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Wisconsin Agricultural Experiment Station and other State Experiment Stations, Cooperating

WESTERN REGIONAL SPRING 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 for 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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Western Regional Spring Barley Nursery – 2000 Crop

Nursery samples were received for malting quality evaluation from three experimental stations located in three states. Ten of the 26 entries (#17 - #26) were new in this year's nursery (Table 1).

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

The mean values for 11 quality factors are listed over the three stations located in the Western Region (Table 2) and over all varieties (Table 3). Individual station data are reported in Tables 4 through 6. 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 and 3, are presented below.

Over half of the plump barleys from Aberdeen, ID (Table 4) had unacceptably high protein contents. The extract values were generally excellent, averaging nearly 80%, while soluble protein levels varied between 3.8 and 6.5%. Over half of the S/T ratios were unacceptably low, while six submissions had values that were too high. The diastatic power values fluctuated considerably, with ten values that were too high and eight that were too low. Over half of the α-amylase and β-glucan levels were too high. The best performers were 92-AB5180, 98AB12362, 97-AB8333, 95-AB15156, Foster, BA2B96-5038 and Colter.

The barleys from Pullman, WA (Table 5) were very plump and generally had good protein contents. The extract values were very good, with only two falling below the desired limit. Over half of the soluble protein levels were unacceptably low and this was reflected in the S/T ratios, with two thirds of these values being too low. Most of the diastatic power values were good, but over half of the α-amylase levels exceeded the upper limits. The β-glucan levels

were generally a bit high, with a third of them exceeding the desired limit. A few of the lines apparently modified well, however, with β-glucan levels near 100 ppm and SK-TR150, with a value of 23 ppm, was overmodified. The best performers were SK-CDC BOLD, BA6B94-8253, SK-TR150, ND15422, SK-TR346 and Stander.

Two thirds of the barleys from Powel, WY (Table 6) were thin and half of them had unacceptably high protein contents. Most of the soluble protein values were good, but two thirds of the S/T ratios were too low. Half of the diastatic power values fell outside of the desired limits, with twelve that were too high and four that were too low. Two thirds of the α-amylase and β-glucan values exceeded the desired limits. The best performers were ND15422, MT910189, BA2B96-5119 and SK-TR346. The SK-TR150 malt was apparently overmodified with our malting schedule and this reduced its quality score by several points.

Overall, the barleys grown at Aberdeen and Pullman were very plump (Table 2), while the entries grown at Powell ranged from very thin to very plump. The protein contents of the submissions from Pullman were generally very good, while those from Powell were higher, but still acceptable and those from Aberdeen were mostly too high. The extract values of the entries from Aberdeen, Pullman and Powell were not significantly different, but there were more unacceptably low values from the Powell submissions than in those from the other locations. The soluble protein values of the lines grown at Aberdeen and Powell were generally very good, while those from Pullman were a bit too low. The submissions from Pullman yielded good diastatic power values, while the lines from Aberdeen and Powell tended to be outside of the desired limits. The α-amylase and β-glucan values from all locations were generally a bit high, although the β-glucan values from Pullman indicated these samples had modified a bit better than those grown at the other locations. Samples from Pullman had the best quality scores, followed by those from Aberdeen, while the Powell samples gave the lowest scores.

Overall, most of these lines were plump, but the protein contents tended to be a bit high (Table 3). A quarter of the extract values averaged over 80% and nearly all were greater than the desired minimum of 78%. The soluble protein levels ranged from a bit high to four that were

very low. The diastatic power values ranged from three that were too low to five that exceeded the desired limits, while most α-amylase values were too high. Half of the β-glucan levels were too high and only three of the values were near the ideal of 100 ppm. SK-TR150 consistently overmodified in these experiments, while the PB1 entries modified very poorly, as indicated by their β-glucan levels. The best performers were ND15422, MT910189, SK-CDC BOLD, BA2B96-5038, SK-TR150 and SK-TR346.

