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Wisconsin Agricultural Experiment Station and other State Experiment Stations, Cooperating

MISSISSIPPI VALLEY UNIFORM BARLEY NURSERY - 2000 Crop

Preliminary Quality Report

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Contents

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 to those persons who have a direct and special interest in the development of improved barleys.

This report includes data furnished by the Agricultural Research Service as well as 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 malted and analyzed by the Cereal Crops Research Unit, Madison, WI

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Mississippi Valley Uniform Barley Nursery - 2000

Nursery samples were received for malting quality evaluation from four experimental stations located in three states. Twelve of 28 entries (#19 - #30) were new in this year's nursery (Table 1).

These samples were germinated for 5 days and intermittently turned for 3 minutes each half hour, which should have yielded malts having modification levels that are similar to those produced by industry. The malting conditions and analytical methods employed are presented in Appendix A. The criteria and value assignments used to calculate quality scores are listed in the same Appendix (Table A1).

Mean values of 11 quality factors are listed over the three stations located in the Mississippi Valley area (Table 2) and over all varieties (Table 3). Tables 8 and 9 report the same factors, but also include data from samples that were grown in Aberdeen, Idaho. Individual station data are reported in Tables 4 through 7. The parentages of the nursery entries are listed in Table 1. Evaluations of data from individual locations and overall performance evaluations, derived primarily from Tables 2, 3, 8 and 9, are presented below.

Half of the plump barleys from Morris, MN (Table 4) had unacceptably high protein contents. A third of the extract values fell below the desired limit, and half of the soluble protein levels were too high. The S/T ratios ranged from four submissions that were too low, to seven that were too high. The diastatic power values varied considerably, with three that were below the desired limits and nine that exceeded them. The β-glucan levels ranged from very good to four that exceeded the upper limit, while nearly all α-amylase values were too high. The best performers were M107, Drummond, and Lacey, all of which performed quite nicely, except for their elevated α-amylase levels.

All but five of the plump barleys from Bottineau, ND (Table 5) had acceptable protein contents and the extract values were generally good, averaging 79.3 %. The soluble protein levels ranged from very good to a third that exceeded the upper limit. Most of the diastatic power values were good, but nearly all of the α-amylase values were too high. The β-glucan levels ranged from a couple submissions that had low values, to six that exceeded the upper limit. The best performers were BT462, 2ND16461, BT478 and Drummond.

Only a quarter of the thin barleys from Fargo, ND (Table 6) had unacceptably high protein contents. Over two thirds of the extract values were unacceptably low and soluble protein levels were a bit high, with some exceptions. The diastatic power levels ranged from two that were too low to a dozen that exceeded the upper limit, while all α-amylase levels except that of Robust were unacceptably high. The β-glucan levels ranged from good to a bit high, except for that of Barbless, which was extremely high. None of the submissions performed very well at this location.

A third of the very plump barleys from Aberdeen, ID (Table 7) had unacceptably high protein contents. The extract and soluble protein values were generally quite good, averaging 80

and 5.0% respectively. Two thirds of the S/T ratios were below the desired limit and over half of the β-glucan levels were too high. Half of the diastatic power and two thirds of the α-amylase values were too high. The best performers were M103, Foster, M108, Robust, 6B96-3733, M106 and Colter.

Overall, the barleys grown at Aberdeen (Tables 8 and 9) performed best, because they generally were plumper, yielded higher extract values, with lower soluble protein levels than those submissions from the other locations. Of the lines grown within the Mississippi Valley (Tables 2 and 3) those from Bottineau performed best, exhibiting very good extract and diastatic power values. The lines grown at Fargo were extremely thin and this most likely contributed to their poor performance.

In general, the lines in this year's nursery had elevated α-amylase and soluble protein levels (Tables 3 and 9). The selections grown at Fargo were exceptionally thin and this brought nearly all of their average plumpness values down to an unacceptable level. Two thirds of the first and second year submissions had higher malt quality scores that that of Morex. The selections Drummond and Lacey showed excellent malting quality, except for their elevated α-amylase levels. M108, 6B94-8253, ND16301, 2ND16461, 6B96-3733, BT462 and M107 all had good quality scores. However, in addition to the high α-amylase levels, at least one other malt quality parameter in each of these lines was deficient.

Table 1 **Entries in the Mississippi Valley Uniform Barley Nursery - 2000 Crop**

Entry No.	New Entry	CI# or Contributor	Name	Rowed	Parentage
1		5105	Barbless	6	Oderbrucker/Lion
2		10648	Larker	6	Titan/Kindred/3/Newal/Peatland//Montcalm
3		15773	Morex	6	Cree/Bonanza
4		476976	Robust	6	Morex/Manker
5		Minnesota	Stander (M64)	6	Robust 2*/3/Cree/Bonanza//Manker/4/Robust/Bumper
6		North Dakota	Foster (ND 11055)	6	Robust/3/ND5570//Glenn/Karl
7		Busch Ag. Res.	6B93-2978	6	Bumper/Karl//Bumper/Manker/3/Bumper/Karl/4/Excel
8		Minnesota	MNBrite (MNS85)	6	M90-89/M69
9		North Dakota	Drummond (ND15477)	6	ND9712//Stander/ND12200
10		Minnesota	Lacey (M98)	6	M78/M79
11		Busch Ag. Res.	6B94-8253	6	B1614/Stander
12		Minnesota	M103	6	M84/M81
13		Minnesota	M104	6	M92-211/M83
14		North Dakota	ND16301	6	Foster//ND12200/6B88-3213
15		North Dakota	2ND16461	2	ND13296/ND14760
16		Busch Ag.	6B95-2482	6	6B89-2126/ND10981
17		Busch Ag.	6B96-3733	6	B3213//6B89-2126/Foster
18		Saskatchewan	BT462	6	BT409/Foster
19	X	Minnesota	M106	6	M92-334/M81
20	X	Minnesota	M107	6	M92-334/M81
21	X	Minnesota	M108	6	M92-395/M83
22	X	North Dakota	ND15422	6	ND9712//ND11646/Stander
23	X	North Dakota	ND17079	6	ND12738//ND14119/F103-79
24	X	North Dakota	ND17082	6	ND12738//ND14119/F103-79
25	X	North Dakota	ND17090	6	ND14490/ND15608
26	X	North Dakota	2ND17275	2	Conlon/ND15238
27	X	Busch Ag.	6B95-2089	6	6B84-2912/B1601//6B88-3213
28	X	Busch Ag.	6B96-3373	6	B1614//6B88-3521/Excel
29	X	Saskatchewan	BT470	6	M75/SM93058
30	X	Saskatchewan	BT478	6	M67/SM93067

MISSISSIPPI VALLEY UNIFORM BARLEY NURSERY - 2000 Crop

Table 2 - Station Means* of Barley and Malt Quality Factors for 30 Varieties or Selections**.

