sidney, with elevated β-glucan levels and lower FAN and S/T values. The averaged viscosity was lowest in Sidney worts.

The lines that performed best throughout the Mississippi Valley Nursery were Tradition, SR412, Stellar, ND21532, ND21306, M125, 2ND22895, ND20448 and BT493 (Table 3). Tradition was plump and only exceeded the "ideal" commercial protein limit at Osnabrock. Tradition's extract values were generally good and F – C differences were very good, except that from the Sidney location. The average soluble protein levels were very good, while the S/T ratio was within the acceptable range, though on the low side, strongly affected by the very low S/T result from the Sidney location. Tradition typically has an elevated amylolytic profile, and that was the case in this nursery. Beta-glucan, FAN and turbidity levels were good, while the average viscosity was a bit above the desired value. SR412 was plump and its average protein value was good, though protein levels from the individual locations ranged from a bit low to a bit high. Extract values were generally good, while soluble protein, β-glucan, FAN, viscosity and turbidity values were very good. This line had an amylolytic package similar to that of Tradition in this nursery and performed similarly to Tradition. SR412 had slightly higher soluble protein and slightly lower viscosity and β-glucan values than Tradition, implying slightly faster modification. Stellar's extract, F – C, soluble protein, S/T, β-glucan, FAN and viscosity values were good, while turbidity was a bit over the desired limit, negatively affected by the elevated values from Osnabrock and Aberdeen. ND21532 was thin at three of five locations, but surely showed the potential to "fill out" at Morris where it was 93.4% plump. Protein levels ranged from a bit low to very good and were similar to most of the newer check varieties. Extract, F – C, soluble protein, S/T, β-

glucan, FAN, viscosity and turbidity values were very good. This line performed consistently well in the Mississippi valley, but may not be suited to drier locations, although similar in quality to many of the MVN check varieties grown in dry locations. ND21306 was very plump, with good average protein contents, although the protein levels at individual locations ranged widely from too low at Morris to 13.5% at Sidney. Extract values were very good, except for that from Sidney. The soluble protein, S/T, FAN and turbidity values were very good. Modification appeared to be balanced, however, this line was less modified at most locations when compared to the experimental checks. ND21306 had an amylolytic profile similar to Lacey. M125 was plump and generally had good protein contents, with the exception of a bit low at Morris and extremely low at Aberdeen. M125 had excellent extract values. Carbohydrate modification was slow at three locations resulting in elevated F – C and β-glucan levels. The amylolytic enzyme levels in M125 were similar to that of Lacey. This line had consistently higher turbidities compared to the experimental check varieties. 2ND22895 was plump and generally had good protein contents. This two-rowed line had the highest average extract in the nursery. Carbohydrate modification was poor resulting in elevated F – C, β-glucan and viscosity values. Soluble protein, S/T, FAN, and turbidity values were good. The enzyme package in 2ND22895 was a bit lower than that found in Conlon. ND20448 was plump and had good protein contents, except when grown at Aberdeen. The extract, F – C, soluble protein, S/T, β-glucan, FAN and turbidity values were good, while viscosity values were a bit high. Diastatic power levels ranged widely from too low at Aberdeen and Morris to quite high at Fargo, while α–amylase levels were very adequate. BT493 was generally plump, except when grown at Sidney. Protein levels were generally good and consistently lower than the experimental checks. The extract, F – C, soluble protein, β-glucan, FAN and turbidity values were good. Protein modification progressed a bit too far using our standard micro-malting protocol, and resulted in high S/T and high FAN values. This line had consistently lower β-glucan levels than found in the experimental checks.

2006 MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY

Table 1 - Nursery submissions and pedigree

Entry#	CI # or Contributing Program	Name	Parentage
1.	5105	Barbless	Oderbrucker/Lion
2.	15773	Morex	Cree/Bonanza
3.	476976	Robust	Morex/Manker
4.	Busch Ag. Res.	Legacy	Bumper/Karl//Bumper/Manker/3/Bumper/Karl/4/Excel
5.	PI 613603	Lacey	M78/M79
6.	North Dakota	Conlon	Bowman*2/Brigitta mutant//ND10232
7.	Busch Ag. Res.	Tradition	6B89-2126/ND10981
8.	North Dakota	Stellar (ND16301)	Foster//ND12200/6B88-3213
9.	Saskatchewan	BT493	SM95001 / SM95098
10.	Minnesota	M122	FEG18-20 / M110
11.	Minnesota	M123	FEG39-03 / Lacey
12.	North Dakota	ND20299	ND16924/ND17082
13.	North Dakota	ND20448	ND16918/C98-10-155-3
14.	North Dakota	2ND21863	ND1872/ND19130
15.	Busch Ag. Res.	6B01-2208	LEGACY / 6B94-7544
16.	Busch Ag. Res.	6B01-2218	6B94-7378 // B2027 / M84
17.	Busch Ag. Res.	6B01-2513	LEGACY / 6B95-6311
18.	Saskatchewan	SR403	SM97292/SM97216
19.	Saskatchewan	SR404	SM97292/SM97216
20.	Minnesota	M125	M110 / M111
21.	Minnesota	M126	M109 / M111
22.	Minnesota	M128	FEG26-50 / FEG18-27
23.	Minnesota	M129	FEG59-09 / M110
24.	North Dakota	ND20508	ND16918*2 / Clho 6610
25.	North Dakota	ND20666	ND17008 / ND17239
26.	North Dakota	ND21306	DRUMMOND*2 / FEG4-66L
27.	North Dakota	ND21532	ND17008 / STELLAR-ND
28.	North Dakota	2ND21867	ND18172 / ND19130
29.	North Dakota	2ND22895	ND18370 / Rawson sib
30.	North Dakota	2ND22927	Rawson sib / ND19931
31.	North Dakota	2ND22996	ND19922 / ND18172-1
32.	Busch Ag. Res.	6B01-2157	LEGACY / 6B94-7544
33.	Busch Ag. Res.	6B01-2221	LEGACY//B3213/LEGACY
34.	Busch Ag. Res.	6B02-3295	6B95-2209 / 6B96-3272
35	Saskatchewan	SR410 (SM03152)	BT471 / SM98231
36	Saskatchewan	SR412 (SM03219)	BT459 / BT941

*Entries 20-36 are new for 2006.

MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - 2006 Crop

Table 2 - Station Means* of Barley and Malt Quality Factors for 36 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
Morris, MN	39.6	A	92.3	A	55	C	80.9	A	0.9	BC	2.1	B	11.3	C	5.15	C	47.4	A	127	D	59.8	C	152	BC	206	C	1.50	A	10.0	B	49.9
Sidney, MT	36.7	B	75.7	C	84	A	78.4	D	1.8	A	2.0	B	13.5	A	5.61	B	43.1	C	157	B	65.2	B	185	A	199	C	1.48	B	8.2	BC	40.0
Fargo, ND	34.2	C	80.7	B	63	B	79.2	C	1.1	B	1.9	C	13.3	B	5.60	B	43.4	C	170	A	69.3	A	175	AB	250	B	1.50	A	7.3	C	44.8
Osnabrock, ND	35.9	C	90.7	A	42	D	80.4	B	0.8	C	2.8	A	13.2	B	5.86	A	45.7	B	148	C	64.0	B	143	C	310	A	1.50	A	12.3	A	47.0

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

** Barbless, Morex, Robust, Legacy, Lacey, Conlon, Tradition, Stellar, BT493, M122, M123, ND20299, ND20448, 2ND21863, 6B01-2208, 6B01-2218, 6B01-2513, SR403, SR404, M125, M126, M128, M129, ND20508, ND20666, ND21306, ND21532, 2ND21867, 2ND22895, 2ND22927, 2ND22996, 6B01-2157, 6B01-2221, 6B02-3295, SR410, SR412

MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - 2006 CROP

Table 3 - Varietal Means* of Barley and Malt Quality Factor for all 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
Barbless	34.4	GHIJKLM	80.2	HIJKL	59	FGHIJ	75.8	M	2.0	A	1.8	HIJ	13.6	AB	4.68	N	36.0	L	128	IJK	49.5	I	354	AB	171	LM	1.51	BCDE	10.9	BCDEFG	28.8
Morex	33.9	HIJKLM	76.1	KLM	60	DEFGH	78.7	IJKL	1.0	BCD	1.9	EFGHIJ	13.5	ABC	5.48	FGHIJ	41.6	IJK	169	BCDEF	62.6	BCDEFG	176	DEFGHIJ	263	ABCDEFGHI	1.49	DEFGH	6.6	EFG	41.5
Robust	35.8	EFGHI	85.4	DEFGHIJ	57	HIJ	79.6	EFGHI	1.3	ABCD	1.9	FGHIJ	13.2	BCDEFGH	5.64	CDEFG	44.2	EFGHIJ	158	BCDEFGH	53.4	GHI	229	CDEF	269	ABCDEFGH	1.49	DEFGH	5.2	FG	41.0
Legacy	33.8	HIJKLM	79.2	IJKL	61	CDEFGH	79.8	DEFGH	1.3	BCD	2.5	ABCDE	12.5	GHIJKLMN	5.88	ABCDE	48.7	ABC	155	BCDEFGHI	70.9	ABC	201	DEFGH	268	ABCDEFGHI	1.51	BCDEF	7.2	DEFG	43.8
Lacey (M98)	36.7	EFG	85.6	CDEFGHIJ	57	HIJ	79.9	CDEFGH	1.2	BCD	2.2	CDEFGHI	13.3	ABCDE	5.70	BCDEFG	45.0	EFGHI	155	BCDEFGHI	64.0	ABCDEF	126	GHIJK	243	CDEFGHIJ	1.47	FGH	8.3	CDEFG	48.3
Conlon	42.9	D	91.7	ABCDE	60	EFGHI	80.4	BCDEF	1.7	AB	1.9	GHIJ	12.9	CDEFGHIJK	5.07	KLM	41.0	JK	118	JKL	62.2	BCDEFG	249	CD	185	KLM	1.49	DEFGH	8.0	CDEFG	43.3
Tradition	34.6	FGHIJKLM	85.7	CDEFGHIJ	64	ABCDE	79.7	DEFGH	1.2	BCD	1.9	FGHIJ	12.8	DEFGHIJKL	5.19	IJKL	42.1	HIJK	175	BCDE	65.6	ABCDEF	125	GHIJK	211	IJKLM	1.51	BCDEF	9.0	CDEFG	56.3
Stellar-ND	36.4	EFG	90.2	ABCDEF	60	DEFGH	80.0	CDEFG	1.0	BCD	2.3	ABCDEFGHI	12.6	FGHIJKLM	5.55	EFGH	45.1	DEFGHI	158	BCDEFGH	64.8	ABCDEF	86	JK	236	DEFGHIJK	1.50	BCDEF	11.0	BCDEFG	53.0
BT493	35.9	EFG	82.8	FGHIJKL	66	AB	80.5	BCD	1.1	BCD	2.8	AB	12.1	MN	5.88	ABCDE	50.2	A	132	HIJK	65.8	ABCDE	81	JK	288	ABCD	1.51	BCDEF	9.7	CDEFG	49.0
M122	34.5	GHIJKLM	81.6	GHIJKL	58	GHIJ	79.7	DEFGH	1.4	ABCD	2.1	DEFGHIJ	12.9	CDEFGHIJK	5.68	BCDEFG	45.7	BCDEFG	155	BCDEFGHI	67.6	ABCDE	172	DEFGHIJ	244	CDEFGHIJ	1.48	EFGH	5.4	FG	43.3
M123	36.8	EFG	82.4	FGHIJKL	61	CDEFGH	79.5	FGHI	0.8	CD	2.3	ABCDEFGHI	13.3	ABCDE	5.70	BCDEFG	44.6	EFGHI	157	BCDEFGH	55.7	FGHI	117	GHIJK	245	BCDEFGHIJ	1.49	DEFGH	15.2	ABCD	45.5
ND20299	37.4	E	92.4	ABCD	60	EFGHI	79.9	CDEFGH	1.2	BCD	2.5	ABCDEFG	12.5	IJKLMN	5.44	GHIJ	45.1	CDEFGHI	158	BCDEFGH	60.4	DEFGH	212	DEFG	215	HIJKLM	1.52	ABCD	19.6	A	48.0
ND20448	35.6	EFGHIJ	89.4	ABCDEFG	67	A	79.9	CDEFGH	0.9	CD	2.2	CDEFGHI	12.5	HIJKLMN	5.56	EFGH	46.4	BCDE	149	CDEFGHI	66.6	ABCDE	131	GHIJK	227	EFGHIJK	1.51	BCDE	7.2	DEFG	49.0
2ND21863	46.6	A	94.5	A	55	J	80.9	B	1.3	ABCD	1.8	HIJ	11.9	N	4.76	MN	41.6	IJK	98	L	53.4	GHI	314	BC	163	M	1.55	A	6.1	EFG	47.8
6B01-2208	33.7	HIJKLM	84.0	EFGHIJK	58	GHIJ	79.5	FGHI	0.9	CD	2.5	ABCDEF	13.0	BCDEFGHIJ	5.85	ABCDEF	47.7	ABCDE	149	DEFGHI	69.9	ABCD	146	EFGHIJK	250	BCDEFGHIJ	1.48	DEFGH	9.0	CDEFG	43.8
6B01-2218	32.6	M	81.4	GHIJKL	63	ABCDEF	79.9	CDEFGH	1.0	BCD	2.0	EFGHIJ	13.2	BCDEF	5.69	BCDEFG	45.0	DEFGHI	177	BCD	69.8	ABCD	78	JK	231	EFGHIJK	1.46	GH	6.4	EFG	46.0
6B01-2513	33.4	IJKLM	77.8	JKLM	63	ABCDE	79.2	GHIJ	0.9	CD	2.2	BCDEFGHI	13.2	BCDEFGHI	5.87	ABCDE	45.9	BCDEFG	167	BCDEF	73.1	A	73	K	243	CDEFGHIJ	1.46	H	7.2	DEFG	46.3
SR403	33.3	JKLM	79.8	HIJKL	61	CDEFGH	79.7	DEFGH	1.0	BCD	2.7	ABC	12.5	GHIJKLMN	5.94	ABCD	48.6	ABCD	135	GHIJK	68.3	ABCDE	124	GHIJK	273	ABCDEFG	1.49	DEFGH	13.1	ABCDEF	41.8
SR404	33.0	KLM	71.1	M	63	ABCDEF	80.0	CDEFGH	1.1	BCD	2.6	ABCD	12.3	KLMN	5.89	ABCDE	49.2	AB	147	EFGHI	72.2	AB	167	DEFGHIJK	275	ABCDEF	1.49	DEFGH	10.3	BCDEFG	41.0
M125	37.2	E	87.1	ABCDEFGHI	58	GHIJ	80.5	BCDE	1.5	ABC	2.3	ABCDEFGHI	12.4	JKLMN	5.44	GHIJ	45.8	BCDEFG	165	BCDEF	62.2	BCDEFG	145	EFGHIJK	218	FGHIJKL	1.49	DEFGH	16.2	ABC	50.0
M126	35.1	EFGHIJKL	78.6	JKL	59	FGHIJ	80.2	BCDEF	1.0	BCD	2.1	CDEFGHI	12.5	JKLMN	5.47	GHIJ	45.4	CDEFGH	165	BCDEF	66.9	ABCDE	132	GHIJK	225	FGHIJKL	1.49	DEFGH	11.9	ABCDEFG	46.5
M128	35.8	EFGHI	80.6	HIJKL	62	BCDEFG	79.8	DEFGH	1.3	BCD	2.5	ABCDE	12.6	FGHIJKLM	5.69	BCDEFG	46.6	BCDE	154	BCDEFGHI	58.6	EFGHI	188	DEFGHI	231	EFGHIJK	1.52	ABCD	14.1	ABCDE	45.8
M129	36.3	EFG	83.7	EFGHIJKL	61	DEFGH	80.0	CDEFGH	1.1	BCD	2.8	A	13.2	BCDEFG	6.05	AB	47.5	ABCDE	140	FGHIJ	65.4	ABCDEF	138	FGHIJK	308	A	1.49	DEFGH	11.3	BCDEFG	44.8
ND20508	32.7	LM	79.0	IJKL	64	ABCD	78.1	L	1.3	ABCD	1.9	GHIJ	13.9	A	5.64	CDEFG	42.0	HIJK	225	A	68.1	ABCDE	113	HIJK	223	FGHIJKL	1.50	DEFGH	7.3	DEFG	42.0
ND20666	35.4	EFGHOJK	87.8	ABCDEFGH	58	GHIJ	78.4	JKL	1.1	BCD	2.0	DEFGHIJ	13.5	ABCD	5.44	GHIJ	42.5	FGHIJK	151	CDEFGHI	67.2	ABCDE	91	IJK	224	FGHIJKL	1.51	BCDEF	7.4	DEFG	48.5
ND21306	35.0	EFGHIJKL	90.4	ABCDEF	63	ABCDEF	79.6	EFGHI	1.4	ABCD	1.7	IJ	12.7	EFGHIJKLM	5.14	JKL	42.4	GHIJK	148	DEFGHI	67.0	ABCDE	185	DEFGHI	210	JKLM	1.50	CDEFG	6.1	EFG	50.3
ND21532	33.8	HIJKLM	81.7	GHIJKL	65	ABC	79.8	DEFGH	1.0	BCD	1.8	HIJ	12.3	KLMN	5.23	HIJK	44.4	EFGHI	166	BCDEF	71.7	AB	113	HIJK	218	GHIJKL	1.49	DEFGH	5.5	FG	51.0
2ND21867	44.0	CD	93.8	AB	56	IJ	80.4	BCDEF	1.2	BCD	1.5	J	12.8	EFGHIJKL	4.85	LMN	39.3	K	110	KL	51.2	HI	204	DEFGH	186	KLM	1.49	DEFGH	4.4	G	47.3
2ND22895	45.4	EF	94.1	A	60	EFGHI	82.2	A	1.4	ABCD	1.8	HIJ	12.2	LMN	5.07	KLM	42.7	FGHIJK	99	L	58.6	EFGHI	412	A	206	JKLM	1.54	AB	8.0	CDEFG	49.5
2ND22927	47.1	A	94.5	A	63	ABCDE	81.7	A	1.2	BCD	2.4	ABCDEFG	12.1	MN	5.55	EFGHI	47.5	ABCDE	92	L	63.0	ABCDEFG	235	CDE	248	BCDEFGHIJ	1.54	ABC	17.9	AB	38.3
2ND22996	44.8	BCD	93.6	ABC	58	GHIJ	80.7	BC	0.9	CD	2.4	ABCDEFG	13.2	BCDEFGH	6.00	ABC	46.0	BCDEF	115	JKL	73.2	A	123	GHIJK	282	ABCDE	1.47	FGH	9.4	CDEFG	39.3
6B01-2157	33.7	HIJKLM	85.8	CDEFGHIJ	60	DEFGHI	79.1	HIJK	1.3	BCD	2.2	CDEFGHI	13.6	ABC	6.20	A	47.3	ABCDE	181	B	70.8	ABC	111	HIJK	301	AB	1.48	EFGH	5.8	EFG	43.5
6B01-2221	33.3	JKLM	75.7	LM	64	ABCDE	79.3	GHI	1.2	BCD	2.4	ABCDEFGH	12.7	EFGHIJKLM	5.78	BCDEFG	46.1	BCDEF	163	BCDEFG	65.6	ABCDEF	151	EFGHIJK	296	ABC	1.49	DEFGH	8.0	CDEFG	40.8
6B02-3295	34.4	GHIJKLM	84.9	DEFGHIJ	60	DEFGHI	78.3	KL	0.9	CD	2.5	ABCDEF	13.3	ABCDE	5.88	ABCDE	45.4	CDEFGH	166	BCDEF	60.7	CDEFGH	195	DEFGH	261	ABCDEFGHI	1.50	CDEFG	13.6	ABCDEF	39.0
SR410	36.9	FE	85.9	BCDEFGHIJ	63	ABCDEF	79.2	GHIJ	0.8	D	2.2	BCDEFGHI	12.3	KLMN	5.60	DEFG	46.8	BCDE	152	CDEFGHI	69.1	ABCD	125	GHIJK	273	ABCDEFG	1.50	CDEFG	8.4	CDEFG	48.3
SR412	35.7	EFGHI	86.0	BCDEFGHIJ	61	CDEFGH	79.8	DEFGH	0.9	CD	2.3	ABCDEFGHI	12.6	FGHIJKLM	5.53	EFGHI	45.4	CDEFGH	178	BC	69.4	ABCD	79	JK	273	ABCDEFG	1.49	DEFGH	9.5	CDEFG	53.8