Entries in the Western Regional Spring Barley Nursery - 2000 Crop

Table 1

Entry No.	New Entry	Id	Cultivar or Selection	Rowed	Parentage	Source
1		CI 15773	MOREX	6	Cree/Bonanza	St. Paul, MN
2		PI 564743	STANDER	6	Robust 2*/3/Cree/Bonanza//Manker/4/Robust/Bumper	St. Paul, MN
3		SK 76333	HARRINGTON	2	Klages/3/Gazelle/Betzes//Centenial	Saskatoon, SK
4		BA6B93-2978	BA6B93-2978	6	6B86-3517/Excel	BARI (1)
5		WA9504-94	WA9504-94	2	WA7190/Maresi	Pullman, WA
6		MT910189	MT910189	2	ND7293/Bearpaw	Bozeman, MT
7		WA11825-95	WA11825-95	2	9035-84/Baronesse	Pullman, WA
8		SK-TR150	TR150	2	WM861-5/TR118	Saskatoon, SK
9		ND15477	ND15477	6	ND9712//Stander/ND12200	Fargo, ND - Horsley
10		PB1-95-2R-517	PB1-95-2R-517	2	PB1-88-2R-801/VD403582	PB - 1 (2)
11		PB1-95-2R-A629	PB1-95-2R-A629	2	PB1-88-2R-801/VD403582	PB - 1 (2)
12		OR2967102	OR2967102	2	Harrington/Orca//D172(Shyri/Galena)	Corvallis, OR
13		BA6B94-8253	BA6B94-8253	6	B1614/Stander	BARI (1)
14		93AB859	93AB859	2	84Ab2974/Harrington	Aberdeen, ID
15		MTLB-30	VALIER	2	Lewis/Baronesse	Bozeman, MT
16		MTLB-05	MTLB-05	2	Lewis/Baronesse	Bozeman, MT
17	X	PB1-97-2R-7090	PB1-97-2R-7090	2		PB - 1 (2)
18	X	WA11801-95	WA11801-95	2	WA9035-84/Baronesse	Pullman, WA
19	X	WA11832-95	WA11832-95	2	WA9035-84/Baronesse	Pullman, WA
20	X	BA6B95-2482	BA6B95-2482	6	6B89-2126/ND10981	BARI (1)
21	X	BA2B96-5038	BA2B96-5038	2	2B89-4616/TR226	BARI (1)
22	X	BA2B96-5119	BA2B96-5119	2	2B90-5066/TR129	BARI (1)
23	X	2ND17274	2ND17274	2	Conlon/ND15238	Fargo, ND - Frankowiak
24	X	ND15422	ND15422	6	ND9712//ND11646/Stander	Fargo, ND - Horsley
25	X	SK-CDC BOLD	CDC BOLD	2		Saskatoon, SK
26	X	SK-TR346	TR346	2		Saskatoon, SK

(1) Busch Agricultural Resouces, Inc. - Ft Collins, CO
(2) Plant Breeders #1, Moscow, ID

WESTERN REGIONAL SPRING BARLEY NURSERY - 2000 Crop

Table 2 - Station Means* of Barley and Malt Quality Factors for 26 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	44.3	A	95.0	A	65	B	79.5	A	1.7	B	14.2	C	5.14	A	37.7	A	138	B	61.2	A	362	B	31
Pullman, WA	41.0	B	93.1	A	68	AB	79.3	A	1.6	B	12.4	A	4.44	B	37.5	A	121	A	63.7	A	245	A	35
Powell, WY	35.2	C	73.0	B	70	A	79.0	A	1.4	A	13.3	B	4.89	A	38.8	A	142	B	65.3	A	320	AB	26

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

** MOREX, STANDER, HARRINGTON, BA6B93-2978, WA9504-94, MT910189, WA11825-95, SK-TR150, ND15477, PB1-95-2R-517, PB1-95-2R-A629, OR2967102, BA6B94-8253, 93Ab859, VALIER, MTLB-05, PB1-97-2R-7090, WA11801-95, WA11832-95, BAB95-2482, BA2B96-5038, BA2B96-5119, 2ND17274, ND15422, SK-CDC BOLD, SK-TR346