Location	Barley Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°)	Alpha-amylase (20° DU)	Beta-glucan (ppm)	Ave. Quality Score
Morris, MN	34.8 A	83.2 A	38 C	78.2 B	2.1 A	14.0 B	5.85 A	43.5 A	158 AB	74.6 B	186 A	30
Bottineau, ND	31.6 B	79.9 A	44 B	79.3 A	2.4 B	13.3 A	5.81 A	45.6 A	147 A	70.1 A	217 A	33
Fargo, ND	28.9 C	45.5 B	48 A	77.2 C	2.1 A	13.4 A	5.76 A	44.8 A	161 B	78.7 B	187 A	22

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

** Barbless, Larker, Morex, Robust, Stander, Foster, 6B93-2978, MNBrite, Drummond, Lacey, 6B94-8253, M103, M104, ND16301 2ND16461, 6B95-2482, 6B96-3733, BT462, M106, M107, M108, ND15422, ND17079, ND17082, ND17190, 2ND17275, 6B95-2089, 6B96-3373, BT470, BT478

MISSISSIPPI VALLEY UNIFORM BARLEY NURSERY - 2000 Crop

Table 3 - Varietal Means* of Barley and Malt Quality Factors for 3 Stations**.

Variety	Rowed	Barley Kernel Weight (mg)		on 6/64 (%)		Barley Color (Agtron)		Malt Extract (%)		Wort Color		Barley Protein (%)		Wort Protein (%)		S/T (%)		DP (°)		Alpha-amylase (20° DU)		Beta-glucan (ppm)		Ave. Quality Score	Overall Rank
BARBLESS	6	30.9	BC	61.9	A	40	A	74.2	C	1.9	ABCD	14.8	E	4.97	A	34.4	A	162	ABCDEF	64.3	AB	442	F	18	29
LARKER	6	31.5	ABC	69.0	A	40	A	77.5	AB	2.3	ABCDE	13.8	BCDE	5.72	BCDEFGHI	43.2	BCDEFG	151	DEFG	66.5	BC	199	ABCDE	28	19
MOREX	6	30.1	C	61.5	A	44	A	77.6	AB	2.2	ABCDE	13.9	BCDE	5.92	DEFGHI	44.1	BCDEFGH	159	ABCDEFG	74.5	BCD	170	ABCDE	27	21
ROBUST	6	31.3	ABC	65.8	A	43	A	78.0	AB	1.8	ABC	14.3	CDE	5.69	BCDEFGHI	41.0	B	166	ABCDE	53.2	A	302	E	31	11
STANDER	6	31.9	ABC	73.6	A	42	A	79.0	A	2.7	BCDE	13.3	ABC	6.24	GHIJ	49.4	HI	143	EFG	76.1	BCD	159	ABCDE	30	14
FOSTER	6	32.2	ABC	73.1	A	41	A	77.6	AB	2.1	ABCDE	12.9	AB	5.47	ABCDE	43.8	BCDEFGH	142	EFG	66.8	BC	281	CDE	31	11
6B93-2978	6	29.9	C	62.9	A	46	A	78.5	AB	2.4	ABCDE	13.2	ABC	6.21	FGHIJ	48.0	EFGHI	154	CDEFG	79.3	BCD	287	DE	24	24
MNBRITE	6	31.1	ABC	70.4	A	50	A	77.9	AB	2.7	CDE	14.6	DE	6.65	J	47.0	CDEFGHI	187	A	76.2	BCD	105	AB	19	28
DRUMMOND	6	31.0	BC	69.1	A	47	A	78.3	AB	2.0	ABCD	13.5	ABCD	5.54	ABCDEF	42.5	BCDEF	162	ABCDEF	74.2	BCD	171	ABCDE	35	1
LACEY	6	31.8	ABC	71.2	A	44	A	78.6	A	1.9	ABCD	13.6	BCD	5.52	ABCDEF	42.5	BCDEF	165	ABCDE	71.9	BCD	184	ABCDE	34	2
6B94-8253	6	33.1	ABC	75.9	A	42	A	77.6	AB	2.0	ABCDE	13.8	BCDE	5.47	ABCDE	41.7	BC	153	CDEFG	70.1	BCD	219	ABCDE	34	2
M103	6	32.8	ABC	70.6	A	44	A	78.3	AB	2.4	ABCDE	13.6	ABCD	6.30	HIJ	48.6	GHI	154	CDEFG	75.6	BCD	91	A	25	23
M104	6	29.6	C	59.9	A	44	A	79.0	A	2.3	ABCD	13.0	ABC	6.21	FGHIJ	48.2	FGHI	149	EFG	81.0	CD	179	ABCDE	30	14
ND16301	6	32.2	ABC	76.9	A	45	A	79.0	A	2.0	ABCDE	13.3	ABC	5.64	ABCDEFGH	45.1	BCDEFGHI	177	ABCD	76.6	BCD	135	ABCDE	33	5
2ND16461	2	37.2	A	72.5	A	39	A	79.1	A	1.7	A	12.7	A	5.03	AB	42.2	BCDEF	109	H	76.5	BCD	263	BCDE	33	5
6B95-2482	6	31.4	ABC	70.9	A	43	A	79.0	A	1.8	AB	13.7	BCDE	5.54	ABCDEFG	42.0	BCD	181	ABC	74.4	BCD	160	ABCDE	30	14
6B96-3733	6	33.3	ABC	79.9	A	44	A	79.8	A	2.1	ABCDE	13.0	AB	5.96	DEFGHIJ	47.9	DEFGHI	162	ABCDE	82.3	D	235	ABCDE	33	5
BT462	6	31.9	ABC	68.6	A	41	A	78.3	AB	2.0	ABCDE	13.0	AB	5.10	ABC	40.9	B	135	FG	71.8	BCD	234	ABCDE	33	5
M106	6	31.2	ABC	66.8	A	43	A	78.7	A	2.0	ABCDE	13.8	BCDE	5.87	DEFGHI	44.9	BCDEFGHI	162	ABCDEF	79.9	CD	116	ABC	28	19
M107	6	31.8	ABC	60.3	A	43	A	79.7	A	2.5	ABCDE	13.2	ABC	6.12	EFGHIJ	48.1	FGHI	157	BCDEFG	75.7	BCD	90	A	33	5
M108	6	31.6	ABC	68.7	A	43	A	79.2	A	2.4	ABCDE	13.0	AB	6.03	DEFGHIJ	48.6	GHI	143	EFG	77.1	BCD	105	AB	34	2
ND15422	6	31.6	ABC	67.8	A	46	A	78.0	AB	2.0	ABCDE	13.5	ABCD	5.68	BCDEFGHI	43.3	BCDEFG	183	AB	81.5	CD	146	ABCDE	30	14
ND17079	6	32.3	ABC	75.5	A	42	A	77.7	AB	2.1	ABCDE	14.3	CDE	5.87	DEFGHI	43.0	BCDEFG	183	AB	76.3	BCD	290	DE	20	27
ND17082	6	31.0	BC	70.9	A	43	A	77.7	AB	2.1	ABCDE	13.5	ABCD	5.50	ABCDEF	43.3	BCDEFG	167	ABCDE	74.1	BCD	298	E	30	14
ND17190	6	31.3	ABC	77.4	A	40	A	76.0	BC	2.9	E	13.4	ABCD	6.39	IJ	50.2	I	104	H	71.1	BCD	257	ABCDE	18	29
2ND17275	2	36.4	AB	78.6	A	45	A	79.5	A	2.8	DE	14.4	CDE	6.66	J	48.2	FGHI	109	H	84.7	D	171	ABCDE	21	26
6B95-2089	6	30.9	BC	69.1	A	42	A	78.7	A	1.8	ABC	13.5	ABCD	5.47	ABCDE	42.0	BCDE	185	AB	74.5	BCD	143	ABCDE	31	11
6B96-3373	6	30.5	BC	66.9	A	43	A	77.4	AB	2.1	ABCDE	13.8	BCDE	5.40	ABCD	40.4	B	178	ABCDEF	79.2	BCD	207	ABCDE	23	25
BT470	6	30.2	C	66.4	A	47	A	78.7	A	2.6	ABCDE	13.4	ABCD	6.16	EFGHIJ	47.9	EFGHI	161	ABCDEF	76.2	BCD	127	ABCD	26	22
BT478	6	30.6	BC	63.9	A	46	A	78.9	A	2.3	ABCDE	13.0	AB	5.78	CDEFGHI	45.7	BCDEFGHI	133	G	72.8	BCD	126	ABCD	32	10

