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MISSISSIPPI VALLEY REGIONAL SPRING BARLEY NURSERY - 2005 Crop

Preliminary Quality Report

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This is a progress report of cooperative investigations being conducted by 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 analyses by the Agricultural Research Service of samples provided by the Agricultural Research Service and State Agricultural Experiment Stations. The report is not intended for publication and should not be referred to in literature citations nor quoted in publicity or advertising. Use of the data may be granted for certain purposes upon written request to the agency or agencies involved.

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

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Mississippi Valley Regional Spring Barley Nursery – 2005 Crop

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

These samples were germinated for 5 days, with rotation for 3 minutes every half hour. Earlier work has shown that this regime generates 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 17 quality factors are listed over the three stations located in the Mississippi Valley Region (Table 2) and over all varieties (Table 3). Tables 8 and 9 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 7. Evaluations of data from individual locations and overall performance evaluations (derived primarily from Tables 2, 3, 8 and 9) are presented below.

Most of the plump barleys from Aberdeen, ID (Table 4) had good protein contents. The extract values were excellent and only five fine – coarse differences exceeded the desired limit. A quarter of the soluble protein levels were too high, with S/T ratios varying widely, with five below the minimum limits and sixteen that exceeded the maximum limit. Free amino nitrogen levels were very good. Seven lines had wort turbidity levels that exceeded 15 NTU and of those five were classified as hazy. Beta-glucan levels were generally elevated, with twenty-eight that exceeded the desired limits. Relative viscosities were slightly elevated, with two thirds of the worts exceeding the desired maximum value of 1.50. Many lines performed quite well at this location, which yielded an average malt quality score of 47. The best performers were Newdale, Drummond, Lacey, ND20299, 2ND19854, M123, ND20448 and M109. Newdale had an excellent quality profile,

with its typical "good" low viscosity, turbidity, β–glucan and fine – coarse values. This plump variety also had an extract value of over 81%, with solid soluble protein and free amino nitrogen values. Drummond had solid malt quality also, marred only by slightly elevated β–glucan and relative viscosity values. Lacey had an excellent quality profile negatively affected by slightly elevated β–glucan and soluble protein levels. ND20299 had elevated β–glucan, turbidity and relative viscosity values. 2ND19854 had a profile similar to ND20299, but with a higher extract value and unfortunately an elevated fine – coarse difference. M123 and M109 had profiles similar to Lacey, with elevated β–glucan and soluble protein contents, but also had slightly elevated turbidity and relative viscosity values. ND20448 had slightly elevated soluble protein and β–glucan levels, and its extract value was acceptable, but lower than the extract mean from this location.

Eight of the plump barleys from Crookston, MN (Table 5) had unacceptably high protein contents. Extract values were generally a bit low, although only seven fell below the minimum desired limit. A third of the fine – coarse differences and two thirds of the β–glucan contents were too high. All free amino nitrogen, viscosity and amylolitic values were good. Fifteen wort turbidity readings exceeded 15 NTU and soluble protein values were unacceptably high in thirteen worts. The best performers were Newdale, M121, Lacey, M120, M109, 6B00-1328, Stellar, ND19620 and 2ND21863. Newdale scored very well, marred by only a slightly elevated fine – coarse difference and a slightly low diastatic power value. The elevated α–amylase activity of 90 might be a concern. Lacey, M109 and M120 had similar good quality profiles, but elevated turbidities should be noted. M121 had a low, but acceptable extract value, with good clarity, in contrast to the previous three lines from Minnesota. 6B00-1328 had a very nice malt quality profile and would have scored better with slightly lower protein content. Stellar had good quality, but note the minimally acceptable extract value and the turbid wort. ND19620 had elevated β–glucan and turbidity values. 2ND21863 had elevated β–glucan and slightly depressed diastatic power values.

The plump barleys from Morris, MN (Table 6) had good protein levels.

Extract values were very good, averaging nearly 80%, with only Barbless having an unacceptable value. Seven fine – coarse differences exceeded the desired maximum limit, but none were greater than 2.0. The soluble protein levels were generally elevated, with thirteen exceeding the upper limit and causing nearly three quarters of the S/T ratios to be unacceptably high. Only fourteen β–glucan levels were too high and only four turbidities exceeded 15 NTU. The free amino nitrogen, viscosity and amylolitic values were generally very good. Many of these lines performed well generating a mean quality score of 51. The best performers were M120, 6B00-1328, Lacey, Drummond, Stellar, ND19620, Tradition, M109, M121, M124 and M123. M120 had a slightly hazy wort and a slightly depressed diastatic power value. 6B00-1328, Lacey, Drummond and Stellar all had acceptable, but somewhat elevated soluble protein levels. ND19620 had a slightly hazy wort and a slightly elevated β–glucan level. Tradition had an elevated S/T ratio that kept it from receiving a maximum score. M109, M121, M123 and M124 all showed excellent malting quality, but their elevated soluble protein contents, which contributed to unacceptably high S/T ratios should be noted.

A quarter of the barleys from Sidney, MT (Table 7) were too thin and two thirds of the protein contents were unacceptably high. Only five of the extract values fell below the desired minimum, but two-thirds of the fine – coarse differences were unacceptably high. Eleven soluble protein values were too high, while that of Barbless was unacceptably low. The free amino nitrogen and relative viscosity values were generally very good. A quarter of the worts had elevated β–glucan levels, but this was less than expected considering the number of elevated fine – coarse differences. The amylolitic values were acceptable, but quite high. Seven worts had turbidities that exceeded 15 NTU. The best performers were 2ND21863, Lacey, ND20314 and CDC Clyde. 2ND21863 and Lacey had nice quality profiles, except for their slightly elevated fine – coarse differences; both lines had excellent β–glucan contents. ND20314 had good malting quality, high enzyme activity, but a turbid wort. CDC Clyde had a slightly elevated fine – coarse difference and its protein modification may have proceeded too far under our

routine malting conditions yielding a soluble protein value of 5.90% that contributed to an unacceptably high S/T ratio.

Overall, the barleys grown at Morris performed very well attaining an average quality score of over 50. The lines grown there (Tables 2 and 8) were quite plump and had excellent protein contents. Carbohydrate modification was best at this location resulting in the lowest β–glucan and fine – coarse values. Protein modification may have gone a little too far with our standard malting protocol. Soluble protein and S/T values were highest at this location. The nursery also performed well at Aberdeen, with an average score of 47. The barleys from there were very plump and had great extract values. Carbohydrate modification was slow however resulting in elevated β–glucan contents and elevated relative viscosities. Crookston and Sidney followed with good average quality scores, but were lower because of generally elevated barley protein levels and lower extract values.

The best performers throughout the nursery (Tables 3 and 9) were Lacey, Newdale, M120, Stellar, Drummond, ND19620, M124, M109, 6B00-1328, 2ND21863 and M121. Lacey showed good overall plumpness and protein contents, had an adequate extract value averaging 78.5%, a soluble protein level that averaged a couple tenths of a percent less than those of Morex and Robust, good amylolitic values and the lowest average β–glucan level in the nursery. Lacey had excellent relative viscosities and good turbidity values, except at Crookston. Newdale was sufficiently plump and had acceptable protein contents, though on the high side. This line had an excellent average extract value of 80.3%, a soluble protein level similar to Morex and Robust, and a low diastatic power level offset by a fairly high α–amylase value. Newdale had good low β–glucan, relative viscosity and turbidity values. M120 is a first year entry. This line had excellent plumpness and good protein contents. It had an average extract value of over 79%, an average soluble protein value over a half % lower than those of Morex and Robust. M120 had excellent amylolitic and β–glucan values, but elevated turbidities may be a concern. Stellar was very plump, but had a slightly elevated average total protein content. Extract values were sufficient and soluble protein levels were similar to

those of Morex and Robust. Stellar has an amylolitic profile similar to Morex, an excellent average β–glucan content and good viscosity. This line had good turbidity values, except at Crookston. Drummond was plump, but had elevated protein contents at Sidney and Crookston. The extract values were impacted by barley protein content, being quite low in malts derived from Sidney (14.3%) and Crookston (13.6%), but almost 2.0% higher in malts derived from Aberdeen (12.6%) and Morris (13.1%). Drummond had soluble protein levels similar to or a bit lower than that of Morex and Robust, an amylolitic profile similar to Morex, good β–glucan contents and viscosities. Drummond worts had good turbidities, except at Crookston. ND19620 was generally plump and had lower total protein contents than Morex and Robust. The average extract value was 79%, which exceeded that of the control by 0.5%. The soluble protein and β–glucan levels were lower than the controls. The mean diastatic power value was a bit lower than Morex and Robust, however it was pretty good considering ND19620 averaged 1% lower total protein. ND19620 had a mean relative viscosity that was higher that the controls, however it was only unacceptably high in the "Aberdeen" wort. ND19620 had elevated turbidities in worts from all locations. M124 had good plumpness, except when grown at Sidney, and protein contents were generally good. This line had an extract value that was better than that of the experimental controls. The soluble protein and β–glucan levels were better than those of Morex and Robust, while its amylolitic profile was similar. Viscosities were good, except in the "Aberdeen" wort, while turbidities were generally elevated. M109 was plump and had good protein contents, except when grown at Sidney. This line had very good extract values, but somewhat elevated soluble protein content. M109 had an amylolitic profile similar to Morex and Robust and its fine – coarse and β–glucan values were superior to the controls. 6B00-1328 was very plump and its protein contents were a bit lower than those of the experimental controls. This line had an adequate extract value, with excellent fine – coarse, viscosity, turbidity and β–glucan values. Its average soluble protein level was about 0.3% higher than those of the controls. 2ND21863 had excellent plumpness and protein contents.