WESTERN REGIONAL SPRING BARLEY NURSERY - 2000 Crop

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

Variety or Selection	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
MOREX	6	35.8	BC	83.8	AB	71.7	ABCDE	79.0	DEFGHI	1.4	ABC	13.8	AB	5.15	ABCDE	38.9	DEFGHI	162	BC	62.6	DEF	306	BCDEF	33
STANDER	6	36.3	BC	87.4	AB	70.7	ABCDEF	80.2	BCDE	1.6	ABCDE	13.1	AB	5.87	AB	46.5	B	152	BCD	79.1	AB	248	CDEF	36
HARRINGTON	2	38.0	ABC	75.1	AB	64.3	CDEFGHI	78.6	EFGHIJ	1.2	A	14.2	AB	4.86	DEFG	36.0	GHIJK	136	CDEF	66.2	DE	303	BCDEF	25
BA-6B93-2978	6	33.4	C	76.2	AB	73	ABCDE	79.1	DEFGHI	1.4	ABC	13.1	AB	5.17	ABCDE	40.4	CDEFG	179	AB	77.1	BC	284	BCDEF	32
WA9504-94	2	38.0	ABC	78.6	AB	55	I	78.0	GHIJK	2.0	CDE	14.1	AB	4.40	EFGH	32.4	K	132	DEF	43.5	H	440	B	27
MT910189	2	45.6	AB	92.2	AB	70.7	ABCDEF	80.9	ABC	1.2	A	12.3	AB	4.79	DEFG	40.4	CDEFG	131	DEFG	68.4	CD	294	BCDEF	41
WA118525-95	2	38.0	ABC	86.7	AB	70	ABCDEFG	79.0	DEFGHI	1.5	ABCD	11.8	A	4.06	GH	36.4	EFGHIJK	82.2	J	53.8	FG	259	BCDEF	28
SK-TR150	2	43.8	AB	95.2	AB	69	ABCDEFG	80.6	BCD	1.5	ABCD	12.1	AB	5.09	BCDEF	44.5	BC	133	DEF	79.9	AB	46	G	39
ND15477	6	35.6	BC	89.0	AB	77.7	A	79.5	CDEFGHI	1.4	ABC	12.9	AB	4.87	DEFG	39.4	DEFGH	175	AB	60.9	DEF	143	FG	37
PB1-95-2R-517	2	41.6	ABC	86.2	AB	59.3	GHI	76.3	K	2.1	DE	14.0	AB	3.67	H	28.1	L	83.6	IJ	38.5	H	648	A	14
PB1-95-2R-A629	2	42.7	ABC	84.8	AB	59.7	FGHI	76.9	JK	2.2	E	14.3	AB	3.73	H	27.6	L	99	HIJ	42.5	H	595	A	22
OR2967102	6	40.6	ABC	67.7	B	69	ABCDEFG	77.7	IJK	1.4	ABC	14.2	AB	5.03	CDEF	36.3	EFGHIJK	191	A	87.9	A	269	BCDEF	19
BA6B94-8253	6	38.7	ABC	91.6	AB	70.7	ABCDEF	79.1	DEFGHI	1.7	ABCDE	13.6	AB	5.35	ABCD	40.8	CDEF	170	AB	62.1	DEF	243	CDEF	37
93AB859	2	43.2	ABC	87.5	AB	62.7	DEFGHI	79.8	CDEFG	2.2	E	13.4	AB	4.86	DEFG	37.8	DEFGHIJ	150	BCDE	63.2	DEF	413		24
VALIER	2	38.4	ABC	82.8	AB	64.7	CDEFGHI	78.2	FGHIJ	1.3	A	14.6	B	4.63	DEFG	33.5	JK	135	CDEF	66.1	DE	413	BC	20
MTLB-05	2	38.7	ABC	82.3	AB	62.3	EFGHI	78.5	EFGHIJ	1.4	ABC	13.9	AB	4.65	DEFG	34.5	IJK	135	CDEF	69.0	CD	431	B	21
PB1-97-2R-7090	2	47.5	A	94.8	AB	56.7	HI	78.8	DEFGHI	1.4	ABC	14.3	AB	4.78	DEFG	34.8	HIJK	137	CDEF	63.0	DEF	406	BC	24
WA11801-95	2	39.8	ABC	81.1	AB	66	CDEFGH	77.9	HIJK	1.7	ABCDE	14.0	AB	4.68	DEFG	34.2	JK	118	FGH	58.6	DEF	360	BCD	23
WA11832-95	2	40.5	ABC	82.5	AB	70.3	ABCDEFG	78.0	GHIJK	1.3	AB	13.6	AB	4.30	FGH	32.1	K	75.7	J	46.0	GH	415	BC	20
BAB95-2482	6	36.1	BC	90.9	AB	74.7	ABC	79.2	CDEFGHI	1.7	ABCDE	13.2	AB	4.55	DEFG	36.1	FGHIJK	171	AB	55.6	EF	282	BCDEF	35
BA2B96-5038	2	45.1	AB	96.2	AB	65.7	CDEFGHI	82.5	A	1.9	BCDE	12.2	AB	5.92	A	50.7	A	122	EFGH	86.2	AB	128	FG	40
BA2B96-5119	2	42.2	ABC	94.0	AB	66.3	BCDEFGH	80.0	CDEF	1.5	ABCD	12.6	AB	4.75	DEFG	38.8	DEFGHI	111	FGHI	67.4	CD	279	BCDEF	33
2ND17274	2	44.2	AB	98.0	A	70.3	ABCDEFG	79.7	CDEFGH	1.6	ABCDE	14.2	AB	5.71	ABC	41.8	CD	120	FGH	69.1	CD	331	BCDE	36
ND15422	6	37.2	BC	89.7	AB	77.3	AB	79.6	CDEFGH	1.4	ABC	12.5	AB	4.89	DEFG	39.9	DEFG	176	AB	60.9	DEF	174	EFG	43
SK-CDC BOLD	2	43.3	ABC	88.6	AB	73.7	ABCD	81.9	AB	1.6	ABCDE	12.5	AB	5.20	ABCDE	44.5	BC	102	GHIJ	61.9	DEF	204	DEFG	41
SK-TR346	2	40.0	ABC	91.4	AB	72.7	ABCDE	81.0	ABC	1.4	ABC	11.8	A	4.64	DEFG	41.0	CDE	119	FGH	66.0	DE	127	FG	39