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

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

2006 MISSISSIPPI VALLEY SPRING BARLEY REGIONAL NURSERY AND ADDITIONS - ABERDEEN, ID

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	Turbidty (Hach)	Quality Score	Overall Rank
5000	Barbless	6	29.4	46.1	77	*75.5	*2.8	2.1	2	11.9	4.71	39.9	107	36.1	*341	151	1.52	15.6	13	39
5001	Morex	6	33.1	70.8	80	79.9	0.5	2.0	1	10.8	4.51	44.2	136	59.7	102	205	1.46	10.7	45	12
5002	Robust	6	33.8	68.9	79	79.9	1.2	1.6	1	11.1	4.60	43.8	141	50.6	133	209	1.45	3.8	44	19
5003	Legacy(6B93-2978)	6	30.5	53.3	89	79.9	0.7	1.8	1	10.4	4.82	50.7	152	81.1	104	216	1.44	3.2	45	12
5004	Lacey (M98)	6	34.0	66.4	79	79.7	0.4	2.1	1	10.6	4.37	42.8	130	54.5	84	234	1.46	12.2	45	12
5005	Conlon	2	45.3	97.4	69	80.6	1.0	2.5	1	11.7	5.10	44.7	107	61.0	*346	208	1.56	14.7	52	2
5006	Tradition(6B95-2482)	6	34.7	86.5	82	79.8	0.9	2.2	1	11.5	4.64	42.1	162	62.5	165	200	1.52	17.6	54	1
5007	Stellar-ND (ND16301)	6	34.6	83.7	83	79.9	1.1	2.4	1	10.8	4.55	45.3	138	61.1	112	201	1.51	19.6	50	4
5008	BT493	6	35.0	79.0	87	81.4	1.9	2.2	1	10.4	5.18	51.8	142	75.3	56	264	1.49	6.2	49	6
5009	M123	6	33.5	51.7	83	79.7	0.6	2.3	1	10.2	4.65	46.9	134	53.9	66	195	1.47	17.1	45	12
5010	ND20299	6	32.5	71.4	89	79.7	1.1	*3.0	2	8.8	4.01	47.2	121	52.1	151	163	1.53	*35	35	35
5011	ND20448	6	31.8	63.3	91	79.7	1.1	1.9	1	9.3	4.30	47.3	116	58.3	57	189	1.47	9.5	35	35
5012	2ND21863	2	41.6	90.1	74	82.5	1.3	1.9	1	9.3	4.06	49.0	84	53.3	157	185	1.52	8.9	36	33
5013	6B01-2208	6	30.3	54.2	89	79.8	1.1	1.8	1	10.3	4.63	49.0	130	73.7	69	228	1.44	4.2	39	31
5014	6B01-2218	6	31.3	71.3	89	79.8	0.8	1.8	1	10.8	4.55	45.6	139	60.6	38	206	1.44	7.6	44	19
5015	6B01-2513	6	31.0	46.9	93	79.4	1.1	1.7	1	10.7	4.64	44.0	147	71.1	58	232	1.45	6.0	47	7
5016	SR403	6	29.9	50.1	88	80.1	1.3	1.9	1	9.7	4.75	52.0	110	70.8	50	245	1.43	4.7	33	37
5017	SR404	6	30.2	47.0	89	80.6	0.9	1.9	1	9.6	4.85	55.4	120	71.4	73	267	1.45	5.6	42	25
5018	M125	6	32.6	62.3	88	80.2	2.1	2.3	2	9.2	3.96	45.9	111	50.7	87	192	1.48	*26	40	28
5019	M126	6	30.2	43.3	89	80.1	1.3	1.8	1	9.7	4.09	45.5	124	52.3	73	204	1.47	9.7	44	19
5020	M128	6	32.3	59.9	89	80.7	1.0	1.6	1	10.4	4.59	48.7	144	61.6	106	243	1.48	4.1	43	23
5021	M129	6	32.2	65.1	88	81.4	1.1	1.9	1	10.0	4.89	52.1	117	70.5	75	301	1.45	2.8	39	31
5022	ND20508	6	31.2	53.5	90	78.8	0.8	2.0	2	11.6	4.54	41.8	185	54.3	88	210	1.48	13.0	43	23
5023	ND20666	6	32.8	72.7	83	79.4	0.8	1.6	1	11.0	4.46	44.4	133	69.1	31	223	1.46	4.0	45	12
5024	ND21306	6	33.3	83.8	89	80.2	1.3	1.5	1	11.5	4.40	40.4	133	53.8	159	200	1.50	4.2	46	10
5025	ND21532	6	30.6	58.3	89	78.9	0.5	1.6	1	10.3	4.37	44.4	139	61.4	83	207	1.48	3.8	41	27
5026	2ND21867	2	40.0	90.8	77	81.7	0.8	1.4	1	10.2	4.39	45.5	96	48.0	122	200	1.45	3.8	44	19
5028	2ND22895	2	43.2	94.6	78	83.9	0.6	1.6	1	10.6	4.51	45.5	98	60.9	*298	208	1.52	8.1	46	10
5029	2ND22927	2	43.1	93.4	79	82.9	0.8	2.4	2	9.5	4.80	53.4	80	62.1	*222	242	1.53	20	40	28
5030	2ND22996	2	39.9	90.0	75	82.4	0.8	1.7	1	10.5	5.01	51.6	103	77.4	108	258	1.44	4.8	45	12

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	Turbidty (Hach)	Quality Score	Overall Rank
5031	6B01-2157	6	29.9	60.2	88	79.3	1.0	1.5	1	10.6	4.63	47.9	148	71.7	59	227	1.44	2.5	40	28
5032	6B01-2221	6	29.3	43.1	94	79.6	0.9	2.1	1	10.4	4.91	51.7	117	69.5	75	238	1.43	3.3	36	33
5033	6B02-3295	6	29.9	57.2	87	79.2	1.0	1.9	1	10.2	4.74	50.1	118	63.2	61	227	1.45	4.6	33	37
5034	SR410 (SM03152)	6	36.5	83.6	77	80.0	0.6	2.2	1	11.4	5.28	50.3	126	70.3	117	264	1.45	2.9	52	2
5035	SR412 (SM03219)	6	32.9	67.3	84	79.9	1.1	2.2	1	11.3	5.24	48.1	143	71.7	52	268	1.45	3.7	50	4
5036	01Ab10255	2	37.2	70.0	71	81.0	1.0	2.3	1	10.8	5.29	51.3	136	62.7	80	236	1.44	5.2	42	25
5037	01Ab10101	2	33.0	41.6	83	81.8	1.1	2.1	1	10.0	4.93	51.0	131	80.7	45	220	1.44	7.2	45	12
5038	01Ab10055	2	34.0	65.0	84	81.4	1.1	2.1	1	11.1	5.22	50.7	104	69.1	70	244	1.46	5.9	47	7
5039	01Ab10062	2	37.3	83.7	75	81.7	1.0	2.0	1	11.0	4.99	47.9	105	66.5	85	227	1.46	5.8	47	7
5027	MOREX MALT CHECK	6	35.0	84.6	77	80.5	0.8	1.9	1	12.7	5.67	48.2	138	65.1	79	313	1.49	5.8	57	
Minima			29.3	41.6	69	78.8	0.4	1.4		8.8	3.96	39.9	80	36.1	31	151	1.43	2.5	13	
Maxima			45.3	97.4	94	83.9	2.1	2.5		11.9	5.29	55.4	185	81.1	165	301	1.56	20.0	54	
Means			33.9	67.6	84	80.4	1.0	1.9		10.5	4.67	47.4	126	62.9	87	221	1.47	7.7	43	
Standard Deviations			4.2	16.3	6	1.2	0.3	0.3		0.8	0.35	3.8	21	9.8	35	30	0.03	5.1	7	
Coefficients of Variation			12.3	24.1	8	1.4	33.6	15.0		7.2	7.43	8.0	17	15.6	40	14	2.27	65.7	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