This line averaged 80.0% extract and had excellent soluble protein contents. The enzyme profile was a bit lower than that of Conlon, but good considering there was 1% less total protein. 2ND21863 was a bit under-modified by our standard malting protocol, but it was better than that of Conlon. This line had superior β–glucan and fine – coarse values, while viscosity and turbidity values were very good, and similar to Conlon. M121 was very plump and had lower protein contents than Morex and Robust. This line had adequate extract values, excellent soluble protein, viscosity, and turbidity values. M121 had lower diastatic power levels than the experimental controls and it β–glucan contents were a bit elevated, but still superior to the controls.

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Table 1 - Nursery submissions and pedigree

Entry#	CI # or Contributor	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 615584	Drummond	ND9712//Stander/ND12200
6.	PI 613603	Lacey	M78/M79
7.	North Dakota	Conlon	Bowman*2/Brigitta mutant//ND10232
8.	Busch Ag. Res.	Tradition	6B89-2126/ND10981
9.	Minnesota	M109	Lacey/M95
10.	Manitoba	Newdale	CDC Stratus//TR236/WM862-6
11.	Saskatchewan	CDC Clyde (BT490)	SM95096/SM94043
12.	North Dakota	ND19620	ND15483/ND16258
13.	North Dakota	Stellar (ND16301)	Foster//ND12200/6B88-3213
14.	North Dakota	2ND19854	ND15403-3/ND1642
15.	Busch Ag. Res.	6B00-1323	6B94-8126 // LEGACY / 6B95-6311
16.	Busch Ag. Res.	6B00-1328	6B94-8126 // LEGACY / 6B95-6311
17.	Saskatchewan	BT493	SM95001 / SM95098
18.	Minnesota	M120	BT462 / Lacey
19.	Minnesota	M121	M110 / M111
20.	Minnesota	M122	FEG18-20 / M110
21.	Minnesota	M123	FEG39-03 / Lacey
22.	Minnesota	M124	M96-186 / M109
23.	North Dakota	ND19655	ND15483/ND17224
24.	North Dakota	ND20299	ND16924/ND17082
25.	North Dakota	ND20303	ND16924/ND17082
26.	North Dakota	ND20314	ND16924/ND15422
27.	North Dakota	ND20448	ND16918/C98-10-155-3
28.	North Dakota	2ND21863	ND1872/ND19130
29.	Busch Ag. Res.	6B01-2208	LEGACY / 6B94-7544
30.	Busch Ag. Res.	6B01-2218	6B94-7378 // B2027 / M84
31.	Busch Ag. Res.	6B01-2356	LEGACY/MNBRITE//LEGACY/6B94-7378
32.	Busch Ag. Res.	6B01-2513	LEGACY / 6B95-6311
33.	Saskatchewan	BT497	SM96137/SM96003
34.	Saskatchewan	SR403	SM97292/SM97216
35.	Saskatchewan	SR404	SM97292/SM97216

*Entries 18-35 are new for 2005.

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Table 2 - Station Means* of Barley and Malt Quality Factors for 35 Varieties or Selections.**

LOCATION	Kernel Weight (mg)		on 6/64" (%)		Barley Color (Agtron)		Malt Extract (%)		F - C (%)		Wort Color		Wort Clarity		Barley Protein (%)		Wort Protein (%)		S/T (%)		DP (°ASBC)		Alpha-amylase (20°DU)		Beta-glucan (ppm)		FAN (ppm)		Viscosity Relative		Turbidity (HACH)		pH		Quality Score	
Crookston	35.7	A	90.7	A	54	C	78.3	B	1.2	B	2.7	A	1.6	A	13.3	B	5.88	B	46.0	B	172	B	67.8	B	194	A	238	A	1.45	A	16.3	A	5.94	A	43.9
Morris	35.1	B	88.4	B	58	B	79.7	A	0.8	C	2.2	B	1.3	B	12.6	C	6.04	A	49.6	A	141	C	72.4	A	159	B	228	A	1.46	AB	9.8	B	5.90	B	50.7
Sidney	34.4	C	79.9	C	68	A	78.1	B	1.5	A	1.8	C	1.4	B	14.0	A	5.84	B	43.3	C	199	A	68.2	B	165	B	233	A	1.46	A	9.1	B	5.90	B	40.6

* 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, Drummond, Lacey, Conlon, Tradition, M109, Newdale, CDC Clyde, ND19620, Stellar, 2ND19854, 6B00-1323, 6B00-1328, BT493, M120, M121, M122, M123, M124, ND19655, ND20299, ND20303, ND20314, ND20448, 2ND21863, 6B01-2208, 6B01-2218, 6B01-2356, 6B01-2513, BT497, SR403, SR404