* 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, Bottineau and Fargo, ND

2000 MISSISSIPPI VALLEY REGIONAL NURSERY - MORRIS, MN

Table 4

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
3129	BARBLESS	6	33.6	*67.8	40	74.7	1.9	2	15.6	5.43	36.4	151	56.4	320	20	26
3130	LARKER	6	34.5	80.2	32	76.0	2.0	2	15.5	5.58	38.1	176	61.5	252	17	30
3131	MOREX	6	33.1	75.0	41	78.1	2.3	1	14.7	6.29	43.3	175	80.7	163	22	23
3132	ROBUST	6	34.4	80.4	39	78.3	2.0	2	14.7	5.81	41.0	159	53.5	306	37	7
3133	STANDER	6	35.2	85.0	36	79.2	2.7	1	13.6	6.26	48.6	149	80.9	179	34	13
3134	FOSTER	6	35.3	86.0	37	77.7	2.2	2	12.9	5.53	43.7	141	67.4	286	34	13
3135	6B93-2978	6	32.4	79.7	30	78.0	2.3	1	14.2	6.39	46.7	163	77.3	*453	20	26
3136	MNBRITE	6	34.3	85.5	45	78.4	2.0	1	14.5	6.35	45.0	198	78.7	151	24	20
3137	DRUMMOND	6	33.3	80.5	40	78.4	1.9	1	13.3	5.42	43.0	162	86.9	141	40	2
3138	LACEY	6	34.5	85.5	40	78.9	1.8	2	13.4	5.18	39.8	153	68.5	176	40	2
3140	6B94-8253	6	36.1	82.9	35	77.2	2.0	1	14.0	5.32	40.0	160	63.4	186	35	11
3141	M103	6	37.0	87.4	39	78.1	2.4	1	14.3	6.65	47.2	166	83.2	44	23	21
3142	M104	6	33.9	84.0	42	79.7	2.0	1	13.5	5.83	45.3	137	81.4	307	36	10
3143	ND16301	6	34.2	84.6	40	79.0	2.0	1	13.6	5.62	44.0	184	77.0	125	39	4
3144	2ND16461	2	*41.2	86.8	32	79.5	1.7	1	12.5	5.10	41.7	93	76.2	208	37	7
3145	6B95-2482	6	35.5	89.0	36	79.8	1.8	1	14.0	5.62	40.8	200	71.9	133	34	13
3146	6B96-3733	6	36.0	89.2	38	80.5	2.1	1	12.8	5.97	48.6	165	84.6	171	37	7
3147	BT462	6	34.9	80.6	32	77.6	2.0	2	14.1	5.31	37.9	137	71.4	216	21	25
3148	M106	6	34.9	84.0	38	78.9	2.1	1	14.5	5.98	43.8	163	77.2	98	35	11
3149	M107	6	36.1	80.0	39	80.2	2.1	1	13.4	5.96	46.4	161	74.3	101	41	1
3150	M108	6	34.6	84.4	40	79.2	2.2	1	12.8	5.72	46.7	139	74.7	121	38	6
3151	ND15422	6	34.0	77.2	41	77.0	2.2	1	14.2	5.87	41.7	198	80.5	109	27	18
3152	ND17079	6	35.0	88.9	39	77.4	2.1	1	14.9	6.02	41.4	193	76.0	211	20	26
3153	ND17082	6	33.2	84.7	41	77.3	2.1	1	14.0	5.61	43.1	167	75.3	169	32	16
3154	ND17190	6	33.4	86.2	38	75.1	2.8	1	13.6	6.53	50.4	120	74.5	206	20	26
3155	2ND17275	2	39.3	84.7	40	79.5	2.1	1	14.8	6.39	45.3	105	95.1	261	23	21
3156	6B95-2089	6	33.3	82.8	34	78.6	1.9	1	13.8	5.67	42.9	192	77.5	75	32	16
3157	6B96-3373	6	32.7	81.7	38	77.7	2.2	1	14.1	5.95	43.7	172	76.8	137	27	18
3158	BT470	6	33.7	94.1	42	79.0	2.2	1	13.9	5.97	43.6	170	66.3	156	39	4
3159	BT478	6	33.5	76.0	39	78.0	2.4	1	14.1	6.10	44.3	104	69.7	114	22	23