2006 MISSISSIPPI VALLEY SPRING BARLEY REGIONAL NURSERY - MORRIS, 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	Turbidty (Hach)	Quality Score	Overall Rank
5100	Barbless	6	36.2	83.6	56	77.8	1.8	2.0	1	11.5	4.92	44.0	112	51.5	264	177	1.52	6.3	41	32
5101	Morex	6	36.4	86.9	56	78.7	0.9	2.1	1	11.8	5.10	43.6	115	50.9	313	295	1.54	7.3	44	26
5102	Robust	6	38.6	91.7	51	80.4	0.8	2.2	1	11.1	5.36	48.8	120	48.7	238	*319	1.50	5.0	45	25
5103	Legacy(6B93-2978)	6	35.8	85.9	47	80.6	1.1	2.4	1	11.2	5.34	49.7	103	59.3	203	202	1.51	4.7	41	32
5104	Lacey (M98)	6	41.1	94.8	48	80.6	1.0	2.3	1	12.6	5.45	45.0	125	53.1	140	217	1.48	9.0	58	6
5105	Conlon	2	49.4	97.6	55	81.9	0.4	2.0	1	11.3	4.96	44.6	99	58.0	251	163	1.52	9.1	51	16
5106	Tradition(6B95-2482)	6	37.2	94.2	63	80.7	0.6	1.9	1	11.7	5.04	45.4	141	60.6	65	190	1.49	5.0	61	3
5107	Stellar-ND (ND16301)	6	39.0	95.5	48	81.4	0.5	2.2	1	11.3	5.28	48.2	132	61.5	45	208	1.50	6.5	52	15
5108	BT493	6	38.7	95.6	62	81.9	0.8	2.5	1	10.8	5.21	51.6	99	60.3	97	258	1.52	7.0	48	21
5109	M122	6	37.2	87.8	51	80.9	0.8	2.1	1	10.4	5.00	50.3	107	60.1	118	184	1.47	4.7	44	26
5110	M123	6	40.0	93.8	55	80.4	0.5	2.6	2	12.0	5.29	46.4	120	48.3	114	219	1.50	*28	61	3
5111	ND20299	6	38.1	94.9	51	80.7	1.0	2.5	1	10.9	5.12	47.6	125	59.7	133	169	1.50	11.3	44	26
5112	ND20448	6	38.0	94.3	63	80.5	0.4	2.4	1	11.5	5.50	49.4	114	60.1	155	190	1.51	7.3	44	26
5113	2ND21863	2	50.3	97.8	50	82.3	1.4	1.8	1	10.6	4.53	44.4	76	48.6	372	127	1.58	6.8	46	23
5115	6B01-2208	6	35.4	88.4	48	80.8	1.3	2.3	1	11.6	5.31	49.7	123	65.7	143	187	1.48	8.1	53	13
5116	6B01-2218	6	34.3	89.7	57	82.1	1.1	1.9	1	11.2	5.13	47.9	154	70.4	39	187	1.46	7.3	51	16
5117	6B01-2513	6	35.0	84.8	55	80.9	1.2	2.2	1	11.5	5.35	48.0	138	69.3	51	183	1.46	7.3	57	8
5118	SR403	6	35.4	87.8	53	81.1	1.3	2.4	1	11.0	5.33	49.7	106	60.0	166	186	1.50	14.6	44	26
5119	SR404	6	36.6	87.7	57	82.1	1.5	2.6	1	10.0	5.12	53.2	112	65.5	299	186	1.54	17.1	37	36
5120	M125	6	41.0	96.3	54	81.7	1.2	2.3	1	11.0	5.40	51.0	150	59.4	93	191	1.47	12.2	55	12
5121	M126	6	37.3	86.2	52	81.6	0.8	2.4	1	10.8	4.93	49.0	130	63.0	142	175	1.49	*23	44	26
5122	M128	6	40.4	91.8	55	80.8	1.4	2.6	2	11.2	5.17	47.1	129	50.0	266	187	1.58	*27	40	35
5123	M129	6	39.4	92.7	53	80.9	1.4	2.5	1	11.8	5.35	48.6	115	55.4	202	243	1.52	14.9	46	23
5124	ND20508	6	34.4	87.0	64	79.3	1.2	1.8	1	12.5	5.38	43.8	*228	67.3	52	251	1.49	6.4	65	1
5125	ND20666	6	38.7	95.6	51	79.4	0.6	2.2	1	11.9	5.26	47.6	135	61.5	74	206	1.53	9.5	57	8
5126	ND21306	6	38.3	97.2	58	81.1	0.9	1.8	1	10.9	4.91	46.9	132	65.4	73	211	1.48	4.8	53	13
5127	ND21532	6	36.6	93.4	58	81.5	1.0	1.6	1	10.8	4.82	46.7	164	72.5	58	198	1.50	3.7	56	10
5128	2ND21867	2	47.7	97.4	50	81.9	0.8	1.4	1	11.2	4.73	45.1	105	49.0	118	200	1.49	3.7	58	6
5129	2ND22895	2	51.9	98.2	57	83.5	1.1	1.7	1	11.2	4.91	46.8	90	57.4	359	214	1.53	6.2	51	16
5130	2ND22927	2	51.6	98.4	59	82.4	0.4	2.3	1	11.0	5.13	48.4	85	58.7	194	194	1.52	14.3	41	32

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	Turbidty (Hach)	Quality Score	Overall Rank
5131	2ND22996	2	50.8	98.5	51	82.0	0.4	2.1	1	11.7	5.44	46.8	114	67.1	48	211	1.48	9.2	62	2
5132	6B01-2157	6	35.3	93.3	54	80.0	0.9	1.8	1	12.0	5.64	48.2	168	70.9	86	236	1.48	5.0	60	5
5133	6B01-2221	6	34.7	79.0	57	80.3	0.8	1.9	1	10.7	4.98	47.4	143	59.2	97	235	1.48	8.0	49	20
5134	6B02-3295	6	37.1	93.7	54	79.0	0.9	2.4	2	11.8	5.10	44.1	153	52.1	218	229	1.52	*26	50	19
5135	SR410 (SM03152)	6	39.4	95.3	56	79.3	0.6	1.8	1	10.9	5.04	47.9	133	67.0	103	200	1.49	4.9	48	21
5136	SR412 (SM03219)	6	38.5	95.3	53	80.6	0.8	1.9	1	11.1	4.87	44.9	161	64.8	89	204	1.49	8.7	56	10
5099	MOREX MALT CHECK	6	35.0	85.7	78	81.7	2.2	2.4	1	12.1	6.02	51.1	123	68.5	117	343	1.49	5.1	50	
5114	MOREX MALT CHECK	6	34.7	88.0	74	81.2	0.6	2.5	1	11.7	5.96	51.7	121	65.0	110	211	1.50	5.4	53	
Minima			34.3	79.0	47	77.8	0.4	1.4		10.0	4.53	43.6	76	48.3	39	127	1.46	3.7	37	
Maxima			51.9	98.5	64	83.5	1.8	2.6		12.6	5.64	53.2	168	72.5	372	295	1.58	17.1	65	
Means			39.6	92.3	55	80.9	0.9	2.1		11.3	5.15	47.4	124	59.8	152	203	1.50	8.0	50	
Standard Deviations			5.2	4.9	4	1.2	0.3	0.3		0.6	0.24	2.3	22	6.9	93	30	0.03	3.5	7	
Coefficients of Variation			13.1	5.3	8	1.4	37.0	14.6		4.9	4.64	4.9	18	11.5	61	15	1.88	43.2	14	