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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		Wort Clarity		Barley Protein (%)		Wort Protein (%)		S/T (%)		DP (°ASBC)		Alpha-amylase (20°DU)		Beta-glucan (ppm)		FAN (ppm)		Viscosity (Relative)		Turbidity (Hach)		pH		Quality Score
Barbless	33.3	JKLMN	76.4	KL	60	ABCDEFGHI	75.1	K	2.2	A	1.9	HIJKL	1.3	CD	14.1	AB	5.10	LM	38.2	M	142	KLM	50.4	N	367	A	185	IJKL	1.47	ABCDEFGH	12.0	EFGHI	5.96	AB	31.0
Morex	32.5	KLMN	78.3	JKL	61	ABCDEFGH	78.4	GHIJ	1.7	ABC	1.9	HIJKL	1.0	D	13.9	ABCD	5.62	GHIJK	42.7	JKL	179	BCDEFGH	68.7	GHIJ	183	DEFGH	222	EFGHIJ	1.46	BCDEFGHIJ	7.3	FGHI	5.98	AB	40.7
Robust	34.3	EFGHIJ	85.2	CDEFGHIJ	59	ABCDEFGHI	78.2	IJ	1.9	AB	1.7	KL	1.0	D	13.9	ABC	5.74	EFGHIJ	43.6	HIJK	184	ABCDEFG	53.6	MN	220	CDEFG	224	EFGHIJ	1.45	FGHIJKL	4.5	I	5.91	ABCDE	43.0
Legacy	33.6	HIJKL	83.9	DEFGHIJK	50	J	78.7	EFGHIJ	1.5	BCD	2.2	DEFGHIJKL	1.0	D	13.7	ABCDEF	6.45	BC	48.3	CDEF	193	ABCD	82.8	ABCD	238	BCDEF	272	BCDE	1.44	GHIJKL	4.1	I	5.90	ABCDE	39.0
Drummond	33.6	HIJKLM	85.5	BCDEFGHIJ	59	BCDEFGHIJ	78.3	GHIJ	1.3	BCDE	2.2	DEFGHIJK	1.3	CD	13.7	ABCDEF	5.60	GHIJK	43.1	IJKL	190	ABCDE	65.2	HIJK	114	HI	233	DEFGHI	1.45	CDEFGHIJKL	11.1	EFGHI	5.96	AB	49.3
Lacey	35.2	DEFGH	88.3	ABCDEFG	60	ABCDEFGHI	78.5	FGHIJ	1.1	CDE	2.1	EFGHIJKL	1.3	CD	13.1	BCDEF	5.55	GHIJKL	43.1	IJKL	182	ABCDEFG	65.0	HIJK	64	I	225	DEFGHIJ	1.43	IJKL	12.8	EFGHI	5.94	ABCDE	57.7
Conlon	44.4	A	95.8	A	54	FGHIJ	79.6	ABCDE	1.5	BCD	1.7	L	1.0	D	13.0	BCDEFG	5.15	KLM	40.1	LM	120	MN	64.8	HIJK	325	AB	192	HIJKL	1.47	ABCDEFG	6.9	GHI	5.93	ABCDE	46.3
Tradition	33.5	IJKLMN	87.7	ABCDEFGH	66	AB	78.3	GHIJ	1.3	CDE	2.3	DEFGHIJ	2.0	BC	13.5	ABCDEF	5.47	HIJKL	42.8	JKL	206	A	67.0	GHIJK	157	EFGHI	213	GHIJKL	1.48	ABC	18.6	DEFG	6.00	A	45.0
M109	35.1	DEFGHI	86.6	BCDEFGHI	54	HIJ	79.3	ABCDEFGH	0.9	DE	2.3	DEFGHIJ	1.3	CD	13.4	ABCDEF	5.81	EFGHI	45.7	FGHIJ	179	BCDEFGH	65.4	HIJK	133	FGHI	253	CDEFG	1.45	CDEFGHIJKL	12.0	EFGHI	5.95	ABCD	51.3
Newdale	38.1	C	81.6	GHIJKL	56	CDEFGHIJ	80.3	A	0.9	DE	1.7	KL	1.0	D	13.4	ABCDEF	5.70	EFGHIJ	44.9	GHIJK	128	LMN	84.7	ABC	90	HI	223	EFGHIJ	1.43	JKL	3.2	I	5.96	ABC	51.0
CDC Clyde	33.9	FGHIJK	84.6	DEFGHIJ	60	ABCDEFGHI	79.8	ABCD	1.1	CDE	2.2	DEFGHIJK	1.0	D	12.8	EFGH	6.19	CDE	50.2	ABCD	156	HIJK	79.2	CDE	190	DEFGH	265	BCDEF	1.46	BCDEFGHIJK	5.2	I	5.87	BCDEF	42.3
ND19620	34.6	EFGHIJ	88.0	ABCDEFG	64	ABCDE	79.0	CDEFGHI	1.0	DE	2.4	CDEFGH	2.0	BC	12.8	EFGH	5.32	IJKLM	43.5	HIJK	174	BCDEFGHI	60.2	KLM	149	FGHI	191	HIJKL	1.48	ABCD	17.4	DEFGH	5.96	ABC	50.7
Stellar	34.9	DEFGHIJ	90.1	ABCDEF	65	ABC	78.3	HIJ	0.7	E	2.1	EFGHIJKL	1.3	CD	13.6	ABCDEF	5.76	EFGHI	43.8	HIJK	198	AB	67.6	GHIJ	103	HI	247	CDEFG	1.48	ABCD	11.7	EFGHI	5.90	ABCDE	53.3
2ND19854	41.2	B	92.0	ABCD	54	GHIJ	79.9	ABCD	1.5	BCD	2.8	ABC	3.0	A	12.1	GH	4.96	M	42.7	JKL	114	N	56.6	LMN	318	ABC	180	JKL	1.48	AB	38.3	AB	5.92	ABCDE	49.3
6B00-1323	34.6	EFGHIJ	79.5	HIJKL	55	EFGHIJ	79.5	ABCDEF	1.1	CDE	2.5	BCDE	1.0	D	13.8	ABCDE	6.88	AB	51.2	ABC	186	ABCDEF	80.9	CD	104	HI	325	A	1.43	KL	4.4	I	5.88	BCDEF	40.0
6B00-1328	35.1	DEFGHI	91.2	ABCDE	62	ABCDEFGH	78.5	FGHIJ	0.7	E	1.8	JKL	1.0	D	13.6	ABCDEF	5.90	DEFGH	44.2	GHIJK	192	ABCD	66.1	HIJK	91	HI	226	DEFGHIJ	1.44	HIJKL	5.3	I	5.91	ABCDE	53.7
BT493	35.9	DE	92.0	ABCD	59	BCDEFGHIJ	79.3	ABCDEFG	1.0	DE	2.9	AB	1.0	D	14.3	A	7.23	A	51.7	AB	180	ABCDEFGH	84.9	ABC	141	FGHI	307	AB	1.46	BCDEFGHIJ	7.0	GHI	5.79	F	41.7
M120	35.6	DE	90.1	ABCDEF	63	ABCDEF	79.1	CDEFGHI	1.2	CDE	2.5	BCDEF	2.3	B	12.7	FGH	5.08	LM	41.9	KL	153	IJK	57.1	LMN	95	HI	171	KL	1.47	ABCDEF	21.5	CDE	5.97	AB	54.7
M121	35.4	DEFG	90.2	ABCDEF	58	BCDEFGHIJ	78.3	GHIJ	1.2	CDE	2.0	FGHIJKL	1.0	D	13.3	ABCDEF	5.62	GHIJK	45.3	FGHIJK	165	EFGHIJK	63.3	IJKL	133	FGHI	212	GHIJKL	1.44	HIJKL	6.1	HI	5.94	ABCDE	53.3
M122	34.8	DEFGHIJ	85.0	DEFGHIJ	58	BCDEFGHIJ	78.4	GHIJ	1.5	BCD	1.9	HIJKL	1.0	D	13.4	ABCDEF	5.69	EFGHIJ	43.9	GHIJK	169	CDEFGHI	65.5	HIJK	261	BCDE	213	GHIJKL	1.45	EFGHIJKL	4.7	I	5.95	ABC	41.3
M123	35.5	DEF	82.3	FGHIJKL	66	AB	78.4	GHIJ	1.0	DE	2.1	EFGHIJKL	2.0	BC	13.5	ABCDEF	5.84	DEFGH	44.7	GHIJK	192	ABCD	57.5	LM	122	GHI	211	GHIJKL	1.45	CDEFGHIJKL	17.8	DEFGH	5.90	ABCDE	44.0
M124	34.4	EFGHIJ	79.1	IJKL	58	BCDEFGHIJ	78.6	EFGHIJ	0.8	DE	2.5	BCDE	1.7	CD	12.9	DEFGH	5.75	EFGHIJ	46.1	FGHIJ	183	ABCDEFG	64.9	HIJK	154	FGHI	219	FGHIJK	1.46	BCDEFGHI	18.8	DEF	5.98	AB	50.7
ND19655	32.0	MN	83.5	EFGHIJK	56	DEFGHIJ	78.3	GHIJ	1.1	CDE	2.4	BCDEFG	1.3	CD	12.9	CDEFGH	6.15	CDEF	50.9	ABC	144	JKL	67.8	GHIJ	231	BCDEF	241	CDEFGH	1.46	CDEFGHIJK	11.6	EFGHI	5.83	EF	36.7
ND20299	34.5	EFGHIJ	91.0	ABCDE	66	AB	78.1	IJ	1.3	BCDE	3.1	A	3.0	A	12.7	FGH	5.61	GHIJK	46.4	FGHI	177	BCDEFGHI	62.3	JKL	277	ABCD	210	GHIJKL	1.49	A	42.7	A	5.94	ABCDE	45.0
ND20303	33.8	GHIJK	84.6	DEFGHIJ	63	ABCDEFG	77.8	J	1.4	BCD	2.7	ABCD	3.0	A	13.0	CDEFGH	5.65	FGHIJ	44.8	GHIJK	160	GHIJK	67.5	GHIJ	234	BCDEF	222	EFGHIJ	1.47	ABCDEFGH	30.0	BC	5.95	ABCD	41.7
ND20314	36.3	D	89.5	ABCDEFG	58	BCDEFGHIJ	78.9	DEFGHI	0.8	DE	2.9	ABC	2.3	B	12.9	CDEFGH	6.13	CDEF	49.6	BCDE	184	ABCDEFG	70.9	FGH	117	GHI	254	CDEFG	1.47	ABCDEFGH	25.6	CD	5.90	ABCDE	49.3
ND20448	34.8	DEFGHIJ	93.4	ABC	68	A	78.2	IJ	0.9	DE	1.8	IJKL	1.0	D	13.4	ABCDEF	6.02	CDEFG	47.2	DEFG	189	ABCDE	70.3	FGHI	148	FGHI	225	DEFGHIJ	1.47	ABCDEFG	6.1	HI	5.87	BCDEF	44.3
2ND21863	44.6	A	93.5	AB	52	IJ	80.1	AB	1.0	DE	1.9	GHIJKL	1.3	CD	12.1	H	5.26	JKLM	45.9	FGHIJ	118	N	54.9	MN	165	EFGHI	169	L	1.48	ABCDEF	6.9	GHI	5.88	BCDEF	51.0
6B01-2208	32.6	KLMN	88.0	ABCDEFG	60	ABCDEFGHI	78.3	GHIJ	0.9	DE	2.4	CDEFGH	1.0	D	14.0	AB	7.05	A	52.9	AB	190	ABCDE	88.2	AB	160	EFGHI	287	ABC	1.43	IJKL	4.4	I	5.84	DEF	35.0
6B01-2218	31.9	N	85.3	BCDEFGHIJ	65	AB	78.6	EFGHIJ	1.1	CDE	1.7	L	1.0	D	13.9	ABC	6.13	CDEF	45.9	FGHIJ	195	ABC	73.7	EFG	162	EFGHI	270	BCDE	1.45	DEFGHIJKL	4.0	I	5.91	ABCDE	41.3
6B01-2356	33.6	HIJKLM	83.7	DEFGHIJK	62	ABCDEFGH	79.0	CDEFGHI	1.0	DE	2.2	EFGHIJKL	1.0	D	13.1	BCDEFG	6.31	BC	50.7	ABC	182	ABCDEFG	78.3	CDE	167	EFGHI	227	DEFGHIJ	1.44	IJKL	4.4	I	5.88	BCDEF	41.7
6B01-2513	32.1	LMN	75.1	L	65	ABCD	78.3	HIJ	0.9	DE	1.9	GHIJKL	1.0	D	13.4	ABCDEF	5.96	DEFGH	46.6	EFGH	184	ABCDEFG	76.3	DEF	108	HI	212	GHIJKL	1.44	IJKL	5.3	I	5.92	ABCDE	44.3
BT497	34.3	EFGHIJ	88.6	ABCDEFG	64	ABCDE	79.9	ABC	1.0	DE	2.4	CDEFGHI	1.0	D	13.3	ABCDEF	6.82	AB	53.4	A	161	FGHIJK	89.6	A	181	DEFGH	274	BCD	1.48	ABCDE	6.1	HI	5.85	CDEF	41.0
SR403	32.6	KLMN	85.4	BCDEFGHIJ	63	ABCDEFG	78.9	DEFGHI	1.0	DE	2.5	BCDE	1.3	CD	13.3	ABCDEF	6.83	AB	52.7	AB	160	GHIJK	78.3	CDE	112	HI	282	ABC	1.43	L	7.9	FGHI	5.84	DEF	40.3
SR404	34.6	EFGHIJ	86.4	BCDEFGHIJ	61	ABCDEFGH	79.1	BCDEFGHI	1.0	DE	2.4	CDEFGHI	1.0	D	13.6	ABCDEF	6.81	AB	52.6	AB	167	DEFGHIJ	82.1	BCD	220	CDEFG	269	BCDEF	1.44	HIJKL	4.7	I	5.84	DEF	36.7