Table 4

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
3139	MOREX MALT CHECK	6	30.9	71.2	67	80.0	1.6	1	12.6	5.45	46.3	140	70.2	171	31	
3160	MOREX MALT CHECK	6	30.6	70.6	69	79.9	1.6	1	12.7	5.49	46.9	157	68.0	160	34	
Minima			32.4	75.0	30	74.7	1.7		12.5	5.10	36.4	93	53.5	44	17	
Maxima			39.3	94.1	45	80.5	2.8		15.6	6.65	50.4	200	95.1	320	41	
Means			34.5	83.7	38	78.2	2.1		14.0	5.85	43.5	158	74.6	177	30	
Standard Deviations			1.4	4.2	3	1.4	0.2		0.7	0.41	3.3	28	8.8	72	8	
Coefficients of Variation			4.2	5.0	9	1.7	11.7		5.3	6.94	7.6	18	11.8	41	26	

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

2000 MISSISSIPPI VALLEY REGIONAL NURSERY - BOTTINEAU, ND

Table 5

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
3098	BARBLESS	6	30.9	74.7	40	77.0	2.1	1	14.1	5.27	38.2	166	51.2	354	27	25
3099	LARKER	6	31.1	82.2	44	80.2	2.8	1	12.0	5.88	50.5	119	64.3	210	37	9
3100	MOREX	6	29.7	73.5	45	78.8	2.0	1	12.8	5.60	45.4	148	67.3	258	34	15
3101	ROBUST	6	30.8	75.4	45	78.7	1.6	1	13.9	5.39	40.8	160	50.2	426	37	9
3102	STANDER	6	31.4	85.1	41	79.9	3.1	1	13.1	6.38	51.2	133	73.0	132	34	15
3103	FOSTER	6	32.1	82.0	44	78.7	2.0	1	12.9	5.34	43.8	136	65.5	312	33	22
3104	6B93-2978	6	30.7	79.7	49	79.7	2.7	1	12.6	6.28	50.3	142	74.8	169	33	22
3105	MNBRITE	6	31.4	82.0	48	78.7	4.1	1	14.7	7.42	51.6	169	67.7	32	19	28
3106	DRUMMOND	6	31.3	80.2	46	79.1	2.1	1	13.7	5.71	43.1	147	64.1	230	41	3
3107	LACEY	6	32.3	82.0	44	79.4	1.8	1	13.7	5.55	43.6	174	79.3	259	35	13
3108	6B94-8253	6	32.5	84.9	44	78.5	2.0	1	13.7	5.48	42.0	146	72.7	289	39	5
3109	M103	6	32.8	84.1	41	79.7	2.6	1	12.8	6.18	51.2	146	65.7	71	34	15
3110	M104	6	29.4	71.5	44	80.2	2.7	1	13.0	6.63	51.5	145	77.9	103	36	12
3111	ND16301	6	32.5	87.0	47	79.7	1.8	1	13.3	5.30	42.8	164	71.7	181	39	5
3112	2ND16461	2	*38.3	88.1	37	80.2	1.6	1	12.1	4.99	43.0	99	75.2	239	43	2
3113	6B95-2482	6	30.4	76.7	48	78.9	1.4	1	13.4	4.97	37.9	170	67.7	239	35	13
3114	6B96-3733	6	33.2	86.6	46	80.0	1.8	1	13.4	5.83	46.1	170	73.8	293	34	15
3115	BT462	6	31.9	80.4	40	79.8	2.1	2	12.4	4.87	41.2	131	64.0	279	46	1
3116	M106	6	30.1	73.7	41	79.5	1.9	2	13.2	5.51	44.0	152	76.7	181	38	7
3117	M107	6	30.5	72.0	43	80.6	3.3	1	13.2	6.32	49.7	144	73.4	61	34	15
3119	M108	6	32.1	82.8	40	80.4	2.9	1	13.2	6.43	49.8	131	74.0	55	34	15
3120	ND15422	6	31.7	77.8	45	79.0	1.9	1	13.2	5.44	43.1	171	84.6	199	34	15
3121	ND17079	6	32.4	80.6	44	78.2	2.0	1	14.2	5.68	41.4	178	76.0	384	24	26
3122	ND17082	6	31.2	81.0	43	78.8	2.0	2	13.2	5.21	42.0	156	71.7	439	38	7
3123	ND17190	6	31.4	87.1	41	77.6	3.5	1	13.2	6.57	52.0	87	57.0	284	23	27
3124	2ND17275	2	36.4	88.9	42	80.2	4.4	1	14.4	7.69	55.5	104	69.2	35	16	29
3125	6B95-2089	6	31.3	81.9	48	79.8	1.7	1	13.4	5.13	39.0	164	70.4	223	37	9
3126	6B96-3373	6	29.9	70.9	47	77.7	2.2	2	14.3	5.00	36.3	180	77.7	368	13	30
3127	BT470	6	29.2	71.3	46	80.5	3.3	1	12.7	6.40	52.9	132	82.3	72	29	24
3128	BT478	6	29.6	73.5	46	80.7	2.6	1	12.5	5.79	47.1	134	62.8	119	41	3