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

2006 MISSISSIPPI VALLEY SPRING BARLEY REGIONAL NURSERY - SIDNEY, MT

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	Turbidty (Hach)	Quality Score	Overall Rank
5137	Barbless	6	35.1	74.7	81	*73.7	3.0	1.8	2	14.7	4.46	32.4	142	42.4	398	139	1.51	*18.9	20	36
5138	Morex	6	34.8	67.3	84	77.6	1.6	1.5	1	14.0	5.10	37.0	208	66.4	113	178	1.47	5.9	31	33
5139	Robust	6	36.6	79.8	77	78.9	2.3	1.6	1	13.7	5.47	40.1	174	51.3	252	196	1.49	5.1	43	19
5140	Legacy(6B93-2978)	6	36.1	75.5	85	78.8	2.1	1.8	1	13.2	5.63	45.4	209	82.9	264	223	1.48	4.7	53	6
5141	Lacey (M98)	6	37.1	78.2	81	79.2	2.0	1.9	1	13.6	5.73	45.2	163	63.1	137	198	1.47	6.6	50	11
5142	Conlon	2	37.7	77.4	81	78.5	*3.7	1.8	1	14.4	5.25	37.4	133	56.7	197	158	1.45	6.4	27	35
5144	Tradition(6B95-2482)	6	34.4	74.0	84	78.6	2.3	1.8	2	13.0	5.06	39.5	192	61.4	171	169	1.51	14.9	43	19
5145	Stellar-ND (ND16301)	6	37.6	84.6	84	78.8	2.1	2.1	1	13.0	5.47	42.2	156	62.2	134	193	1.51	8.8	58	1
5146	BT493	6	35.1	63.9	91	78.9	1.9	2.4	1	12.8	6.15	50.8	152	73.2	102	245	1.48	6.0	45	14
5147	M122	6	34.9	74.5	82	79.2	2.6	2.1	1	13.5	5.80	44.5	159	66.8	238	212	1.47	5.2	52	9
5148	M123	6	37.1	71.3	83	79.0	1.8	2.3	1	13.6	5.87	46.1	151	52.2	152	215	1.48	11.7	47	12
5149	ND20299	6	38.6	87.0	85	79.3	2.4	2.7	2	12.8	5.60	45.8	148	56.4	336	196	1.55	*29	57	2
5150	ND20448	6	35.4	80.6	89	78.8	2.0	2.0	1	13.1	5.49	45.1	134	62.6	155	197	1.50	5.9	55	5
5151	2ND21863	2	42.8	86.0	80	79.2	1.2	1.6	1	12.3	4.64	37.9	106	47.0	174	124	1.49	4.4	42	21
5152	6B01-2208	6	35.2	76.1	82	78.1	1.1	2.1	1	13.7	6.02	47.2	159	71.4	219	258	1.48	4.5	33	30
5153	6B01-2218	6	33.1	72.6	83	78.4	1.2	1.9	1	13.8	5.75	42.7	169	63.0	138	183	1.47	5.8	44	16
5154	6B01-2513	6	36.1	76.7	85	77.8	1.1	2.1	1	14.2	6.13	44.6	171	68.4	134	196	1.47	5.4	36	25
5155	SR403	6	34.3	66.9	86	77.3	1.3	2.1	1	14.0	5.94	43.9	146	68.4	137	207	1.46	4.6	37	23
5156	SR404	6	33.8	56.3	89	77.7	1.2	2.2	1	13.6	6.03	45.7	170	78.8	165	226	1.47	5.6	34	29
5157	M125	6	36.3	73.8	80	78.6	2.1	2.7	2	13.3	5.54	43.5	165	56.9	186	179	1.50	*26	52	9
5158	M126	6	36.0	69.9	83	78.6	1.4	2.0	1	13.3	5.57	42.5	166	63.0	146	215	1.48	7.9	53	6
5159	M128	6	36.7	74.1	87	79.0	1.4	2.3	1	13.1	5.88	47.9	163	62.6	210	184	1.49	5.9	47	12
5160	M129	6	36.1	75.8	85	79.3	1.4	2.5	1	13.4	6.31	47.8	138	72.2	129	234	1.46	4.8	44	16
5161	ND20508	6	32.5	57.7	85	76.3	1.8	2.0	1	14.4	5.49	40.2	198	59.9	181	155	1.50	10.3	28	34
5162	ND20666	6	32.6	68.1	83	76.2	2.0	1.8	1	14.5	5.20	36.8	162	62.6	76	151	1.48	5.9	35	28
5163	ND21306	6	34.9	80.7	86	77.7	2.1	1.9	1	13.5	4.98	39.7	132	55.2	319	150	1.52	11.1	36	25
5164	ND21532	6	34.6	73.1	87	78.3	1.5	2.1	1	12.7	5.36	44.1	150	66.7	214	165	1.51	9.7	53	6
5165	2ND21867	2	42.7	85.8	80	78.3	1.6	1.6	1	13.4	4.86	37.5	109	45.6	178	138	1.46	6.6	37	23
5166	2ND22895	2	44.1	86.8	79	80.2	1.3	1.7	1	13.0	5.08	39.6	101	59.1	362	161	1.50	7.5	45	14
5167	2ND22927	2	*48.0	90.3	80	79.8	1.7	2.3	1	12.6	5.71	46.0	89	63.8	168	212	1.48	12.4	44	16

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	Turbidty (Hach)	Quality Score	Overall Rank
5168	2ND22996	2	42.8	85.2	79	79.5	1.2	2.2	1	13.9	6.25	45.0	122	85.6	167	243	1.45	5.8	36	25
5169	6B01-2157	6	35.0	77.6	82	77.9	1.8	2.2	1	14.4	6.40	46.7	187	80.5	115	276	1.45	3.9	40	22
5170	6B01-2221	6	35.3	70.2	89	78.3	2.1	2.1	1	14.1	6.14	44.6	190	79.8	231	259	1.47	3.5	33	30
5172	6B02-3295	6	35.9	79.1	85	78.0	1.5	2.1	1	13.6	6.10	47.5	159	73.5	239	216	1.48	3.7	33	30
5173	SR410 (SM03152)	6	37.7	77.6	86	78.7	0.9	1.9	1	12.9	5.75	45.7	165	82.7	88	250	1.46	4.4	56	3
5174	SR412 (SM03219)	6	35.6	75.5	81	78.9	1.5	2.0	1	13.4	5.77	43.2	198	84.6	46	260	1.47	5.8	56	3
5143	HARRINGTON MALT CHECK	6	37.7	86.2	75	81.7	1.5	1.7	1	12.9	5.83	48.0	129	78.9	112	229	1.48	4.2	53	
5171	MOREX MALT CHECK	6	34.5	87.4	82	80.8	1.0	2.6	1	12.5	6.20	53.5	118	75.9	162	252	1.50	5.2	42	
Minima			32.5	56.3	77	76.2	0.9	1.5		12.3	4.46	32.4	89	42.4	46	124	1.45	3.5	20	
Maxima			44.1	90.3	91	80.2	3.0	2.7		14.7	6.40	50.8	209	85.6	398	276	1.55	14.9	58	
Means			36.4	75.7	84	78.5	1.7	2.0		13.5	5.61	43.1	157	65.2	185	199	1.48	6.7	43	
Standard Deviations			2.8	7.7	3	0.9	0.5	0.3		0.6	0.47	4.0	29	11.1	79	39	0.02	2.7	10	
Coefficients of Variation			7.7	10.2	4	1.1	28.0	13.5		4.3	8.42	9.2	19	17.0	42	20	1.53	41.0	23	