* 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 and Sidney MT

2005 MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY 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	Turbidity (NTU)	pH	Quality Score	Overall Rank
5540	Barbless	6	34.0	*82.8	76	76.9	*3.3	n.d.	3	12.4	4.10	33.5	94	36.1	*594	161	*1.72	30.0	5.93	24	39
5541	Morex	6	37.1	91.8	74	78.7	1.2	1.6	1	14.3	5.65	40.3	189	62.0	313	201	1.53	5.3	5.87	40	31
5542	Robust	6	37.3	94.1	73	80.1	1.0	1.6	1	13.5	6.02	47.0	146	54.4	274	217	1.51	4.8	5.79	46	21
5543	Legacy(6B93-2978)	6	36.6	94.7	81	80.7	0.9	1.7	1	12.1	5.93	51.3	162	77.1	231	217	1.50	4.1	5.85	49	14
5544	Drummond (ND15477)	6	35.8	95.6	79	79.6	0.8	1.7	1	12.6	5.29	43.1	161	69.9	158	187	1.51	7.7	5.89	61	2
5545	Lacey (M98)	6	40.9	96.6	74	79.8	0.6	1.9	1	13.1	5.88	46.4	147	63.9	144	243	1.49	8.3	5.84	57	3
5546	Conlon	2	48.5	99.2	71	79.3	1.3	1.9	2	13.6	5.43	41.6	139	70.2	371	187	1.57	11.1	5.82	36	41
5547	Tradition(6B95-2482)	6	39.3	97.0	68	78.6	1.1	1.6	1	15.1	5.81	38.6	190	63.9	277	199	1.50	6.0	5.84	36	36
5548	M109	6	40.1	97.1	64	80.5	1.1	2.0	2	13.0	5.92	46.7	157	70.1	207	230	1.51	12.7	5.90	53	9
5549	Newdale	6	42.7	96.6	66	81.1	0.2	1.5	1	12.4	5.54	46.2	138	75.1	70	232	1.44	4.2	5.87	62	1
5550	CDC Clyde (BT490)	6	36.6	96.6	73	81.1	0.9	1.8	1	13.4	6.10	46.4	109	84.5	280	236	1.54	5.6	5.81	44	26
5551	ND19620	6	38.2	97.9	78	79.6	1.3	n.d.	3	13.3	5.60	42.4	162	62.0	280	178	1.57	*58.0	5.87	56	6
5552	Stellar (ND16301)	6	38.8	97.8	78	80.9	1.2	1.8	1	12.8	5.71	47.6	145	69.4	219	224	1.54	9.8	5.81	49	14
5553	2ND19854	2	43.4	98.4	66	81.1	1.8	1.9	2	12.3	5.12	42.5	131	56.8	423	218	1.54	22.0	5.82	57	3
5554	6B00-1323	6	38.3	94.8	73	81.8	0.8	1.9	1	12.3	6.18	51.3	114	72.3	220	257	1.52	4.8	5.85	39	33
5555	6B00-1328	6	38.6	98.2	72	80.3	1.5	1.9	1	13.6	6.53	49.5	144	67.4	189	235	1.49	8.6	5.77	41	30
5556	BT493	6	39.2	97.5	76	82.1	0.9	2.1	1	12.8	6.42	52.2	131	85.3	100	260	1.50	5.9	5.80	50	13
5557	M120	6	40.9	98.9	76	80.1	0.9	n.d.	3	13.9	5.65	41.2	147	62.7	139	239	1.51	35.0	5.83	49	14
5558	M121	6	39.0	96.9	68	78.1	0.7	1.8	1	14.6	6.22	43.5	166	65.4	229	224	1.49	6.2	5.83	35	38
5559	M123	6	38.9	95.1	77	79.4	0.8	1.9	1	13.2	5.90	45.3	148	63.2	188	203	1.51	12.4	5.80	54	7
5560	M124	6	39.4	97.1	66	80.4	0.9	n.d.	3	12.6	5.54	45.6	135	58.2	305	195	1.57	*45.0	5.86	53	9
5561	ND19655	6	35.2	96.0	72	79.4	0.9	1.9	1	12.9	6.07	50.1	124	70.4	246	224	1.52	9.3	5.75	43	28
5562	ND20299	6	39.8	97.9	81	79.2	0.9	2.1	2	12.4	5.47	44.6	146	66.2	333	228	1.55	16.8	5.89	57	3
5563	ND20303	6	39.4	97.3	77	79.7	0.4	1.9	1	11.9	5.43	46.1	116	73.7	303	240	1.53	10.7	5.90	51	11
5564	ND20314	6	40.1	97.1	79	79.9	0.9	2.1	1	12.8	6.00	48.3	155	65.0	252	266	1.52	8.4	5.83	46	21
5566	ND20448	6	37.9	97.6	81	78.7	0.5	1.6	1	13.4	5.79	43.8	157	67.5	157	228	1.49	4.9	5.83	54	7
5567	2ND21863	2	47.5	98.0	61	79.9	0.9	1.6	1	12.4	4.80	39.4	119	53.4	394	173	1.52	7.3	5.84	47	20
5568	6B01-2208	6	37.3	96.9	69	79.3	1.0	2.3	1	14.2	6.78	49.9	165	89.8	146	312	1.45	7.5	5.80	39	33
5569	6B01-2218	6	37.1	97.4	76	79.6	0.6	1.5	1	13.5	5.83	43.6	191	81.2	187	263	1.48	3.8	5.86	49	14
5570	6B01-2356	6	39.7	97.2	72	80.2	0.3	1.8	1	12.8	5.94	47.7	150	73.4	185	261	1.47	4.1	5.83	49	14

Table 4

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Viscosity Relative	Turbidity (NTU)	pH	Quality Score	Overall Rank
5571	6B01-2513	6	37.4	94.9	76	79.4	0.2	1.8	1	13.0	6.27	49.7	157	78.4	125	269	1.49	6.0	5.81	49	14
5572	BT497	6	37.7	96.6	82	82.7	0.5	2.0	1	11.3	5.55	52.9	119	91.1	153	262	1.52	6.5	5.84	44	26
5573	SR403	6	36.0	93.4	75	81.4	0.5	2.3	1	11.4	5.82	55.2	116	77.3	128	283	1.49	7.9	5.76	40	31
5574	SR404	6	37.2	95.2	73	82.2	1.1	2.1	1	11.0	5.69	53.4	132	73.4	223	262	1.51	13.2	5.82	45	25
5575	94Ab13449	6	37.8	95.2	69	81.9	0.9	n.d.	3	10.7	5.04	50.9	104	59.2	123	218	1.51	*68.0	5.83	38	35
5576	98Ab11993	2	44.8	99.2	63	81.7	0.9	1.6	1	11.0	4.81	47.0	83	67.9	192	189	1.53	5.5	5.95	46	21
5577	01Ab7784	6	40.9	96.2	75	80.8	0.6	1.5	1	10.8	4.89	46.1	105	54.0	185	196	1.51	3.6	5.87	42	29
5578	97Ab7973	2	46.3	99.1	73	81.5	1.2	1.9	1	11.1	5.07	47.6	90	57.3	170	210	1.49	10.5	5.89	46	21
5579	98Ab11707	2	45.2	96.7	68	81.0	1.3	1.7	1	11.3	4.84	46.1	79	60.0	351	211	1.51	3.9	5.92	51	11
5565	MOREX MALT CHECK	6	35.4	87.9	80	80.1	0.6	2.1	1	12.6	6.43	54.6	145	74.5	37	293	1.45	4.3	5.83	53	
Minima			34.0	91.8	61	76.9	0.2	1.5		10.7	4.10	33.5	79	36.1	70	161	1.44	3.6	5.75	24	
Maxima			48.5	99.2	82	82.7	1.8	2.3		15.1	6.78	55.2	191	91.1	423	312	1.57	35.0	5.95	62	
Means			39.5	96.7	73	80.2	0.9	1.8		12.7	5.66	46.3	138	67.9	223	227	1.51	9.3	5.84	47	
Standard Deviations			3.3	1.6	5	1.2	0.3	0.2		1.1	0.54	4.5	28	10.9	85	33	0.03	7.0	0.04	8	
Coefficients of Variation			8.4	1.7	7	1.5	39.6	12.4		8.4	9.55	9.7	20	16.0	38	14	1.90	74.8	0.77	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