Table 5

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score
3118	MOREX MALT CHECK	6	31.2	70.8	69	80.2	1.6	1	12.9	5.51	44.7	133	76.9	164	39
Minima			29.2	70.9	37	77.0	1.4		12.0	4.87	36.3	87	50.2	32	13
Maxima			36.4	88.9	49	80.7	4.4		14.7	7.69	55.5	180	84.6	439	46
Means			31.4	79.9	44	79.3	2.4		13.3	5.81	45.6	147	70.1	217	33
Standard Deviations			1.4	5.5	3	0.9	0.7		0.7	0.70	5.2	23	8.1	116	8
Coefficients of Variation			4.6	6.8	7	1.2	31.3		4.9	12.06	11.3	16	11.5	54	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 J. Heward, Busch Ag. Resources Inc., Ft. Collins, CO

2000 MISSISSIPPI VALLEY REGIONAL NURSERY - FARGO, ND

Table 6

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
3161	BARBLESS	6	28.2	43.3	40	*71.0	1.7	1	14.8	*4.20	*28.5	168	85.2	*651	8	30
3162	LARKER	6	28.8	44.5	45	76.2	2.0	1	14.0	5.70	41.1	157	73.6	136	31	3
3163	MOREX	6	27.6	35.9	46	76.0	2.2	1	14.2	5.87	43.6	154	75.5	89	24	11
3164	ROBUST	6	28.7	41.7	46	77.0	1.9	1	14.4	5.88	41.3	179	*55.8	175	19	21
3165	STANDER	6	29.1	50.7	48	78.0	2.2	1	13.2	6.08	48.3	148	74.4	165	23	16
3166	FOSTER	6	29.2	51.4	42	76.4	2.0	1	12.9	5.54	43.9	150	67.6	244	27	10
3167	6B93-2978	6	26.6	29.3	60	77.7	2.1	1	12.8	5.95	46.9	156	85.9	240	20	17
3168	MNBRITE	6	27.7	43.7	56	76.7	2.0	1	14.6	6.19	44.5	193	82.3	132	14	26
3169	DRUMMOND	6	28.3	46.7	55	77.4	1.9	1	13.4	5.49	41.5	176	71.5	141	24	11
3170	LACEY	6	28.7	46.1	49	77.5	2.1	1	13.8	5.83	44.2	167	67.9	118	28	6
3171	6B94-8253	6	30.7	60.0	48	77.2	2.1	1	13.6	5.60	43.0	154	74.1	182	29	5
3172	M103	6	28.5	40.2	51	77.1	2.2	1	13.6	6.07	47.3	149	78.0	159	19	21
3173	M104	6	25.6	24.2	46	77.1	2.3	1	13.6	6.17	47.8	165	83.6	126	18	24
3174	ND16301	6	29.9	59.0	48	78.4	2.2	1	13.0	6.01	48.5	184	81.0	99	20	17
3175	2ND16461	2	32.2	42.6	48	77.7	1.9	1	12.6	5.01	42.0	91	78.2	341	19	21
3176	6B95-2482	6	28.2	47.1	45	78.2	2.1	1	13.6	6.04	47.2	172	83.5	107	20	17
3177	6B95-3733	6	30.6	64.0	48	79.0	2.3	1	12.9	6.09	49.0	151	88.5	241	28	6
3178	BT462	6	29.0	44.9	51	77.5	2.0	1	12.4	5.12	43.7	136	79.9	208	33	1
3179	M106	6	28.6	42.8	50	77.8	2.1	1	13.8	6.12	47.0	171	85.8	70	12	27
3180	M107	6	28.8	28.9	46	78.2	2.2	1	13.1	6.09	48.2	167	79.3	109	24	11
3182	M108	6	28.2	38.9	50	78.1	2.2	1	12.9	5.94	49.4	158	82.7	140	30	4
3183	ND15422	6	29.1	48.5	51	78.1	2.0	1	13.2	5.73	45.2	181	79.4	131	28	6
3184	ND17079	6	29.5	56.9	44	77.6	2.1	1	13.7	5.90	46.1	179	76.8	276	15	25
3185	ND17082	6	28.6	47.1	44	77.1	2.1	1	13.3	5.68	44.7	177	75.2	285	20	17
3186	ND17190	6	29.2	59.0	42	75.4	2.4	1	13.5	6.06	48.1	104	81.7	280	12	27
3187	2ND17275	2	*33.4	62.2	52	78.8	1.8	1	14.0	5.90	43.8	118	89.8	216	24	11
3188	6B95-2089	6	28.1	42.5	45	77.8	1.8	1	13.4	5.60	44.2	198	75.5	132	24	11
3189	6B96-3373	6	28.8	48.1	44	76.9	2.0	1	13.0	5.24	41.1	183	83.1	115	28	6
3190	BT470	6	27.7	33.9	52	76.5	2.2	1	13.7	6.11	47.3	182	80.1	152	10	29
3191	BT478	6	28.7	42.3	52	78.0	1.9	1	12.4	5.46	45.7	160	86.0	145	33	1