* 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; Pullman, WA and Powell, WY

2000 WESTERN REGIONAL SPRING 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 (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Quality Score	Overall Rank
3026	MOREX	6	39.4	94.6	72	79.8	1.3	2	14.1	5.26	37.7	186	59.9	299	32	21
3027	STANDER	6	39.9	95.0	70	81.1	1.6	1	13.7	6.28	47.2	153	77.1	272	37	11
3028	HARRINGTON	2	41.1	*83.4	62	78.4	1.2	1	15.2	4.68	33.1	117	53.2	404	28	27
3029	BA-6B93-2978	6	36.9	94.2	74	80.5	1.4	1	13.5	5.71	43.0	188	76.7	342	35	15
3030	WA9504-94	2	43.5	94.9	55	79.5	2.2	2	13.6	4.56	34.4	125	42.2	458	39	8
3031	MT910189	2	49.2	94.9	66	80.8	1.2	1	13.3	5.00	39.3	130	68.1	450	35	15
3032	WA118525-95	2	42.5	91.9	57	78.6	1.4	1	13.3	4.56	34.8	90	55.9	287	31	22
3034	SK-TR150	2	46.1	94.9	58	79.3	1.7	1	14.8	5.84	41.0	156	78.7	96	31	22
3035	ND15477	6	38.5	94.8	76	79.4	1.4	1	14.4	5.29	38.2	188	60.6	158	29	25
3036	PB1-95-2R-517	2	48.4	97.2	56	76.7	1.6	1	15.0	3.85	26.7	89	38.2	772	16	37
3037	PB1-95-2R-A629	2	48.8	96.1	53	77.4	2.2	2	14.9	4.03	28.4	100	47.2	737	22	34
3038	OR2967102	6	48.5	94.8	63	78.7	1.3	1	14.6	5.25	36.8	186	76.9	275	26	30
3039	BA6B94-8253	6	40.7	95.4	72	79.6	2.0	1	14.8	5.95	42.1	175	60.0	262	34	18
3040	93AB859	2	47.9	95.2	64	80.2	n.d.	3	14.2	5.18	37.8	151	60.0	511	20	36
3041	VALIER	2	42.6	94.4	66	78.6	1.4	1	15.0	4.93	35.2	135	62.5	439	27	28
3042	MTLB-05	2	43.2	95.4	64	79.0	1.6	1	14.5	5.07	36.3	132	65.0	549	27	28
3043	PB1-97-2R-7090	2	50.0	96.3	62	78.7	1.7	1	14.8	5.22	36.5	134	64.9	411	23	32
3044	WA11801-95	2	45.3	97.8	67	78.8	2.2	2	13.9	4.84	35.4	115	54.3	368	33	20
3045	WA11832-95	2	45.0	94.2	72	78.8	1.6	1	13.7	4.39	32.3	74	42.8	398	23	32
3046	BAB95-2482	6	39.2	94.7	71	79.7	2.0	2	13.8	4.70	36.8	185	49.2	301	37	11
3047	BA2B96-5038	2	49.7	98.0	60	83.3	1.9	1	11.7	5.86	50.9	117	85.1	181	45	4
3048	BA2B96-5119	2	46.1	96.4	63	79.1	1.6	1	14.2	5.18	36.6	124	64.6	348	26	30
3049	2ND17274	2	48.5	98.8	68	79.5	1.6	1	15.3	5.95	40.6	113	54.3	488	38	9
3050	ND15422	6	41.0	96.2	77	79.5	1.3	1	13.9	5.34	39.4	199	59.4	176	34	18
3051	SK-CDC BOLD	2	46.9	93.9	68	81.7	1.6	1	14.6	5.51	40.6	106	62.7	255	37	11
3052	SK-TR346	2	44.0	96.6	66	80.5	1.4	1	13.6	5.19	38.6	132	70.4	165	29	25
3054	B1614	6	40.4	94.0	70	79.8	1.6	1	14.2	5.84	43.8	160	60.4	207	37	11
3055	COLTER	6	42.0	90.4	65	81.4	1.4	1	10.5	4.23	42.3	99	48.2	272	42	7
3056	FOSTER	6	41.3	97.2	69	80.2	1.5	1	12.8	5.45	45.3	156	79.3	269	45	4
3057	92AB5180	6	40.8	90.1	59	81.5	1.5	1	11.7	5.26	46.7	140	59.6	263	53	1