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, BARI - Ft. Collins

2006 MISSISSIPPI VALLEY SPRING BARLEY REGIONAL NURSERY - FARGO, 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	Turbidty (Hach)	Quality Score	Overall Rank
5358	Barbless	6	33.5	79.6	58	*75.5	2.1	1.6	1	14.1	4.56	*32.7	121	50.4	454	189	1.53	8.5	21	36
5359	Morex	6	31.8	63.7	61	79.1	0.9	1.9	1	14.0	5.79	43.8	166	65.7	179	279	1.47	5.8	43	29
5360	Robust	6	32.8	78.8	61	79.0	1.2	1.9	1	13.7	5.77	43.5	161	58.4	244	271	1.48	5.1	47	21
5361	Legacy(6B93-2978)	6	30.8	66.7	66	79.1	1.1	2.2	1	13.4	6.17	46.9	171	73.9	236	301	1.50	7.0	45	23
5362	Lacey (M98)	6	33.5	79.5	60	79.8	0.9	1.9	1	13.0	5.61	44.9	165	74.7	147	256	1.46	9.2	59	6
5363	Conlon	2	41.8	95.4	63	79.7	1.6	1.6	1	13.4	4.80	37.3	124	65.1	285	183	1.47	6.7	44	26
5364	Tradition(6B95-2482)	6	32.6	83.9	63	79.5	1.0	1.7	1	13.2	5.14	41.2	194	75.2	124	217	1.51	7.8	52	13
5365	Stellar-ND (ND16301)	6	33.5	87.9	64	79.5	0.8	1.9	1	13.2	5.84	46.0	180	76.6	80	269	1.48	7.5	61	3
5366	BT493	6	34.0	81.6	67	79.8	0.9	2.1	1	12.7	5.88	46.4	155	63.4	73	277	1.50	9.8	61	3
5367	M122	6	33.1	77.8	59	78.9	0.9	1.9	1	13.9	5.92	43.5	188	73.5	192	273	1.48	6.0	44	26
5368	M123	6	34.4	73.7	63	78.5	0.2	1.8	1	14.0	5.61	40.4	198	59.1	130	233	1.49	9.9	41	32
5369	ND20299	6	36.1	93.1	60	79.5	0.8	2.2	2	12.8	5.34	42.8	192	65.7	209	232	1.53	*17.9	57	9
5370	ND20448	6	33.6	88.5	68	79.4	0.5	1.7	1	13.0	5.25	41.6	209	76.7	95	229	1.51	6.3	60	5
5371	2ND21863	2	45.7	96.5	57	80.6	1.4	1.6	1	12.2	4.71	41.7	105	58.2	409	190	1.60	4.6	52	13
5372	6B01-2208	6	29.9	76.2	62	78.5	0.6	2.0	1	13.6	6.03	45.5	182	76.8	116	290	1.46	5.3	45	23
5373	6B01-2218	6	30.7	79.0	66	79.0	0.8	1.8	1	13.6	5.90	46.2	200	79.1	75	266	1.46	5.0	53	12
5374	6B01-2513	6	30.4	67.0	68	78.4	0.2	1.9	1	13.3	5.91	45.7	190	81.6	61	273	1.46	5.8	52	13
5375	SR403	6	31.8	77.3	61	79.3	1.0	2.1	1	12.9	6.04	47.2	161	76.6	130	291	1.48	6.0	46	22
5376	SR404	6	29.7	58.9	64	79.2	1.1	2.2	1	13.4	6.25	47.9	176	76.2	99	310	1.48	6.4	45	23
5377	M125	6	34.4	84.9	59	80.0	1.7	1.8	1	12.8	5.42	44.2	179	69.4	175	231	1.51	9.7	58	7
5378	M126	6	31.9	68.6	60	79.7	1.2	1.9	1	13.0	5.69	45.5	182	74.5	145	266	1.50	7.0	55	11
5379	M128	6	31.6	71.7	64	78.9	1.3	1.9	1	13.2	5.58	43.1	174	61.6	182	256	1.54	10.8	49	19
5380	M129	6	33.9	79.2	63	79.5	1.4	2.0	1	13.7	5.94	44.4	160	68.6	163	312	1.51	8.1	50	18
5381	ND20508	6	31.3	77.4	65	77.4	1.3	1.6	1	14.5	5.72	40.2	246	71.7	127	234	1.53	6.5	29	34
5382	ND20666	6	34.4	91.0	59	78.8	1.3	1.6	1	13.9	5.46	41.0	166	76.3	64	233	1.50	4.4	52	13
5383	ND21306	6	33.5	91.5	63	79.2	1.3	1.4	1	13.3	5.36	42.1	164	73.9	176	219	1.51	3.8	58	7
5384	ND21532	6	31.2	74.0	70	79.0	1.1	1.6	1	12.6	5.40	43.9	181	80.0	90	236	1.48	3.1	62	2
5386	2ND21867	2	42.3	95.2	56	80.4	1.8	1.5	1	13.2	4.88	37.3	111	53.9	307	174	1.53	3.8	42	30
5387	2ND22895	2	42.1	94.6	62	82.2	1.8	1.6	1	12.4	5.09	41.5	99	60.0	465	199	1.60	7.6	51	17
5388	2ND22927	2	44.6	96.4	69	81.9	1.6	2.1	1	12.1	5.61	47.5	97	65.4	309	242	1.57	13.7	42	30

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	Turbidty (Hach)	Quality Score	Overall Rank
5389	2ND22996	2	41.7	96.0	59	80.3	1.4	2.0	1	13.8	6.11	44.7	118	73.2	181	277	1.48	6.3	34	33
5390	6B01-2157	6	31.5	80.4	60	78.7	1.7	1.7	1	14.1	6.31	45.9	220	71.2	104	273	1.47	4.7	44	26
5391	6B01-2221	6	30.8	62.7	67	78.8	0.8	2.0	1	12.9	5.81	44.9	191	66.9	133	283	1.50	7.2	48	20
5392	6B02-3295	6	31.5	77.0	60	77.3	0.4	2.1	1	14.1	5.75	42.0	198	62.1	134	217	1.50	11.7	29	34
5393	SR410 (SM03152)	6	34.0	78.0	65	78.6	0.6	1.8	1	12.9	5.50	44.1	180	67.5	142	228	1.52	6.7	56	10
5394	SR412 (SM03219)	6	32.1	81.0	64	79.4	0.3	2.0	1	13.0	5.43	43.9	213	70.6	85	290	1.49	7.5	65	1
5357	MOREX MALT CHECK	6	34.5	86.4	80	81.3	1.0	2.3	1	12.0	6.02	52.5	123	66.9	119	320	1.49	5.0	50	
5385	MOREX MALT CHECK	6	35.0	89.0	79	81.2	1.2	2.1	1	12.2	6.00	52.2	136	71.8	101	307	1.50	6.0	50	
Minima			29.7	58.9	56	77.3	0.2	1.4		12.1	4.56	37.3	97	50.4	61	174	1.46	3.1	21	
Maxima			45.7	96.5	70	82.2	2.1	2.2		14.5	6.31	47.9	246	81.6	465	312	1.60	13.7	65	
Means			34.2	80.7	63	79.3	1.1	1.8		13.3	5.60	43.7	170	69.3	175	250	1.50	7.0	49	
Standard Deviations			4.3	10.3	3	1.0	0.5	0.2		0.6	0.43	2.6	35	7.7	104	37	0.03	2.3	10	
Coefficients of Variation			12.5	12.8	6	1.2	43.2	11.3		4.3	7.68	6.0	21	11.2	59	15	2.29	33.3	20	

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, University of North Dakota - Fargo

2006 MISSISSIPPI VALLEY SPRING BARLEY REGIONAL NURSERY - OSNABROCK, 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	Turbidty (Hach)	Quality Score	Overall Rank
5395	Barbless	6	33.0	82.9	39	*76.3	1.0	2.0	1	14.1	4.80	34.9	138	53.8	302	179	1.50	9.8	23	36
5396	Morex	6	32.4	86.4	40	79.5	0.6	2.2	1	14.4	5.92	42.2	187	67.6	99	299	1.49	7.5	51	15
5397	Robust	6	35.1	91.3	40	80.0	0.9	2.0	1	14.1	5.97	44.3	175	55.3	181	290	1.50	5.6	44	30
5398	Legacy(6B93-2978)	6	32.6	88.5	46	80.8	0.8	3.7	1	12.4	6.38	53.0	137	67.4	101	347	1.53	12.5	50	19
5399	Lacey (M98)	6	35.0	90.0	39	80.1	0.9	2.5	1	14.2	6.01	44.8	165	65.0	79	299	1.49	8.5	48	25
5400	Conlon	2	42.8	96.3	40	81.4	1.0	2.1	1	12.6	5.25	44.6	115	68.9	265	235	1.51	9.8	55	8
5401	Tradition(6B95-2482)	6	34.1	90.5	46	80.0	0.8	2.2	1	13.5	5.52	42.1	171	65.2	142	269	1.52	8.4	61	4
5402	Stellar-ND (ND16301)	6	35.4	92.9	45	80.2	0.7	2.9	1	13.1	5.63	43.8	163	58.8	84	273	1.52	21	65	1
5403	BT493	6	35.6	90.1	42	81.4	0.9	4.1	1	12.1	6.29	52.1	120	66.5	52	374	1.53	16.1	50	19
5404	M122	6	32.6	86.2	38	79.7	1.1	2.2	1	13.8	6.01	44.3	165	69.8	140	308	1.48	5.7	49	22
5405	M123	6	35.7	90.7	42	80.1	0.9	2.7	1	13.7	6.01	45.4	159	63.3	74	314	1.50	11.1	53	11
5406	ND20299	6	36.8	94.6	43	80.2	0.6	2.6	2	13.6	5.70	44.3	166	59.7	170	261	1.52	20	51	15
5407	ND20448	6	35.5	94.2	46	80.9	0.8	2.6	1	12.5	5.98	49.4	141	67.0	121	291	1.53	9.4	52	14
5408	2ND21863	2	47.5	97.7	33	81.6	1.3	2.1	1	12.4	5.14	42.5	103	59.9	299	211	1.55	8.6	55	8
5409	6B01-2208	6	34.4	95.2	39	80.5	0.5	3.6	2	13.1	6.04	48.5	132	65.8	105	266	1.52	18.0	49	22
5410	6B01-2218	6	32.2	84.4	44	80.1	1.1	2.3	1	14.3	5.96	43.2	185	66.7	61	288	1.45	7.6	51	15
5411	6B01-2513	6	32.0	82.8	45	79.6	0.9	2.7	1	13.5	6.08	45.1	171	73.2	44	319	1.45	10.2	58	6
5412	SR403	6	31.9	87.2	43	80.9	0.5	4.3	2	12.3	6.45	53.7	128	68.2	64	409	1.53	27	48	25
5414	SR404	6	31.8	81.4	41	80.9	0.6	3.4	1	12.4	6.15	49.9	131	68.3	103	379	1.48	12.1	49	22
5415	M125	6	37.1	93.3	37	81.6	1.1	2.4	2	12.6	5.42	44.4	165	62.9	126	272	1.47	16.9	60	5
5416	M126	6	35.2	89.6	39	81.0	0.7	2.3	1	12.8	5.69	44.6	180	67.1	95	245	1.48	9.7	65	1
5417	M128	6	34.4	84.9	41	80.5	0.8	3.3	1	12.8	6.14	48.3	150	60.1	95	296	1.49	12.8	53	11
5418	M129	6	35.8	87.0	41	80.1	0.3	4.4	2	13.7	6.61	49.3	146	65.3	59	443	1.48	17.3	47	27
5419	ND20508	6	32.7	93.8	43	79.4	0.9	2.1	1	14.2	5.96	43.6	229	73.5	92	252	1.48	5.8	51	15
5420	ND20666	6	35.7	96.6	39	79.3	0.4	2.6	1	13.5	5.84	44.7	142	68.5	151	307	1.53	9.6	57	7
5421	ND21306	6	33.4	92.2	44	80.2	1.1	1.9	1	13.3	5.29	41.0	165	73.3	170	261	1.48	4.7	53	11
5422	ND21532	6	32.7	86.2	45	80.2	0.3	2.0	1	13.0	5.35	43.1	171	67.5	91	273	1.48	5.3	65	1
5423	2ND21867	2	43.5	96.9	37	80.9	0.8	1.6	1	13.4	4.92	37.4	116	56.4	214	233	1.49	3.5	42	33
5424	2ND22895	2	43.5	96.8	41	82.9	1.4	2.1	1	12.4	5.21	42.8	107	58.0	*464	251	1.55	10.6	55	8
5425	2ND22927	2	44.0	92.8	45	82.8	0.9	3.1	3	12.7	5.74	48.0	96	64.0	268	344	1.58	*31	40	34