Table 6

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score
3181	MOREX MALT CHECK	6	30.9	70.9	72	80.0	1.6	1	12.8	5.47	46.2	145	73.6	124	41
Minima			25.6	24.2	40	75.4	1.7		12.4	5.01	41.1	91	67.6	70	8
Maxima			32.2	64.0	60	79.0	2.4		14.8	6.19	49.4	198	89.8	341	33
Means			28.7	45.5	48	77.4	2.1		13.4	5.81	45.3	161	79.5	171	22
Standard Deviations			1.2	9.8	4	0.8	0.2		0.6	0.32	2.6	24	5.7	68	7
Coefficients of Variation			4.2	21.4	9	1.1	7.8		4.5	5.48	5.7	15	7.1	40	31

Malt Check Data are Excluded from Rank Sorting and Statistics
Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics
For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

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

2000 MISSISSIPPI VALLEY REGIONAL NURSERY AND ADDITIONS- ABERDEEN, ID
Table 7

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
3219	BARBLESS	6	36.3	84.0	67	*74.0	1.1	1	15.1	3.95	26.7	125	*39.1	649	12	34
3220	LARKER	6	36.7	88.2	66	77.0	1.3	1	14.9	4.56	31.1	172	52.2	329	19	33
3222	MOREX	6	37.5	91.0	69	78.7	1.2	1	14.3	4.73	34.0	183	58.9	369	27	26
3223	ROBUST	6	38.6	93.9	67	79.4	1.1	1	13.9	4.98	36.3	162	52.8	374	42	4
3224	STANDER	6	39.1	94.0	66	80.8	1.6	1	12.9	5.36	44.5	134	67.2	362	39	14
3225	FOSTER	6	40.5	97.2	64	80.1	1.5	1	12.5	4.93	42.8	147	61.9	346	46	2
3226	6B93-2978	6	37.2	93.4	75	80.0	1.3	1	13.3	4.87	38.1	176	70.1	399	34	21
3227	MNBRITE	6	39.3	94.7	68	78.5	1.4	1	14.4	5.24	37.8	207	65.7	371	23	29
3228	DRUMMOND	6	38.8	96.5	68	80.0	1.4	1	14.2	5.08	37.6	174	67.9	170	32	22
3229	LACEY	6	39.8	95.8	65	80.1	1.4	1	13.7	5.15	37.9	174	63.8	135	41	8
3230	6B94-8253	6	42.3	98.1	72	78.4	1.8	1	14.0	5.38	39.1	165	61.8	347	23	29
3231	M103	6	41.1	97.3	69	79.8	1.5	1	13.6	5.25	40.5	152	58.7	232	50	1
3232	M104	6	38.7	94.3	66	80.3	1.4	1	13.5	5.41	40.7	171	63.7	215	38	16
3233	ND16301	6	41.7	97.6	73	80.2	1.5	1	13.2	4.81	37.6	180	56.8	181	41	8
3234	2ND16461	2	47.9	96.6	62	80.3	1.2	1	12.6	4.33	35.2	99	60.2	575	28	25
3235	6B95-2482	6	41.7	97.2	71	79.7	1.2	1	14.0	4.68	34.2	187	55.4	308	35	19
3236	6B96-3733	6	42.4	98.5	72	81.2	1.5	1	13.5	5.64	44.8	162	62.7	215	42	4
3237	BT462	6	42.1	96.7	75	80.5	1.8	2	13.0	4.54	34.9	134	54.1	242	40	13
3238	M106	6	41.6	96.6	65	80.8	1.6	1	13.3	5.48	42.6	164	63.5	288	42	4
3239	M107	6	42.4	95.4	63	81.1	1.6	1	13.2	5.52	43.9	163	62.8	304	39	14
3240	M108	6	40.5	96.8	63	81.3	1.6	1	13.8	5.58	42.9	147	64.2	248	45	3
3241	ND15422	6	40.4	95.1	70	79.6	1.5	1	14.3	5.09	37.7	218	64.1	243	29	24
3243	ND17079	6	40.8	96.4	75	79.4	1.9	1	14.8	5.64	39.7	185	62.7	460	22	31
3244	ND17082	6	39.1	95.0	72	80.3	1.7	1	13.5	5.16	39.3	176	58.9	347	38	16
3245	ND17190	6	40.1	98.1	64	79.4	2.0	1	12.5	5.77	46.9	95	77.7	370	27	26
3246	2ND17275	2	47.6	98.7	64	79.5	1.8	1	15.4	5.60	37.6	131	74.0	501	26	28
3247	6B95-2089	6	39.0	95.5	68	80.7	1.3	1	13.5	4.65	35.8	163	64.2	259	41	8
3248	6B96-3733	6	41.3	96.6	65	79.5	1.5	1	14.1	4.82	36.1	184	59.1	358	30	23
3249	BT470	6	39.0	93.9	69	81.5	1.6	1	13.1	5.36	44.4	187	68.7	247	38	16
3250	BT478	6	36.9	86.1	62	81.1	1.3	1	13.2	4.93	39.7	196	66.6	147	41	8

Table 7

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
3251	M101	6	41.1	94.7	71	79.6	1.5	1	15.0	5.51	38.7	174	65.3	327	22	31
3252	M105	6	37.9	94.6	61	79.6	1.4	1	14.0	5.25	38.3	151	67.8	260	41	8
3253	B2601	6	36.5	*79.0	72	78.9	1.4	1	13.7	4.51	35.3	147	58.3	660	35	19
3254	COLTER	6	39.8	86.3	60	81.4	1.2	1	*11.0	3.80	37.4	111	52.5	285	42	4
3221	MOREX MALT CHECK	6	31.2	73.6	71	80.4	1.7	1	12.3	5.53	48.5	150	69.9	110	46	
3242	MOREX MALT CHECK	6	31.0	71.0	72	80.1	1.6	1	12.7	5.33	44.5	151	75.7	186	42	
Minima			36.3	84.0	60	77.0	1.1		12.5	3.80	26.7	95	52.2	135	12	
Maxima			47.9	98.7	75	81.5	2.0		15.4	5.77	46.9	218	77.7	660	50	
Means			40.2	94.7	68	80.0	1.5		13.8	5.05	38.5	162	62.6	327	34	
Standard Deviations			2.6	3.7	4	1.0	0.2		0.7	0.48	4.2	28	5.9	127	9	
Coefficients of Variation			6.5	3.9	6	1.2	14.7		5.3	9.55	10.8	18	9.4	39	26	

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. Wesenberg, USDA/ARS, Aberdeen, ID

MISSISSIPPI VALLEY UNIFORM BARLEY NURSERY - 2000 Crop

Table 8 - Station Means* of Barley and Malt Quality Factors for 30 Varieties or Selections**.