2005 MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - CROOKSTON, MN

Table 5

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Viscosity Relative	Turbidity (NTU)	pH	Quality Score	Overall Rank
5618	Barbless	6	34.0	*76.2	55	*74.5	*2.4	2.1	1	14.4	4.92	35.6	149	47.5	*434	192	1.47	10.4	5.97	27	34
5619	Morex	6	33.6	87.2	57	78.1	1.2	2.3	1	13.6	5.37	40.3	187	69.5	179	232	1.45	12.5	6.04	42	20
5620	Robust	6	33.9	87.8	51	77.8	*2.5	1.8	1	13.5	5.21	40.9	187	50.7	265	214	1.44	5.4	5.97	47	13
5621	Legacy(6B93-2978)	6	34.7	90.5	*30	77.9	1.2	2.5	1	14.1	6.21	46.2	197	76.4	245	273	1.44	5.1	5.93	35	31
5622	Drummond (ND15477)	6	33.6	88.5	50	77.8	1.2	3.2	2	13.6	5.58	43.4	180	64.2	152	243	1.44	23.0	5.98	49	12
5623	Lacey (M98)	6	35.6	94.5	55	78.2	0.9	2.6	2	12.7	5.32	42.2	181	63.8	72	216	1.42	20.0	5.98	58	3
5624	Conlon	2	*45.3	96.2	48	80.3	1.2	1.8	1	13.1	5.20	40.3	130	66.9	280	206	1.45	6.7	5.96	50	10
5625	Tradition(6B95-2482)	6	33.8	90.8	61	77.2	1.3	n.d.	3	13.6	5.22	39.8	206	63.2	216	220	1.47	35.0	6.06	36	27
5626	M109	6	36.2	92.9	43	79.5	1.4	3.1	2	13.3	5.81	46.6	177	63.3	163	253	1.44	24.0	5.97	56	4
5627	Newdale	6	38.9	85.1	52	81.2	1.4	1.9	1	12.9	5.56	45.7	129	90.0	117	242	1.43	4.5	5.98	62	1
5628	CDC Clyde (BT490)	6	36.0	90.7	50	79.2	1.1	2.9	1	14.1	6.69	49.6	164	79.1	229	317	1.44	6.7	5.87	36	27
5629	ND19620	6	35.1	91.6	56	79.1	1.0	2.9	2	12.2	5.03	42.7	162	56.9	184	206	1.47	21.0	5.99	53	8
5630	Stellar (ND16301)	6	35.6	95.1	57	77.8	1.1	2.6	2	13.3	5.56	42.6	189	61.9	143	232	1.47	25.0	5.91	54	7
5631	2ND19854	2	*40.4	89.9	42	79.8	1.1	n.d.	3	11.5	4.80	43.0	110	50.9	252	189	1.45	45.0	5.96	47	13
5632	6B00-1323	6	35.1	80.1	47	78.8	1.5	3.1	1	14.3	6.94	50.1	178	77.3	132	348	1.42	6.0	5.87	36	27
5633	6B00-1328	6	35.3	95.9	58	78.0	0.8	2.0	1	13.4	5.61	43.2	185	62.5	133	223	1.45	7.5	5.93	55	6
5634	BT493	6	35.1	89.5	53	79.4	1.6	3.1	1	13.4	6.67	51.5	156	75.6	215	315	1.46	9.6	5.81	46	16
5635	M120	6	37.0	96.3	64	78.9	1.2	n.d.	3	11.9	4.99	42.7	151	55.7	94	159	1.47	36.0	5.97	56	4
5636	M121	6	36.4	95.1	56	77.8	1.1	2.3	1	12.9	5.43	45.4	164	61.8	112	230	1.44	8.6	5.96	59	2
5637	M122	6	34.5	85.9	55	77.6	1.9	2.1	1	13.6	5.61	41.9	176	65.1	290	208	1.44	6.5	5.96	38	22
5638	M123	6	36.4	89.3	57	77.4	0.8	2.5	2	14.2	5.91	42.7	207	53.5	160	180	1.45	19.1	5.94	36	27
5639	M124	6	35.1	88.2	53	78.1	0.6	3.2	2	12.8	5.82	45.9	181	58.9	207	248	1.46	30.0	5.99	47	13
5640	ND19655	6	32.9	89.8	52	78.6	1.0	3.2	2	12.2	6.11	53.0	129	62.2	299	225	1.47	20.0	5.84	39	21
5641	ND20299	6	35.5	95.9	61	77.7	0.7	n.d.	3	12.9	5.86	49.2	186	63.4	188	200	1.47	38.0	5.94	37	25
5642	ND20303	6	35.0	93.4	53	77.6	0.8	n.d.	3	13.6	6.06	46.2	175	69.4	197	215	1.46	29.0	5.94	34	32
5644	ND20314	6	36.8	92.8	54	78.2	0.6	n.d.	3	13.4	6.19	49.3	188	69.3	139	274	1.46	40.0	5.93	44	18
5645	ND20448	6	35.2	96.5	68	77.7	0.8	1.9	1	13.3	5.97	48.5	216	69.3	132	208	1.47	6.6	5.91	46	16
5646	2ND21863	2	*46.3	96.7	45	80.2	1.1	2.3	2	11.9	5.26	46.8	108	50.4	253	164	1.50	12.2	5.90	51	9
5647	6B01-2208	6	32.5	93.3	53	77.0	0.5	3.0	1	14.1	7.45	55.0	213	93.3	173	282	1.41	5.3	5.88	26	35
5648	6B01-2218	6	33.1	93.5	63	77.8	1.1	2.0	1	14.2	6.40	46.2	216	79.2	161	279	1.43	4.1	5.94	38	22

Table 5

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Viscosity Relative	Turbidity (NTU)	pH	Quality Score	Overall Rank
5649	6B01-2356	6	34.2	90.1	59	78.6	1.2	2.3	1	12.5	6.23	50.6	182	77.7	170	227	1.44	5.7	5.93	43	19
5650	6B01-2513	6	33.2	88.5	63	77.7	1.0	2.3	1	13.0	5.93	47.3	194	79.3	86	206	1.43	8.2	5.97	50	10
5651	BT497	6	33.9	90.6	54	78.8	1.3	2.5	1	13.5	6.85	51.9	164	88.9	256	269	1.49	9.2	5.90	38	22
5652	SR403	6	33.1	88.3	57	78.1	1.4	3.3	2	13.6	7.15	52.9	148	75.3	148	355	1.44	16.4	5.86	37	25
5653	SR404	6	36.0	89.4	53	77.8	0.8	2.6	1	14.0	6.72	50.6	152	80.3	307	264	1.44	6.9	5.85	30	33
5617	MOREX MALT CHECK	6	35.1	86.3	82	80.4	0.5	2.0	1	12.2	6.29	53.4	145	72.8	84	301	1.47	4.3	5.82	53	
5643	MOREX MALT CHECK	6	34.9	85.1	79	80.3	0.3	2.2	1	12.3	6.74	58.7	135	74.2	142	262	1.50	5.8	5.83	46	
Minima			32.5	80.1	42	77.0	0.5	1.8		11.5	4.80	35.6	108	47.5	72	159	1.41	4.1	5.81	26	
Maxima			38.9	96.7	68	81.2	1.85	3.3		14.4	7.45	55.0	216	93.3	307	355	1.50	45.0	6.06	62	
Means			34.9	91.2	55	78.4	1.1	2.5		13.3	5.88	46.0	172	67.8	187	238	1.45	16.3	5.94	44	
Standard Deviations			1.4	3.8	6	1.0	0.3	0.5		0.7	0.67	4.5	28	11.6	64	47	0.02	12.0	0.05	9	
Coefficients of Variation			4.0	4.2	11	1.2	27.4	18.9		5.6	11.45	9.7	16	17.2	34	20	1.32	73.7	0.91	21	

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

2005 MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - MORRIS, MN

Table 6

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Viscosity Relative	Turbidity (NTU)	pH	Quality Score	Overall Rank
5654	Barbless	6	32.4	75.9	63	*77.0	1.8	1.8	1	12.8	5.59	45.6	126	55.8	271	185	1.47	6.5	5.94	43	29
5655	Morex	6	31.5	77.0	61	79.2	1.8	1.8	1	13.5	5.97	47.1	144	70.6	257	211	1.47	6.0	5.95	41	33
5656	Robust	6	34.6	87.0	60	79.2	1.2	1.9	1	13.2	6.32	50.4	159	58.2	152	235	1.45	5.0	5.87	49	18
5657	Legacy(6B93-2978)	6	33.9	83.7	51	79.7	1.3	2.1	1	12.8	6.64	52.3	158	83.9	234	257	1.45	4.5	5.90	46	24
5658	Drummond (ND15477)	6	34.3	88.2	54	79.5	1.1	2.0	1	13.1	5.88	46.9	165	69.7	93	244	1.45	5.3	5.93	61	1
5659	Lacey (M98)	6	35.2	89.7	58	79.5	0.9	1.9	1	13.2	5.98	46.4	157	67.8	65	259	1.43	7.4	5.91	61	1
5660	Conlon	2	*43.5	94.5	54	79.7	1.4	1.8	1	12.4	5.35	43.9	106	68.1	313	182	1.47	7.5	5.94	52	15
5661	Tradition(6B95-2482)	6	33.5	87.5	65	79.7	1.1	1.9	1	12.7	5.65	47.4	165	70.8	97	202	1.48	7.8	5.97	60	6
5662	M109	6	35.3	89.6	50	80.1	0.5	2.1	1	12.8	5.92	48.1	147	70.1	106	268	1.45	6.7	5.95	56	8
5663	Newdale	6	37.9	87.0	54	81.1	0.3	1.9	1	12.5	5.63	47.4	98	86.4	80	199	1.43	3.2	5.97	53	12
5664	CDC Clyde (BT490)	6	33.3	86.9	62	80.7	0.8	2.0	1	11.4	5.96	53.1	135	82.2	177	222	1.47	4.1	5.89	41	33
5665	ND19620	6	34.6	89.7	64	79.8	0.6	2.3	2	12.2	5.42	46.3	146	64.7	123	187	1.47	13.5	5.95	60	6
5666	Stellar (ND16301)	6	34.8	91.3	64	79.0	0.3	2.0	1	13.3	5.86	45.5	173	72.3	94	264	1.46	5.5	5.91	61	1
5667	2ND19854	2	*41.2	92.9	55	80.3	1.3	n.d.	3	11.9	5.26	44.5	103	64.1	330	177	1.49	*33.0	5.89	49	18
5668	6B00-1323	6	34.8	86.7	53	80.8	0.5	2.6	1	12.6	6.76	55.1	157	85.9	46	279	1.42	4.0	5.90	53	12
5669	6B00-1328	6	35.2	91.3	59	79.3	0.5	1.9	1	13.2	5.90	45.7	160	68.2	58	202	1.43	4.4	5.94	61	1
5671	BT493	6	36.2	94.5	53	79.6	0.5	*3.4	1	14.0	*7.77	55.6	158	95.6	43	305	1.43	6.6	5.76	43	29
5672	M120	6	35.7	93.0	58	80.0	1.0	2.0	2	12.6	5.29	44.4	134	60.1	89	172	1.47	13.9	5.94	61	1
5673	M121	6	36.0	94.7	49	79.2	0.8	2.0	1	13.1	5.98	48.9	149	66.6	119	206	1.43	5.6	5.92	56	8
5674	M122	6	35.9	87.1	53	79.6	0.8	1.7	1	12.4	5.79	48.3	150	71.3	198	249	1.44	3.6	5.95	49	18
5675	M123	6	35.6	82.0	67	79.6	0.7	2.1	2	12.3	5.79	49.0	146	58.9	85	205	1.45	15.7	5.88	55	11
5676	M124	6	35.6	84.9	48	79.8	0.2	2.4	1	12.3	5.80	48.4	158	70.0	94	203	1.44	13.6	5.96	56	8
5677	ND19655	6	32.9	88.8	52	79.4	0.6	2.4	1	12.2	6.04	53.6	104	66.4	304	217	1.47	11.6	5.82	39	35
5678	ND20299	6	33.7	93.4	64	78.9	1.3	n.d.	3	12.0	5.50	47.2	142	60.9	383	203	1.52	*62.0	5.92	48	22
5679	ND20303	6	34.3	91.1	61	78.7	1.3	n.d.	3	12.7	5.63	45.6	123	67.3	320	204	1.48	*36.0	5.93	50	16
5680	ND20314	6	35.5	90.1	57	79.5	0.8	2.4	1	12.6	6.35	52.5	147	76.5	93	236	1.47	7.7	5.86	53	12
5681	ND20448	6	34.4	92.4	66	78.5	0.7	2.0	1	12.8	6.18	50.6	151	69.7	128	223	1.47	6.1	5.83	46	24
5682	2ND21863	2	*44.0	92.1	50	80.9	0.5	2.0	1	11.6	5.38	49.7	92	59.0	154	180	1.48	5.0	5.86	43	29
5683	6B01-2208	6	32.2	87.7	61	80.0	1.1	2.1	1	13.3	6.73	53.3	148	86.3	175	258	1.45	4.3	5.84	46	24
5684	6B01-2218	6	31.5	85.3	64	79.9	0.7	1.6	1	12.7	5.90	47.3	154	70.8	202	262	1.46	4.3	5.91	48	22