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
3058	93AB375	6	41.4	94.7	64	83.9	1.7	1	11.4	5.65	50.7	120	67.4	262	38	9
3059	95AB15156	6	39.1	93.1	68	82.2	1.5	1	12.1	5.50	46.3	146	67.2	180	45	4
3060	96AB10452	6	39.9	96.2	70	81.0	1.8	1	13.6	6.51	48.6	131	67.1	334	31	22
3061	96AB10468	6	39.3	90.7	69	80.4	1.2	2	11.6	3.80	34.5	123	42.2	303	35	15
3062	97AB8333	6	37.0	91.0	64	81.2	n.d.	3	11.8	4.74	40.9	121	55.6	277	49	2
3063	98AB12362	6	41.0	97.2	77	81.0	1.7	2	12.5	5.28	43.8	171	58.4	106	49	2
3064	98AB12399	6	41.1	95.9	75	77.9	1.7	2	12.3	4.17	35.3	98	39.1	322	21	35
3033	HARRINGTON MALT CHECK	2	39.5	95.1	75	81.6	1.5	1	11.5	5.54	51.4	121	64.0	69	42	
3053	HARRINGTON MALT CHECK	2	40.6	94.3	74	81.6	1.4	1	10.8	5.42	51.1	113	71.4	125	48	
Minima			36.9	90.1	53	76.7	1.2		10.5	3.80	26.7	74	38.2	96	16	
Maxima			50.0	98.8	77	83.9	2.2		15.3	6.51	50.9	199	85.1	772	53	
Means			43.1	94.9	66	79.9	1.6		13.6	5.14	39.4	137	60.4	330	33	
Standard Deviations			3.8	2.1	6	1.5	0.3		1.2	0.66	5.7	32	11.8	150	9	
Coefficients of Variation			8.9	2.2	9	1.9	17.0		9.1	12.77	14.4	24	19.6	46	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