Location	Barley Kernel Weight (mg)		on 6/64" (%)		Barley Color (Agtron)		Malt Extract (%)		Wort Color		Barley Protein (%)		Wort Protein (%)		S/T (%)		DP (°)		Alpha-amylase (20° DU)		Beta-glucan (ppm)		Ave. Quality Score
Aberdeen, ID	40.3	A	95.0	A	68	A	79.8	A	1.5	A	13.7	BC	5.08	A	38.7	B	164	B	62.0	A	320	B	34
Morris, MN	34.8	B	83.2	B	38	D	78.2	B	2.1	B	14.0	C	5.85	B	43.5	A	158	AB	74.6	C	186	A	30
Bottineau, ND	31.6	C	79.9	B	44	C	79.3	A	2.4	C	13.3	A	5.81	B	45.6	A	147	A	70.1	B	217	A	33
Fargo, ND	28.9	D	45.5	C	48	B	77.2	C	2.1	B	13.4	AB	5.76	B	44.8	A	161	B	78.7	D	187	A	22

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

** Barbless, Larker, Morex, Robust, Stander, Foster, 6B93-2978, MNBrite, Drummond, Lacey, 6B94-8253, M103, M104, ND16301 2ND16461, 6B95-2482, 6B96-3733, BT462, M106, M107, M108, ND15422, ND17079, ND17082, ND17190, 2ND17275, 6B95-2089, 6B96-3373, BT470, BT478

MISSISSIPPI VALLEY UNIFORM BARLEY NURSERY - 2000 Crop

Table 9 - Varietal Means* of Barley and Malt Quality Factors for 4 Stations**.

Variety	Rowed	Barley Kernel Weight (mg)		on 6/64 (%)		Barley Color (Agtron)		Malt Extract (%)		Wort Color		Barley Protein (%)		Wort Protein (%)		S/T (%)		DP (°)		Alpha-amylase (20° DU)		Beta-glucan (ppm)		Ave. Quality Score	Overall Rank
BARBLESS	6	32.3	A	67.5	A	47	A	74.2	D	1.7	A	14.9	J	4.71	A	32.5	G	153	DEFG	58.0	AB	494	F	17	30
LARKER	6	32.8	A	73.8	A	47	A	77.4	BC	2.0	AB	14.1	EFGHIJ	5.43	ABCDE	40.2	CDEF	156	CDEFG	62.9	ABC	232	ABCDE	26	24
MOREX	6	32.0	A	68.9	A	50	A	77.9	ABC	1.9	AB	14.0	DEFGHI	5.62	BCDEFG	41.6	BCDEF	165	BCDEF	70.6	BCD	220	ABCDE	27	22
ROBUST	6	33.1	A	72.9	A	49	A	78.4	ABC	1.7	A	14.2	FGHIJ	5.52	ABCDEF	39.9	EF	165	BCDEF	53.1	A	320	CDE	34	7
STANDER	6	33.7	A	78.7	A	48	A	79.5	AB	2.4	AB	13.2	ABCDE	6.02	DEFG	48.2	AB	141	FG	73.9	BCD	210	ABCDE	33	11
FOSTER	6	34.3	A	79.2	A	47	A	78.2	ABC	1.9	AB	12.8	AB	5.34	ABCD	43.6	ABCDEF	144	EFG	65.6	ABCD	297	ABCDE	35	3
6B93-2978	6	31.7	A	70.5	A	54	A	78.9	ABC	2.1	AB	13.2	ABCDE	5.87	DEFG	45.5	ABCDEF	159	BCDEFG	77.0	CD	315	CDE	27	22
MNBRITE	6	33.2	A	76.5	A	54	A	78.1	ABC	2.4	AB	14.6	HIJ	6.30	FG	44.7	ABCDEF	192	A	73.6	BCD	172	ABCDE	20	28
DRUMMOND	6	32.9	A	76.0	A	52	A	78.7	ABC	1.8	AB	13.7	BCDEFGH	5.43	ABCDE	41.3	BCDEF	165	BCDEF	72.6	BCD	171	ABCDE	34	7
LACEY	6	33.8	A	77.4	A	50	A	79.0	ABC	1.8	AB	13.7	BCDEFGH	5.43	ABCDE	41.4	BCDEF	167	ABCDE	69.9	BCD	172		36	2
6B94-8253	6	35.4	A	81.5	A	50	A	77.8	ABC	2.0	AB	13.8	CDEFGHI	5.45	ABCDE	41.0	CDEF	156	CDEFG	68.0	BCD	251	ABCDE	32	12
M103	6	34.9	A	77.3	A	50	A	78.7	ABC	2.2	AB	13.6	BCDEFG	6.04	DEFG	46.6	ABCDE	153	DEFG	71.4	BCD	127	A	32	12
M104	6	31.9	A	68.5	A	50	A	79.3	AB	2.1	AB	13.4	BCDEF	6.01	DEFG	46.3	ABCDEF	155	CDEFG	76.7	CD	188	ABCDE	32	12
ND16301	6	34.6	A	82.1	A	52	A	79.3	AB	1.9	AB	13.3	ABCDE	5.44	ABCDE	43.2	ABCDEF	178	ABCD	71.6	BCD	147	ABC	35	3
2ND16461	2	39.9	A	78.5	A	45	A	79.4	AB	1.6	A	12.5	A	4.88	AB	40.5	CDEF	96	I	72.5	BCD	341	E	32	12
6B95-2482	6	34.0	A	77.5	A	50	A	79.2	ABC	1.6	A	13.8	BCDEFGHI	5.33	ABCD	40.0	DEF	182	AB	69.6	BCD	197	ABCDE	31	19
6B96-3733	6	35.6	A	84.6	A	51	A	80.2	A	1.9	AB	13.2	ABCDE	5.88	DEFG	47.1	ABC	162	BCDEF	77.4	CD	230	ABCDE	32	12
BT462	6	34.5	A	75.7	A	50	A	78.9	ABC	2.0	AB	13.0	ABC	4.96	ABC	39.4	F	135	GH	67.4	ABCD	236	ABCDE	35	3
M106	6	33.8	A	74.3	A	49	A	79.3	AB	1.9	AB	13.7	BCDEFGH	5.77	CDEFG	44.4	ABCDEF	163	BCDEF	75.8	CD	159	ABCD	32	12
M107	6	34.5	A	69.1	A	48	A	80.0	A	2.3	AB	13.2	ABCDE	5.97	DEFG	47.1	ABCD	159	BCDEFG	72.5	BCD	144	ABC	35	3
M108	6	33.9	A	75.7	A	48	A	79.8	A	2.2	AB	13.2	ABCDE	5.92	DEFG	47.2	ABC	144	EFG	73.9	BCD	141	ABC	38	1
ND15422	6	33.8	A	74.7	A	52	A	78.4	ABC	1.9	AB	13.7	BCDEFGH	5.53	ABCDEF	41.9	BCDEF	192	A	77.2	CD	171	ABCDE	30	20
ND17079	6	34.4	A	80.7	A	51	A	78.2	ABC	2.0	AB	14.4	GHIJ	5.81	DEFG	42.2	BCDEF	184	AB	72.9	BCD	333	DE	20	28
ND17082	6	33.0	A	77.0	A	50	A	78.4	ABC	2.0	AB	13.5	BCDEFG	5.42	ABCDE	42.3	ABCDE	169	ABCDE	70.3	BCD	310	BCDE	32	12
ND17190	6	33.5	A	82.6	A	46	A	76.9	C	2.7	B	13.2	ABCDE	6.23	EFG	49.4	A	102	I	72.7	BCD	285	ABCDE	21	27
2ND17275	2	39.2	A	83.6	A	50	A	79.5	AB	2.5	AB	14.7	IJ	6.40	G	45.6	ABCDEF	115	HI	82.0	D	253	ABCDE	22	26
6B95-2089	6	32.9	A	75.7	A	49	A	79.2	AB	1.7	A	13.5	BCDEFG	5.26	ABCD	40.5	CDEF	179	ABC	71.9	BCD	172	ABCDE	34	7
6B96-3373	6	33.2	A	74.3	A	49	A	78.0	ABC	2.0	AB	13.9	CDEFGHI	5.25	ABCD	39.3	F	180	ABC	74.2	BCD	245	ABCDE	25	25
BT470	6	32.4	A	73.3	A	52	A	79.4	AB	2.3	AB	13.4	ABCDEF	5.96	DEFG	47.1	ABCD	168	ABCDE	74.4	CD	157	ABCD	29	21
BT478	6	32.2	A	69.5	A	50	A	79.5	AB	2.1	AB	13.1	ABCD	5.57	BCDEFG	44.2	ABCDEF	149	EFG	71.3	BCD	131	AB	34	7