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	Turbidty (Hach)	Quality Score	Overall Rank
5426	2ND22996	2	44.0	94.5	42	81.1	0.7	3.6	2	13.3	6.21	47.6	107	66.9	96	398	1.48	16.3	44	30
5427	6B01-2157	6	33.1	91.7	44	79.6	0.7	3.1	1	13.7	6.46	48.3	150	60.6	138	420	1.50	9.7	44	30
5428	6B01-2221	6	32.4	90.9	42	79.7	1.0	3.6	1	13.1	6.20	47.4	130	56.5	143	405	1.50	13.3	46	28
5429	6B02-3295	6	33.1	89.6	41	78.9	0.7	3.4	1	13.8	6.57	48.1	154	55.1	190	384	1.50	13.0	38	35
5430	SR410 (SM03152)	6	36.6	92.8	44	80.2	1.1	3.3	1	12.5	6.10	49.4	129	59.0	165	413	1.54	17.5	46	28
5431	SR412 (SM03219)	6	36.7	92.1	45	80.4	0.8	3.4	1	12.9	6.06	49.4	140	57.7	97	336	1.51	15.8	50	19
5413	MOREX MALT CHECK	6	35.1	80.7	78	81.1	1.4	2.5	1	11.6	5.92	52.0	124	71.0	44	338	1.47	9.7	53	
Minima			31.8	81.4	33	78.9	0.3	1.6		12.1	4.80	34.9	96	53.8	44	179	1.5	3.5	23	
Maxima			47.5	97.7	46	82.9	1.4	4.4		14.4	6.61	53.7	229	73.5	302	443	1.58	27.0	65	
Means			35.9	90.7	42	80.5	0.8	2.8		13.2	5.86	45.7	148	64.0	133	310	1.50	11.7	51	
Standard Deviations			4.1	4.4	3	0.9	0.3	0.7		0.7	0.46	4.0	28	5.4	69	65	0.03	5.3	8	
Coefficients of Variation			11.5	4.8	7	1.1	31.3	26.7		5.0	7.78	8.7	19	8.5	51	21	1.93	44.9	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 R. Horsley, University of North Dakota - Fargo

MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - 2006 Crop

Table 9 - Station Means* of Barley and Malt Quality Factors for 36 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
Aberdeen, ID	33.8	D	67.9	D	84	A	80.2	B	1.0	B	2.0	CD	10.5	D	4.62	D	47.1	A	127	D	62.2	CD	114	D	220	C	1.47	B	9.2	BC	42.5
Morris, MN	39.6	A	92.3	A	55	C	80.9	A	0.9	BC	2.1	B	11.3	C	5.15	C	47.4	A	127	D	59.8	D	152	BC	206	CD	1.50	A	10.0	AB	49.9
Sidney, MT	36.7	B	75.7	C	84	A	78.4	D	1.8	A	2.0	BC	13.5	A	5.61	B	43.1	C	157	B	65.2	B	185	A	199	D	1.48	B	8.2	BC	40.0
Fargo, ND	34.2	D	80.7	B	63	B	79.2	C	1.1	B	1.9	D	13.3	B	5.60	B	43.4	C	170	A	69.3	A	175	AB	250	B	1.50	A	7.3	C	44.8
Osnabrock, ND	35.9	C	90.7	A	42	D	80.4	B	0.8	C	2.8	A	13.2	B	5.86	A	45.7	B	148	C	64.0	BC	143	C	310	A	1.50	A	12.3	A	47.0

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

** Barbless, Morex, Robust, Legacy, Lacey, Conlon, Tradition, Stellar, BT493, M122, M123, ND20299, ND20448, 2ND21863, 6B01-2208, 6B01-2218, 6B01-2513, SR403, SR404, M125, M126, M128, M129, ND20508, ND20666, ND21306, ND21532, 2ND21867, 2ND22895, 2ND22927, 2ND22996, 6B01-2157, 6B01-2221, 6B02-3295, SR410, SR412

MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - 2006 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 (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
Barbless	33.4	HIJKL	73.4	GHIJ	62	FGHIJK	75.8	O	2.1	A	1.89	FGHIJKL	13.3	AB	4.69	NO	36.8	N	124	HIJK	46.9	K	352	A	167	K	1.51	BCDE	11.8	BCDE	25.6
Morex	33.7	GHIJKL	75.0	EFGHIJ	64	DEFGHIJ	79.0	KLMN	0.9	D	1.96	EFGHIJKL	13.0	ABC	5.29	FGHIJKL	42.2	KLM	162	BCDE	62.0	CDEFGH	161	DEFGHIJ	251	BCDEFGHI	1.49	EFGHIJKL	7.4	DE	41.8
Robust	35.4	DEFGH	82.1	BCDEFG	62	GHIJKL	79.6	FGHIJK	1.3	BCD	1.85	GHIJKL	12.7	BCDEF	5.43	BCDEFGHIJ	44.1	HIJKL	154	BCDEFG	52.8	IJK	210	BCDE	257	BCDEFG	1.48	EFGHIJKL	4.9	DE	41.2
Legacy	33.2	IJKL	74.0	FGHIJ	67	BCDEF	79.8	EFGHIJ	1.2	BCD	2.37	ABCDEFG	12.1	FGHIJ	5.67	ABCDEF	49.1	ABCD	154	BCDEFG	72.9	AB	181	DEFGH	258	BCDEFG	1.49	DEFGHIJK	6.4	DE	44.8
Lacey (M98)	36.2	DEF	81.8	BCDEFGH	61	HIJKL	79.9	DEFGHIJ	1.0	BCD	2.14	ABCDEFGHIJK	12.8	BCDEF	5.43	BCDEFGHIJ	44.5	GHIJKL	150	CDEFG	62.1	CDEFGH	117	FGHIJK	241	BCDEFGHI	1.47	HIJKL	9.1	CDE	47.6
Conlon	43.4	C	92.8	A	62	GHIJKL	80.4	CDEF	1.5	BC	1.99	DEFGHIJKL	12.7	BCDEF	5.07	IJKLM	41.7	LM	116	IJKL	61.9	CDEFGH	269	BC	190	JK	1.50	CDEFGHI	9.3	CDE	44.0
Tradition	34.6	EFGHIJK	85.8	ABCD	68	ABCDE	79.7	FGHIJK	1.1	BCD	1.96	EFGHIJKL	12.6	CDEFGH	5.08	IJKLM	42.1	KLM	172	BC	65.0	ABCDEF	133	EFGHIJK	209	HIJK	1.51	BCDEFG	10.7	CDE	56.4
Stellar-ND	36.0	DEF	88.9	AB	65	CDEFGHIJ	80.0	DEFGHI	1.1	BCD	2.29	ABCDEFGHIJ	12.3	EFGHIJ	5.35	DEFGHIJK	45.1	FGHIJK	154	BCDEFG	64.1	BCDEFG	91	IJK	229	DEFGHIJ	1.51	BCDEFGH	12.7	BCD	52.0
BT493	35.7	DEFG	82.0	BCDEFG	70	AB	80.7	BCD	1.3	BCD	2.66	A	11.8	IJK	5.74	ABCD	50.6	A	134	FGHIJ	67.7	ABCDEF	76	K	284	AB	1.50	BCDEFGHI	9.0	CDE	49.8
M123	36.1	DEF	76.2	DEFGHIJ	65	BCDEFGHI	79.6	GHIJK	0.8	D	2.34	ABCDEFGH	12.7	BCDEF	5.49	BCDEFGH	45.0	FGHIJK	153	BCDEFG	55.3	GHIJ	107	GHIJK	235	CDEFGHIJ	1.49	EFGHIJKL	15.6	BC	45.0
ND20299	36.4	DE	88.2	ABC	66	BCDEFGHI	79.9	DEFGHIJ	1.2	BCD	2.57	ABC	11.8	IJK	5.16	HIJKL	45.5	EFGHIJ	150	CDEFG	58.7	FGHIJ	200	CDEF	204	IJK	1.52	ABCD	22.6	A	45.4
ND20448	34.9	DEFGHIJ	84.2	ABCDEF	71	A	79.8	EFGHIJ	1.0	CD	2.13	ABCDEFGHIJK	11.9	HIJK	5.31	EFGHIJKL	46.6	CDEFGH	143	EFGH	64.9	ABCDEF	116	GHIJK	219	GHIJ	1.51	BCDEFGH	7.7	DE	46.2
2ND21863	45.6	AB	93.6	A	59	KL	81.2	B	1.3	BCD	1.80	HIJKL	11.4	K	4.62	O	43.1	IJKLM	95	LM	53.4	HIJK	282	B	167	K	1.55	A	6.7	DE	46.2
6B01-2208	33.0	IJKL	78.0	CDEFGHI	64	DEFGHIJ	79.5	GHIJK	0.9	D	2.34	ABCDEFGH	12.5	CDEFGHI	5.61	ABCDEFG	48.0	ABCDEF	145	DEFGH	70.7	ABC	130	EFGHIJK	246	BCDEFGHI	1.48	GHIJKL	8.0	CDE	43.4
6B01-2218	32.3	L	79.4	BCDEFGHI	68	ABCDE	79.9	DEFGHIJ	1.0	CD	1.93	EFGHIJKL	12.7	BCDEF	5.46	BCDEFGHI	45.1	FGHIJK	169	BCD	68.0	ABCDEF	70	K	226	EFGHIJ	1.46	L	6.7	DE	45.2
6B01-2513	32.9	JKL	71.6	HIJ	69	ABC	79.2	IJKLM	0.9	D	2.11	BCDEFGHIJK	12.7	BCDEF	5.62	ABCDEFG	45.5	EFGHIJ	163	BCDE	72.7	AB	70	K	241	BCDEFGHI	1.46	KL	6.9	DE	46.0
SR403	32.6	KL	73.9	FGHIJ	66	BCDEFGH	79.8	FGHIJK	1.1	BCD	2.53	ABCD	12.0	GHIJK	5.70	ABCDE	49.3	ABC	130	GHIJ	68.8	ABCDE	109	GHIJK	268	ABCDEF	1.48	FGHIJKL	11.4	BCDE	40.6
SR404	32.4	L	66.3	J	68	ABCD	80.1	DEFGH	1.1	BCD	2.47	ABCDE	11.8	IJK	5.68	ABCDEF	50.4	AB	142	EFGH	72.1	AB	148	EFGHIJK	274	ABCD	1.48	EFGHIJKL	9.4	CDE	42.0
M125	36.3	DEF	82.1	BCDEFG	64	DEFGHIJ	80.4	CDEF	1.6	B	2.30	ABCDEFGHI	11.8	IJK	5.15	HIJKL	45.8	EFGHIJ	154	BCDEFG	59.9	EFGHI	133	EFGHIJK	213	GHIJ	1.49	EFGHIJKL	18.2	AB	47.0
M126	34.1	FGHIJKL	71.5	HIJ	65	CDEFGHIJ	80.2	DEFG	1.1	BCD	2.09	CDEFGHIJK	11.9	HIJK	5.20	HIJKL	45.4	EFGHIJ	157	BCDEF	64.0	BCDEFG	120	FGHIJK	221	FGHIJ	1.48	EFGHIJKL	11.5	BCDE	45.0
M128	35.1	DEFGHIJ	76.5	DEFGHI	67	ABCDE	80.0	DEFGHI	1.2	BCD	2.33	ABCDEFGH	12.1	FGHIJ	5.47	BCDEFGH	47.0	CDEFGH	152	BCDEFG	59.2	FGHI	172	DEFGHI	233	CDEFGHIJ	1.51	BCDEF	12.1	BCD	45.2
M129	35.5	DEFGH	80.0	BCDEFGH	66	BCDEFGHI	80.2	DEFG	1.1	BCD	2.65	AB	12.5	CDEFGH	5.82	AB	48.4	ABCDE	135	FGHI	66.4	ABCDEF	126	FGHIJK	307	A	1.48	EFGHIJKL	9.6	CDE	43.6
ND20508	32.4	L	73.9	FGHIJ	69	ABC	78.3	N	1.2	BCD	1.89	FGHIJKL	13.4	A	5.42	CDEFGHIJ	41.9	KLM	217	A	65.3	ABCDEF	108	GHIJK	220	GHIJ	1.49	DEFGHIJ	8.4	CDE	43.2
ND20666	34.8	DEFGHIJ	84.8	ABCDE	63	EFGHIJK	78.6	LMN	1.0	BCD	1.95	EFGHIJKL	13.0	ABCD	5.25	GHIJKL	42.9	JKLM	148	CDEFG	67.6	ABCDEF	79	JK	224	FGHIJ	1.50	CDEFGHIJ	6.7	DE	47.8
ND21306	34.7	DEFGHIJK	89.1	AB	68	ABCD	79.7	FGHIJK	1.3	BCD	1.69	KL	12.5	CDEFGH	4.99	KLMN	42.0	KLM	145	DEFGH	64.3	BCDEF	180	DEFGH	208	HIJK	1.50	DEFGHIJ	5.7	DE	50.4
ND21532	33.1	IJKL	77.0	DEFGHI	70	AB	79.6	GHIJK	0.9	D	1.77	IJKL	11.9	HIJK	5.06	JKLM	44.4	GHIJKL	161	BCDE	69.6	ABCD	107	GHIJK	216	GHIJ	1.49	DEFGHIJKL	5.1	DE	49.0
2ND21867	43.2	C	93.2	A	60	JKL	80.6	BCDE	1.1	BCD	1.50	L	12.3	DEFGHIJ	4.75	MNO	40.6	M	107	KLM	50.6	JK	188	DEFG	189	JK	1.48	EFGHIJKL	4.3	E	46.4
2ND22895	45.0	ABC	94.2	A	63	DEFGHIJK	82.5	A	1.2	BCD	1.75	JKL	11.9	HIJK	4.96	LMNO	43.2	IJKLM	99	LM	59.1	FGHI	389	A	206	IJK	1.54	AB	8.0	CDE	47.8
2ND22927	46.3	A	94.3	A	66	BCDEFG	82.0	A	1.1	BCD	2.43	ABCDEF	11.6	JK	5.40	DEFGHIJ	48.7	ABCDE	89	M	62.8	CDEFG	232	BCD	247	BCDEFGHI	1.53	ABC	18.3	AB	38.6
2ND22996	43.8	BC	92.8	A	61	IJKL	81.1	BC	0.9	D	2.29	ABCDEFGHI	12.6	BCDEFG	5.80	ABC	47.1	CDEFGH	113	JKL	74.0	A	120	FGHIJK	277	ABC	1.47	JKL	8.5	CDE	40.4
6B01-2157	33.0	JKL	80.6	BCDEFGH	66	BCDEFGHI	79.1	JKLM	1.2	BCD	2.04	CDEFGHIJK	13.0	ABCD	5.89	A	47.4	BCDEFG	175	B	71.0	ABC	100	HIJK	286	AB	1.47	IJKL	5.2	DE	43.4
6B01-2221	32.5	KL	69.2	IJ	70	AB	79.3	HIJKL	1.1	BCD	2.31	ABCDEFGHI	12.2	EFGHIJ	5.61	ABCDEFG	47.2	CDEFGH	154	BCDEFG	66.4	ABCDEF	135	EFGHIJK	284	AB	1.48	GHIJKL	7.1	DE	39.8
6B02-3295	33.5	HIJKL	79.3	BCDEFGHI	65	BCDEFGHI	78.5	MN	0.9	D	2.36	ABCDEFG	12.7	BCDEF	5.65	ABCDEF	46.4	CDEFGHI	157	BCDEF	61.2	DEFGHI	168	DEFGHI	254	BCDEFGH	1.49	DEFGHIJKL	11.8	BCDE	38.4
SR410	36.8	D	85.5	ABCD	66	BCDEFGHI	79.4	HIJK	0.7	D	2.21	ABCDEFGHIJK	12.1	FGHIJ	5.54	ABCDEFGH	47.5	ABCDEFG	146	DEFGH	69.3	ABCD	123	FGHIJK	271	ABCDE	1.49	DEFGHIJKL	7.3	DE	49.0
SR412	35.2	DEFGHI	82.2	BCDEFG	65	BCDEFGHI	79.8	EFGHIJ	0.9	D	2.28	ABCDEFGHIJ	12.3	CDEFGHI	5.47	BCDEFGH	45.9	DEFGHIJ	171	BC	69.9	ABCD	74	K	272	ABCDE	1.48	EFGHIJKL	8.3	CDE	53.0

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

Appendix A: METHODS

Cleaning All samples were cleaned on a Carter Dockage Tester and any material not retained on a 5/64" screen was discarded.

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 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 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. **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-6A (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 2006 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	>45	7	>45	7
(20° DU)	40–45	4	40–45	4
	< 40	0	< 40	0
Beta-glucan	< 100	7	<120	7
(ppm)	100–150	3	120 – 170	3
	> 150	0	> 170	0