2000 WESTERN REGIONAL SPRING BARLEY NURSERY - PULLMAN, WA
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
3192	MOREX	6	35.1	82.2	76	78.0	1.3	1	13.4	4.45	35.7	148	57.2	222	31	17
3193	STANDER	6	36.7	90.9	73	79.9	1.5	1	12.9	5.29	43.4	143	80.0	162	46	5
3194	HARRINGTON	2	42.1	92.0	67	79.3	1.1	1	13.2	4.64	36.7	139	78.0	229	35	11
3195	BA6B93-2978	6	34.9	82.4	76	78.3	1.2	1	12.5	4.55	38.1	163	76.6	212	33	14
3196	WA9504-94	2	39.1	92.0	56	78.5	2.1	2	13.6	4.06	31.2	129	42.8	395	26	21
3197	MT910189	2	46.1	97.2	72	80.9	1.2	1	11.7	4.45	39.6	132	71.0	195	43	7
3198	WA11825-95	2	38.0	91.9	73	79.3	1.8	2	10.6	3.67	36.9	71	51.7	123	33	14
3199	SK-TR150	2	45.5	97.6	68	80.4	1.5	1	11.7	4.71	43.7	127	82.0	23	48	3
3200	ND15477	6	34.7	87.4	78	79.7	1.6	2	11.5	4.39	40.0	152	58.8	72	42	8
3201	PB1-95-2R-517	2	40.4	88.2	64	77.5	n.d	3	11.4	3.36	31.3	74	40.0	415	21	26
3203	PB1-95-2R-A629	2	42.1	91.9	66	78.1	n.d	3	11.5	3.30	29.6	86	39.8	463	28	18
3204	BCD 47	6	44.1	94.5	70	78.9	1.3	1	12.7	4.53	36.4	176	79.5	105	28	18
3205	BA6B94-8253	6	40.6	96.0	71	79.2	1.7	1	12.6	5.05	41.3	147	64.9	128	50	2
3206	93AB859	2	45.7	98.1	63	80.1	2.6	2	12.0	4.41	38.8	134	64.2	320	39	10
3207	VALIER	2	39.9	92.2	64	78.4	1.2	1	13.5	4.31	32.9	126	68.9	411	25	22
3208	MTLB-05	2	40.6	92.7	60	78.8	1.3	1	13.1	4.27	34.2	120	73.3	369	27	20
3209	PB1-97-2R-7090	2	49.1	97.1	*46	78.3	1.3	1	13.8	4.31	33.2	125	59.6	491	23	24
3210	WA11801-95	2	42.7	96.3	63	78.4	1.5	2	13.5	4.38	33.4	103	54.4	354	23	24
3211	WA11832-95	2	42.5	95.5	71	77.8	1.1	1	13.2	3.97	31.0	59	44.0	409	24	23
3212	BA6B95-2482	6	36.0	92.1	74	78.5	1.6	2	12.7	4.17	33.6	149	58.3	234	34	12
3213	BA2B96-5038	2	45.3	98.4	72	82.5	1.9	1	11.8	5.61	51.7	107	90.8	59	42	8
3214	BA2B96-5119	2	42.8	98.0	69	80.2	1.5	1	11.5	4.36	39.2	88	67.4	183	32	16
3215	2ND17274	2	42.7	98.5	67	79.0	1.7	1	13.6	5.44	42.4	118	76.8	277	34	12
3216	ND15422	6	37.4	92.6	73	79.6	1.5	1	12.0	4.46	37.6	159	58.9	95	47	4
3217	SK-CDC BOLD	2	44.1	90.9	73	81.2	1.6	1	12.2	5.04	42.7	107	66.5	192	51	1
3218	SK-TR346	2	40.2	94.4	67	80.5	1.4	1	11.7	4.42	38.9	107	65.8	93	46	5
3202	MOREX MALT CHECK	6	30.5	69.9	71	79.4	1.6	1	12.1	5.30	46.5	143	57.7	135	48	
Minima			34.7	82.2	56	77.5	1.1		10.6	3.30	29.6	59	39.8	23	21	
Maxima			49.1	98.5	78	82.5	2.6		13.8	5.61	51.7	176	90.8	491	51	
Means			41.1	93.1	69	79.3	1.5		12.5	4.45	37.4	123	64.3	240	35	
Standard Deviations			3.8	4.4	5	1.2	0.3		0.9	0.55	5.0	30	13.6	138	9	
Coefficients of Variation			9.3	4.8	8	1.5	22.4		7.1	12.33	13.4	24	21.2	57	27	

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 S.E. Ullrich, Washington State University - Pullman