* 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, Bottineau and Fargo, 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 M31A analyzer.

Barley Moisture Content Five g of ground sample was dried for 3 h at 106°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 which 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 roll mill that was adjusted so that 75% of the grist remained on a 525 µm sieve. Ground malts for moisture, protein and amylolytic activity analyses were ground in a Labconco Burr mill (see Barley Mill).

Malt Moisture Content See Barley Moisture Content.

Malt Protein Content See Barley Protein Content.

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

Wort Color was determined on a Skalar SAN plus analyzer by subtracting the absorbance at 700 nm from that at 430nm and dividing by a factor that was determined by comparison with values obtained in a collaborative test.

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).

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.

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 Selections 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.

Table A1 **2000 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	≥ 77.0	5
(%)	85.0–89.9	3	70.0–76.9	3
	< 85.0	0	< 70.0	0
Malt Extract	≥ 81.0	10	≥ 80.0	10
(% db)	79.5–80.9	7	79.0–79.9	7
	78.0–79.4	4	78.0–78.9	4
	<78.0	0	< 78.0	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)	12.6–13.4	5	12.6–13.9	5
	10.1–12.5	10	10.6–12.5	10
	≤ 10.0	5	≤ 10.5	5
Wort Protein	> 6.0	0	> 6.0	0
(% db)	5.1–6.0	3	5.3–6.0	3
	4.4–5.0	7	4.6–5.2	7
	< 4.4	0	< 4.6	0
S/T (Soluble/Total	> 46.0	0	> 46.0	0
Protein, % db)	40.0–46.0	5	40.0–46.0	5
	< 40.0	0	< 40.0	0
DP (Diastatic	> 140.0	0	> 170.0	0
Power, ° ASBC)	130.1–140.0	4	160.1–170.0	4
	110.0–130.0	7	140.0–160.0	7
	95.0–109.9	4	130.0–139.9	4
	< 95.0	0	< 130.0	0
Alpha-amylase	> 55.0	0	> 60.0	0
(20° DU)	50.1–55.0	4	55.1–60.0	4
	40.0–50.0	7	45.0–55.0	7
	35.0–39.9	4	40.0–44.9	4
	< 35.0	0	< 40.0	0
Beta-glucan	< 40	0	< 40	0
(ppm)	40 –80	3	40 –80	3
	80 – 150	7	80 – 150	7
	150 – 300	3	150 – 300	3
	> 300	0	> 300	0