Table 6

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Viscosity Relative	Turbidity (NTU)	pH	Quality Score	Overall Rank
5685	6B01-2356	6	33.8	88.3	61	80.0	0.6	2.3	1	12.5	6.42	54.5	149	79.2	188	249	1.45	4.0	5.88	46	24
5686	6B01-2513	6	31.3	*72.4	64	79.2	0.7	1.8	1	12.9	6.00	48.6	146	74.2	130	241	1.45	4.6	5.90	43	29
5687	BT497	6	35.0	92.6	65	81.3	0.5	2.5	1	12.3	6.96	59.3	123	93.8	143	263	1.49	5.2	5.80	46	24
5688	SR403	6	33.8	91.1	64	80.5	0.5	2.4	1	12.2	6.73	56.9	125	79.9	98	216	1.43	4.1	5.83	50	16
5689	SR404	6	35.0	92.4	59	81.0	0.5	2.5	1	12.5	7.11	58.1	146	87.9	122	311	1.44	3.5	5.82	49	18
5670	MOREX MALT CHECK	6	33.5	86.6	78	80.6	1.0	2.2	1	12.4	6.46	56.4	120	69.7	164	298	1.51	6.4	5.85	42	
5690	MOREX MALT CHECK	6	35.2	86.5	81	80.6	0.5	2.2	1	12.6	6.51	54.7	125	69.2	127	289	1.49	6.4	5.85	46	
Minima			31.3	75.9	48	78.5	0.2	1.6		11.4	5.26	43.9	92	55.8	43	172	1.42	3.2	5.76	39	
Maxima			37.9	94.7	67	81.3	1.8	2.6		14.0	7.11	59.3	173	95.6	383	311	1.52	15.7	5.97	61	
Means			34.4	88.8	58	79.8	0.8	2.1		12.6	5.99	49.6	141	72.4	159	228	1.46	6.6	5.90	51	
Standard Deviations			1.5	4.5	6	0.7	0.4	0.3		0.5	0.49	4.1	21	10.3	90	36	0.02	3.4	0.05	7	
Coefficients of Variation			4.4	5.0	10	0.9	48.8	12.6		4.3	8.13	8.3	15	14.2	57	16	1.54	51.3	0.89	13	

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

2005 MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY AND ADDITIONS - SIDNEY, MT

Table 7

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Viscosity Relative	Turbidity (NTU)	pH	Quality Score	Overall Rank
5580	Barbless	6	33.5	77.2	62	*73.8	2.5	1.8	2	14.9	4.80	33.4	152	47.8	395	177	1.46	19.1	5.98	23	35
5581	Morex	6	32.4	70.8	65	77.8	2.1	1.6	1	14.6	5.54	40.7	204	66.0	113	224	1.45	3.5	5.95	39	19
5582	Robust	6	34.4	80.7	66	77.7	2.0	1.5	1	14.9	5.67	39.5	205	51.9	243	223	1.45	3.1	5.88	33	30
5583	Legacy(6B93-2978)	6	32.4	77.6	70	78.4	2.0	1.9	1	14.2	6.49	46.3	223	88.2	236	285	1.45	2.7	5.88	36	27
5584	Drummond (ND15477)	6	32.9	79.8	72	77.7	1.7	1.6	1	14.3	5.33	38.9	224	61.7	97	211	1.46	4.9	5.98	38	23
5585	Lacey (M98)	6	34.7	80.8	67	78.0	1.5	1.7	1	13.4	5.34	40.6	207	63.2	56	200	1.44	10.9	5.94	54	2
5586	Conlon	2	*44.4	96.6	61	78.7	1.9	1.4	1	13.7	4.89	36.2	126	59.5	382	189	1.48	6.4	5.88	37	26
5587	Tradition(6B95-2482)	6	33.1	84.7	73	77.9	1.4	1.7	2	14.3	5.55	41.1	245	66.9	158	217	1.48	13.1	5.96	39	19
5588	M109	6	33.8	77.3	68	78.3	0.7	1.7	1	14.0	5.70	42.3	212	62.7	131	239	1.47	5.4	5.93	42	14
5589	Newdale	6	37.5	72.6	63	78.6	0.9	1.5	1	14.9	5.92	41.6	157	77.7	74	226	1.43	2.0	5.92	38	23
5616	CDC Clyde (BT490)	6	32.5	76.1	69	79.5	1.4	1.8	1	12.8	5.90	47.7	170	76.3	166	257	1.46	4.7	5.86	50	5
5592	ND19620	6	34.1	82.8	72	78.1	1.3	2.0	2	14.1	5.49	41.3	213	59.0	141	180	1.48	17.6	5.93	39	19
5593	Stellar (ND16301)	6	34.2	83.9	74	78.0	0.6	1.7	1	14.1	5.86	43.3	233	68.8	74	246	1.50	4.7	5.88	45	10
5594	2ND19854	2	*42.0	93.2	65	79.5	2.0	n.d.	3	12.9	4.82	40.6	130	55.0	372	175	1.51	*37.0	5.90	52	3
5595	6B00-1323	6	33.9	71.8	66	78.9	1.4	1.9	1	14.5	6.95	48.5	223	79.4	135	347	1.44	3.1	5.87	31	33
5596	6B00-1328	6	34.7	86.3	68	78.3	0.7	1.5	1	14.3	6.19	43.7	231	67.6	83	254	1.44	4.0	5.87	45	10
5597	BT493	6	36.4	91.9	70	79.0	1.0	2.2	1	15.3	7.26	48.1	226	83.5	164	301	1.48	4.9	5.79	36	27
5598	M120	6	34.1	80.9	67	78.3	1.4	2.1	2	13.8	4.95	38.7	175	55.4	100	181	1.48	14.5	5.99	47	9
5599	M121	6	33.8	80.9	68	78.0	1.9	1.6	1	13.9	5.46	41.6	182	61.5	168	201	1.45	4.1	5.95	45	10
5600	M123	6	34.7	75.7	73	78.3	1.4	1.8	2	14.2	5.83	42.2	222	60.2	122	249	1.46	18.5	5.88	41	15
5601	M124	6	32.3	64.2	72	78.0	1.8	2.0	2	13.4	5.62	44.1	209	65.9	161	205	1.47	12.7	5.98	49	7
5602	ND19655	6	30.4	72.0	64	77.0	1.7	1.7	1	14.4	6.29	46.1	199	74.7	90	283	1.43	3.2	5.84	32	32
5603	ND20299	6	34.4	83.8	72	77.8	2.0	n.d.	3	13.2	5.47	42.7	202	62.6	261	227	1.49	28.0	5.95	50	5
5604	ND20303	6	32.1	69.2	74	77.1	2.0	n.d.	3	12.6	5.27	42.5	182	65.9	187	247	1.47	25.0	5.98	41	15
5605	ND20314	6	36.7	85.7	63	78.9	1.1	n.d.	3	12.9	5.84	47.0	215	66.9	120	253	1.47	29.0	5.91	51	4
5606	ND20448	6	34.8	91.3	69	78.2	1.2	1.6	1	14.3	5.89	42.6	200	71.9	183	246	1.48	5.5	5.87	41	15
5607	2ND21863	2	*43.6	91.7	61	79.2	1.4	1.4	1	12.7	5.14	41.1	153	55.4	89	162	1.45	3.4	5.87	59	1
5608	6B01-2208	6	32.9	82.9	66	77.9	1.3	2.0	1	14.7	6.97	50.3	208	85.2	133	321	1.44	3.7	5.80	33	30
5609	6B01-2218	6	31.2	77.2	69	78.2	1.4	1.5	1	14.8	6.09	44.1	214	71.2	123	270	1.45	3.7	5.88	38	23
5610	6B01-2356	6	39.7	97.2	72	80.2	0.3	1.8	1	12.8	5.94	47.7	150	73.4	185	261	1.47	4.1	5.83	49	