2000 WESTERN REGIONAL SPRING BARLEY NURSERY AND ADDITIONS - POWELL, WY

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
3065	MOREX	6	32.8	74.5	67	79.1	1.6	1	14.0	5.74	43.4	152	70.6	396	37	7
3066	STANDER	6	32.3	76.3	69	79.8	1.7	1	12.8	6.03	48.9	160	80.3	310	29	12
3067	HARRINGTON	2	30.7	49.9	64	78.2	1.4	1	14.1	5.26	38.1	153	67.3	277	12	24
3068	BA6B93-2978	6	28.5	52.0	69	78.4	1.5	1	13.4	5.26	40.0	185	78.1	297	28	13
3069	WA9504-94	2	31.3	48.9	54	76.1	1.6	2	15.2	4.57	31.5	142	45.6	466	15	19
3070	MT910189	2	41.5	84.5	74	81.1	1.2	1	12.0	4.92	42.3	131	66.0	236	45	2
3071	WA11825-95	2	33.6	76.4	80	79.2	1.3	1	11.3	3.96	37.6	86	53.8	366	20	17
3072	SK-TR150	2	39.9	93.2	81	82.2	1.4	1	9.8	4.72	48.9	115	78.9	19	38	6
3073	ND15477	6	33.6	84.8	79	79.4	1.3	1	12.7	4.92	40.0	183	63.3	198	39	5
3074	PB1-95-2R-517	2	35.9	73.1	58	74.6	1.7	2	15.5	3.80	26.2	88	37.4	756	5	31
3075	PB1-95-2R-A629	2	37.3	66.5	60	75.1	1.5	2	16.5	3.87	24.8	111	40.6	584	15	19
3077	OR2967102	2	32.7	40.5	74	76.6	1.4	1	13.8	4.80	35.8	196	98.9	263	12	24
3078	BA6B94-8253	6	34.9	83.5	69	78.4	1.4	1	13.5	5.04	38.9	188	61.3	338	28	13
3079	ID93AB859	2	35.9	69.3	61	79.0	1.3	1	14.1	4.99	36.9	165	65.5	409	13	21
3080	VALIER	2	32.8	61.8	64	77.5	1.2	1	15.3	4.66	32.3	145	67.0	389	9	26
3081	MTLB-05	2	32.3	58.7	63	77.6	1.2	1	14.1	4.60	33.0	154	68.9	374	9	26
3082	PB1-97-2R-7090	2	43.3	91.0	62	79.5	1.3	1	14.2	4.80	34.8	151	64.4	316	26	15
3083	WA11801-95	2	31.5	49.3	68	76.4	1.3	1	14.5	4.82	33.7	138	66.9	359	13	21
3084	WA11832-95	2	33.9	57.7	68	77.3	1.3	1	14.0	4.54	32.9	93	51.3	438	13	21
3085	BA6B95-2482	6	33.1	85.9	79	79.4	1.6	2	13.0	4.79	37.8	180	59.5	312	34	9
3086	BA2B96-5038	2	40.3	92.1	65	81.7	1.9	1	13.0	6.29	49.5	142	82.6	145	33	11
3087	BA2B96-5119	2	37.7	87.5	67	80.8	1.3	1	12.1	4.71	40.7	121	70.2	306	41	3
3088	2ND17274	2	41.3	96.7	76	80.6	1.5	1	13.6	5.74	42.4	129	76.0	227	36	8
3089	ND15422	6	33.3	80.4	82	79.7	1.4	1	11.6	4.87	42.7	168	64.3	252	48	1
3090	SK-CDC BOLD	2	38.9	80.9	80	82.9	1.6	1	10.8	5.06	50.2	93	56.5	165	34	9
3091	SK-TR346	2	35.7	83.3	85	82.1	1.3	1	10.1	4.31	45.5	118	61.8	123	41	3
3092	MERIT	2	28.3	31.8	78	78.0	1.7	1	14.4	5.51	39.5	181	95.2	176	8	29
3093	ID90241	2	34.4	68.5	60	77.3	1.3	1	14.0	4.35	31.7	129	59.1	384	9	26
3094	ID93AB688	6	31.6	41.7	74	76.0	1.4	1	12.7	4.13	34.6	134	43.2	470	19	18
3095	GALENA	2	30.2	35.3	70	76.8	1.3	1	14.4	3.92	28.5	104	34.2	499	6	30

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
3096	B1202	2	33.3	63.2	68	77.8	1.2	1	13.2	4.69	36.0	126	56.3	309	21	16
3076	HARRINGTON MALT CHECK	2	39.3	94.8	75	81.6	1.4	1	11.5	5.41	49.8	128	71.2	45	42	
3097	HARRINGTON MALT CHECK	2	39.8	94.5	75	81.8	1.6	1	11.8	5.50	50.0	120	76.2	102	46	
Minima			28.3	31.8	54	74.6	1.2		9.8	3.80	24.8	86	34.2	19	5	
Maxima			43.3	96.7	85	82.9	1.9		16.5	6.29	50.2	196	98.9	756	48	
Means			34.9	70.6	70	78.8	1.4		13.2	4.87	38.8	140	64.6	312	25	
Standard Deviations			3.9	18.9	8	2.2	0.2		1.5	0.61	7.0	30	14.8	153	14	
Coefficients of Variation			11.1	26.8	11	2.8	12.1		11.6	12.46	18.1	22	23.0	49	55	

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 L. Bjornestad, University of Wyoming - Powell

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