Table 7

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Viscosity Relative	Turbidity (NTU)	pH	Quality Score	Overall Rank
5611	6B01-2513	6	32.0	64.3	67	77.9	1.0	1.6	1	14.4	5.94	43.8	213	75.4	107	190	1.43	3.1	5.89	40	18
5612	BT497	6	34.1	82.6	73	79.7	1.1	2.1	1	14.0	6.64	49.1	195	85.9	143	291	1.45	3.9	5.85	39	19
5613	SR403	6	30.7	76.8	67	77.9	1.1	1.9	1	14.2	6.62	48.3	207	79.6	89	276	1.41	3.2	5.83	34	29
5614	SR404	6	32.8	77.4	71	78.4	1.7	2.0	1	14.3	6.60	48.9	203	77.9	232	231	1.44	3.8	5.85	31	33
5590	Excel	6	33.3	67.8	69	79.1	0.7	1.9	1	13.3	6.82	52.8	185	82.3	153	273	1.53	3.0	5.90	44	13
5591	HARRINGTON MALT CHECK	2	37.6	85.1	77	81.4	0.9	1.6	1	12.7	6.07	49.8	116	79.0	194	324	1.46	2.6	5.85	36	
5617	MOREX MALT CHECK	6	35.1	86.3	82	80.4	0.5	2.0	1	12.2	6.29	53.4	145	72.8	84	301	1.47	4.3	5.82	53	
Minima			30.4	64.2	61	77.0	0.3	1.4		12.6	4.80	33.4	126	47.8	56	162	1.41	2.0	5.79	23	
Maxima			39.7	97.2	74	80.2	2.5	2.2		15.3	7.26	52.8	245	88.2	395	347	1.53	29.0	5.99	59	
Means			33.8	80.2	68	78.4	1.4	1.7		14.0	5.86	43.6	197	68.8	162	238	1.46	8.3	5.90	41	
Standard Deviations			1.9	8.4	4	0.7	0.5	0.2		0.7	0.64	4.2	29	10.4	85	44	0.03	7.7	0.05	8	
Coefficients of Variation			5.6	10.5	6	0.9	35.7	12.6		5.2	10.92	9.6	15	15.1	53	18	1.74	93.1	0.90	19	

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, BARI - Ft. Collins

MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - 2005 Crop

Table 8 - Station Means* of Barley and Malt Quality Factors for 35 Varieties or Selections.**

LOCATION	Kernel Weight (mg)		on 6/64" (%)		Barley Color (Agtron)		Malt Extract (%)		F - C (%)		Wort Color		Wort Clarity		Barley Protein (%)		Wort Protein (%)		S/T (%)		DP (°ASBC)		Alpha-amylase (20°DU)		Beta-glucan (ppm)		FAN (ppm)		Viscosity Relative		Turbidity (HACH)		pH		Quality Score	
Aberdeen	39.0	A	96.2	A	74	A	80.0	A	0.9	C	1.9	C	1.4	B	12.9	C	5.76	B	46.1	B	144	C	69.1	B	237	A	230	A	1.52	A	12.2	B	5.84	C	47.3
Crookston	35.7	B	90.7	B	54	D	78.3	C	1.2	B	2.7	A	1.6	A	13.3	B	5.88	B	46.0	B	172	B	67.8	B	194	B	238	A	1.45	B	16.3	A	5.94	A	43.9
Morris	35.1	C	88.4	C	58	C	79.7	B	0.8	C	2.2	B	1.3	B	12.6	C	6.04	A	49.6	A	141	C	72.4	A	159	C	228	A	1.46	B	9.8	B	5.90	B	50.7
Sidney	34.4	D	79.9	D	68	B	78.1	C	1.5	A	1.8	C	1.4	B	14.0	A	5.84	B	43.3	C	199	A	68.2	B	165	C	233	A	1.46	B	9.1	B	5.90	B	40.6

* 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, Drummond, Lacey, Conlon, Tradition, M109, Newdale, CDC Clyde, ND19620, Stellar, 2ND19854, 6B00-1323, 6B00-1328, BT493, M120, M121, M122, M123, M124, ND19655, ND20299, ND20303, ND20314, ND20448, 2ND21863, 6B01-2208, 6B01-2218, 6B01-2356, 6B01-2513, BT497, SR403, SR404

MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY - 2005 CROP

Table 9 - 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		Wort Clarity		Barley Protein (%)		Wort Protein (%)		S/T (%)		DP (°ASBC)		Alpha-amylase (20°DU)		Beta-glucan (ppm)		FAN (ppm)		Viscosity (Relative)		Turbidity (Hach)		pH		Quality Score
Barbless	33.5	MNO	78.0	M	64	ABCDEFGH	75.5	I	2.5	A	2.0	EFGHIJK	1.8	BCDE	13.6	ABCDE	4.85	P	37.0	M	130.3	IJK	46.8	J	424	A	179	IJ	1.53	A	16.5	BCD	5.96	A	29.3
Morex	33.6	LMNO	81.7	KLM	64	ABCDEFGH	78.5	GH	1.6	BC	1.8	HIJK	1.0	E	14.0	AB	5.63	HIJKLMN	42.1	JKL	181.3	ABCD	67.0	DE	215	CDEFG	217	FGHI	1.48	BCDEFGHI	6.8	D	5.95	A	40.5
Robust	35.0	HIJKL	87.4	DEFGHIJK	63	BCDEFGHI	78.7	FGH	1.7	B	1.7	K	1.0	E	13.8	ABCD	5.81	FGHIJKL	44.4	GHIJK	174.4	BCDEF	53.8	I	233	CDE	222	FGHI	1.46	CDEFGHIJ	4.6	D	5.88	ABCDE	43.8
Legacy	34.4	IJKLMN	86.6	EFGHIJK	58	GHIJ	79.2	CDEFGH	1.3	BCDEFG	2.0	DEFGHIJK	1.0	E	13.3	ABCDE	6.32	CDEF	49.0	CDEF	185.1	ABC	81.4	BC	236	CDE	258	BCDEF	1.46	CDEFGHIJ	4.1	D	5.89	ABCDE	41.5
Drummond	34.1	JKLMNO	88.0	BCDEFGHIJK	64	ABCDEFGH	78.6	FGH	1.2	BCDEFGH	2.1	CDEFGHIJK	1.3	DE	13.4	ABCDE	5.52	KLMN	43.1	HIJKL	182.4	ABCD	66.4	DE	125	GHI	221	FGHI	1.46	CDEFGHIJ	10.2	CD	5.95	AB	52.3
Lacey	36.6	DEFG	90.4	ABCDEFGH	64	ABCDEFGHI	78.9	EFGH	1.0	DEFGH	2.0	DEFGHIJK	1.3	DE	13.1	ABCDEF	5.63	HIJKLMN	43.9	HIJK	173.1	BCDEF	64.7	DEFG	84	I	229	DEFGH	1.44	GHIJ	11.7	CD	5.92	ABCD	57.5
Conlon	45.4	A	96.6	A	59	FGHIJ	79.5	BCDEFG	1.4	BCDEF	1.7	JK	1.3	DE	13.2	ABCDEF	5.22	MNOP	40.5	L	125.1	JK	66.2	DE	336	B	191	HIJ	1.49	ABCD	7.9	D	5.90	ABCDE	45.0
Tradition	34.9	HIJKLM	90.0	ABCDEFGHIJ	67	ABCD	78.4	H	1.2	BCDEFGH	2.1	CDEFGHIJK	1.8	BCDE	13.9	ABC	5.55	JKLMN	41.8	KL	201.6	A	66.2	DE	187	DEFGH	209	GHIJ	1.48	BCDEFGH	15.5	BCD	5.96	A	42.8
M109	36.4	DEFGH	89.2	BCDEFGHIJ	56	IJ	79.6	ABCDEF	0.9	EFGH	2.2	BCDEFGHIJ	1.5	CDE	13.3	ABCDE	5.84	FGHIJKL	45.9	FGHI	173.2	BCDEF	66.6	DE	152	EFGHI	247	CDEFG	1.46	CDEFGHIJ	12.2	CD	5.94	ABC	51.8
Newdale	39.2	C	85.3	GHIJKL	59	EFGHIJ	80.5	AB	0.7	H	1.7	K	1.0	E	13.2	ABCDEF	5.66	HIJKLMN	45.2	GHIJ	130.3	IJK	82.3	BC	85	I	225	EFGH	1.43	J	3.5	D	5.94	ABC	53.8
CDC Clyde	34.6	IJKLMN	87.6	DEFGHIJK	64	ABCDEFGHI	80.1	ABCD	1.1	CDEFGH	2.1	CDEFGHIJK	1.0	E	12.9	BCDEF	6.16	DEFGH	49.2	CDE	144.3	GHIJ	80.5	BC	213	CDEFG	258	BCDEF	1.48	BCDEFGHI	5.3	D	5.86	BCDEF	42.8
ND19620	35.5	EFGHIJ	90.5	ABCDEFGH	68	ABC	79.1	CDEFGH	1.0	CDEFGH	2.7	AB	2.3	ABC	12.9	ABCDEF	5.39	LMNO	43.2	HIJKL	170.7	BCDEF	60.7	EFGH	182	DEFGH	188	HIJ	1.50	ABC	27.5	AB	5.94	ABC	52.0
Stellar	35.8	DEFGHI	92.0	ABCDEFG	68	AB	78.9	EFGH	0.8	FGH	2.0	DEFGHIJK	1.3	DE	13.4	ABCDE	5.75	GHIJKL	44.7	GHIJK	185.0	ABCD	68.1	D	132	FGHI	241	CDEFG	1.49	BCDE	11.3	CD	5.88	ABCDE	52.3
2ND19854	41.8	B	93.6	ABCD	57	HIJ	80.2	ABC	1.6	BCD	2.6	ABC	2.8	A	12.2	F	5.00	OP	42.6	IJKL	118.4	K	56.7	HI	344	B	190	HIJ	1.50	ABC	34.3	A	5.89	ABCDE	51.3
6B00-1323	35.5	EFGHIJ	83.4	JKLM	60	DEFGHIJ	80.1	ABCD	1.0	CDEFGH	2.3	ABCDEFG	1.0	E	13.4	ABCDE	6.71	ABC	51.2	ABC	168.1	BCDEFG	78.7	BC	133	FGHI	308	A	1.45	EFGHIJ	4.5	D	5.87	ABCDEF	39.8
6B00-1328	36.0	DEFGHI	92.9	ABCDE	64	ABCDEFGH	79.0	EFGH	0.9	FGH	1.8	GHIJK	1.0	E	13.6	ABCDE	6.06	DEFGHIJK	45.5	GHI	179.8	ABCD	66.4	DE	116	HI	228	DEFGH	1.45	EFGHIJ	6.1	D	5.88	ABCDE	50.5
BT493	36.7	DEF	93.4	ABCDE	63	BCDEFGHI	80.0	ABCD	1.0	CDEFGH	2.7	AB	1.0	E	13.9	ABC	7.03	A	51.9	ABC	167.8	BCDEFG	85.0	AB	130	FGHI	295	AB	1.47	BCDEFGHIJ	6.8	D	5.79	F	43.8
M120	36.9	DE	92.3	ABCDEF	66	ABCDE	79.3	CDEFGH	1.1	BCDEFGH	2.5	ABCDE	2.5	AB	13.0	ABCDEF	5.22	MNOP	41.8	KL	151.5	EFGHI	58.5	GHI	106	HI	188	HIJ	1.48	BCDEFGH	24.9	AB	5.93	ABC	53.3
M121	36.3	DEFGH	91.9	ABCDEFG	60	CDEFGHIJ	78.3	H	1.1	BCDEFGH	1.9	FGHIJK	1.0	E	13.6	ABCDE	5.77	GHIJKL	44.8	GHIJK	165.2	CDEFG	63.8	DEFG	157	EFGHI	215	FGHI	1.45	EFGHIJ	6.1	D	5.92	ABCD	48.8
M122	34.8	HIJKLM	85.0	HIJKL	58	GHIJ	78.4	H	1.5	BCDE	1.9	FGHIJK	1.0	E	13.4	ABCDE	5.69	GHIJKL	43.9	HIJK	169.3	BCDEFG	65.5	DEF	261	BCD	213	GHI	1.45	FGHIJ	4.7	D	5.95	A	41.3
M123	36.4	DEFGH	85.5	FGHIJKL	69	AB	78.7	FGH	0.9	EFGH	2.1	DEFGHIJK	1.8	BCDE	13.5	ABCDE	5.86	FGHIJKL	44.8	GHIJK	181.0	ABCD	58.9	FGHI	139	FGHI	209	GHIJ	1.47	BCDEFGHIJ	16.4	BCD	5.88	ABCDEF	46.5
M124	35.6	EFGHIJ	83.6	IJKLM	60	DEFGHIJ	79.1	DEFGH	0.9	FGH	2.6	ABC	2.0	ABCD	12.8	CDEF	5.69	GHIJKL	46.0	FGHI	170.7	BCDEF	63.3	DEFG	192	DEFGH	213	GHI	1.49	BCDEFG	25.3	AB	5.95	AB	51.3
ND19655	32.8	O	86.7	EFGHIJK	60	CDEFGHIJ	78.6	FGH	1.1	CDEFGH	2.3	BCDEFGH	1.3	DE	12.9	BCDEF	6.13	DEFGHI	50.7	ABC	139.0	HIJK	68.4	D	235	CDE	237	DEFG	1.47	BCDEFGHIJ	11.0	CD	5.81	EF	38.3
ND20299	35.8	DEFGHI	92.8	ABCDE	70	AB	78.4	H	1.2	BCDEFGH	2.8	A	2.8	A	12.6	EF	5.58	IJKLMN	45.9	FGHI	169.0	BCDEFG	63.3	DEFG	291	BC	214	FGHI	1.51	AB	36.2	A	5.93	ABC	48.0
ND20303	35.2	FGHIJK	87.8	CDEFGHIJK	66	ABCDE	78.3	H	1.1	BCDEFGH	2.5	ABCD	2.5	AB	12.7	DEF	5.60	IJKLMN	45.1	GHIJ	149.0	FGHIJ	69.1	D	252	CD	226	EFGH	1.48	BCDEFGH	25.2	AB	5.94	ABC	44.0
ND20314	37.3	D	91.4	ABCDEFGH	63	BCDEFGHI	79.1	CDEFGH	0.9	FGH	2.7	AB	2.0	ABCD	12.9	BCDEF	6.10	DEFGHIJ	49.3	CDE	176.6	ABCDE	69.4	D	151	EFGHI	257	BCDEF	1.48	BCDEFGH	21.3	BC	5.88	ABCDE	48.5
ND20448	35.6	EFGHIJ	94.5	ABC	71	A	78.3	H	0.8	FGH	1.8	IJK	1.0	E	13.4	ABCDE	5.96	FGHIJK	46.4	EFGH	180.9	ABCD	69.6	D	150	EFGHI	226	EFGH	1.48	BCDEFGHI	5.8	D	5.86	BCDEF	46.8
2ND21863	45.3	A	94.6	AB	54	J	80.0	ABCD	1.0	DEFGH	1.8	HIJK	1.3	DE	12.1	F	5.14	NOP	44.2	GHIJK	118.2	K	54.6	HI	222	CDEF	170	J	1.49	BCDEF	7.0	D	5.87	ABCDEF	50.0
6B01-2208	33.7	KLMNO	90.2	ABCDEFGHI	62	BCDEFGHI	78.6	GH	1.0	DEFGH	2.4	ABCDEF	1.0	E	14.1	A	6.98	AB	52.1	ABC	183.4	ABCD	88.6	A	157	EFGHI	293	AB	1.44	IJ	5.2	D	5.83	EF	36.0
6B01-2218	33.2	NO	88.4	BCDEFGHIJ	68	AB	78.9	EFGH	1.0	DEFGH	1.6	K	1.0	E	13.8	ABCD	6.06	DEFGHIJK	45.3	GHIJ	193.8	AB	75.6	C	168	DEFGHI	268	ABCDE	1.46	DEFGHIJ	4.0	D	5.90	ABCDE	43.3
6B01-2356	35.1	GHIJKL	87.1	DEFGHIJK	65	ABCDEFG	79.3	CDEFGH	0.8	GH	2.1	DEFGHIJK	1.0	E	13.0	ABCDEF	6.22	CDEFG	49.9	BCD	174.1	BCDEF	77.1	C	172	DEFGHI	236	DEFG	1.45	FGHIJ	4.3	D	5.87	ABCDEF	43.5
6B01-2513	33.5	MNO	80.0	LM	68	ABC	78.5	GH	0.7	H	1.9	FGHIJK	1.0	E	13.3	ABCDE	6.03	EFGHIJK	47.4	DEFG	177.6	ABCDE	76.8	C	112	HI	227	EFGH	1.45	FGHIJ	5.5	D	5.89	ABCDE	45.5
BT497	35.2	FGHIJKL	90.6	ABCDEFGH	69	AB	80.6	A	0.9	FGH	2.3	BCDEFGHI	1.0	E	12.8	CDEF	6.50	BCDE	53.3	A	150.4	FGHI	89.9	A	174	DEFGHI	271	ABCD	1.49	BCDEFG	6.2	D	5.85	CDEF	41.8
SR403	33.4	MNO	87.4	DEFGHIJK	66	ABCDEF	79.5	BCDEFG	0.9	FGH	2.5	ABCDE	1.3	DE	12.9	BCDEF	6.58	ABCD	53.3	A	149.2	FGHIJ	78.0	C	116	HI	282	ABC	1.44	HIJ	7.9	D	5.82	EF	40.3
SR404	35.3	FGHIJK	88.6	BCDEFGHIJ	64	ABCDEFGH	79.9	ABCDE	1.0	CDEFGH	2.3	BCDEFGH	1.0	E	12.9	ABCDEF	6.53	ABCDE	52.8	AB	158.4	DEFGH	79.9	BC	221	CDEF	267	ABCDE	1.46	CDEFGHIJ	6.9	D	5.84	DEF	38.8

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

** Aberdeen ID, Crookston and Morris MN and Sidney MT

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 170 g (db) barley samples were steeped at 16°C for 32-48 h, to 45% moisture, by alternating 4 h of wet steep with 4 h of air rest. The steeped samples were placed in a chamber for 5 d at 17°C and near 100% R.H., in cans that were rotated for 3.0 min every 30 min. The germinated grain (green malt) was kilned for 24 h as follows: 0.5 h from 25°C to 49°C, 9.5 h at 49°C, 0.5 h from 49°C to 54°C, 4.0 h at 54°C, 0.5 h from 54°C to 60°C, 3.0 h at 60°C, 0.5 h from 60°C to 68°C, 2.0 h at 68°C, 0.5h from 68°C to 85°C, and 3.0 h at 85°C.

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 2005 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