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and

Wisconsin Agricultural Experiment Station and other State Experiment Stations, Cooperating

WESTERN REGIONAL SPRING BARLEY NURSERY - 2002 Crop
Preliminary Quality Report

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Detailed Data:
Idaho Falls, ID
Pullman, WA

Appendix:
Methods
Criteria for Quality Score

This is a joint progress report of cooperative investigations being conducted in the Agricultural Research Service of the U.S. Department of Agriculture and State Agricultural Experiment Stations. It contains preliminary data that have not been sufficiently confirmed to justify general release; interpretations may be modified with additional experimentation. Confirmed results will be published through established channels. The report is primarily a tool available to cooperators and their official staffs and for those persons who 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 – 2002 Crop

Nursery samples were received for malting quality evaluation from two experimental stations located in Idaho and Washington. The parentages of the nursery entries are listed in Table 1. Fourteen of 27 entries were new in this year's nursery.

These samples were germinated for 5 days and rotated for 3 minutes every 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 listed in Appendix A. The criteria and value assignments used to calculate quality scores have been revised this year and are listed in Appendix B. The most notable changes have been a wider range for acceptable diastatic power and α -amylase levels, a new range of 42 to 47% for S/T ratios and a lowering of the β -glucan upper limit from 300 to 200 ppm.

Individual station data are reported in Tables 2 and 3, and evaluations of that data are presented below. The same environmental conditions that affected the 2002 malting barley crop had a negative impact on this year's nursery. The statistical analyses that are usually performed on this nursery could not be done due to an insufficient number of locations providing samples of these experimental lines for quality evaluation.

Both malting and feed barleys were submitted from Idaho Falls, ID (Table 2). The ten feed barleys follow 98NZ223 and begin with Steptoe. These barleys were a bit thin, however most of them had good protein contents. The extract values of the malting lines were generally good, whereas those of the feed lines were poor. Most of the clear worts had good low turbidities, whereas those of slightly hazy or hazy clarity had high turbidities, as would be expected. The soluble protein levels varied from several that were too low, including nearly all feed barleys, to four that exceeded the desired limit. Over half of the S/T ratios were too low, including all from the feed barleys, whereas seven S/T values from the malting barleys were too high. The amylolytic levels of the malting lines were generally good, while those from the feed lines were lower. The β -glucan levels, which indicate the level of modification, ranged from very low in a couple lines (overmodified), to eighteen including all of the feed barleys that

exceeded the upper limit (undermodified). Another measure of modification, the F-C values, correlated well with the β -glucan levels with a few exceptions. The free amino nitrogen (FAN) levels ranged from less than 150 ppm in ten lines (mostly feed type) to over 250 ppm in four malting lines. Considering all quality traits, the best performers were Stander, 6B98-9940, Harrington, TR166 and 98AB12362.

Over half of the barleys from Pullman, WA (Table 3) were too thin; however their protein contents were generally quite good. A quarter of the extract values fell below the desired limits and six turbidity values exceeded twelve NTU. The soluble protein levels were generally quite good, but half of the S/T ratios were outside of the desired limits, with seven samples that were too high and seven that were too low. The α -amylase values all fell within the recently expanded acceptable limits, but eight samples had diastatic power levels that were too low. Half of the β -glucan contents exceeded the upper limit, whereas six FAN values exceeded 250 ppm. The best performers overall were ND15422, BCD47 and 6B98-9940.

Of the better performing lines, Stander, which was included as a check for this nursery, yielded quite typical results. The elevated soluble protein and free amino nitrogen levels detracted from Stander's otherwise good qualities, such as its plumpness, low β -glucan and high extract values. Harrington was also included in the nursery as a check, and it did quite well in Idaho Falls ranking third in quality score. At Pullman however, Harrington was thin, had high protein and β -glucan contents, and its extract value was low. These deficiencies moved this check to near the bottom in terms of performance at Pullman. A new entry, 6B98-9940 performed well at both locations. A lack of plumpness may be a problem, and the free amino nitrogen levels were quite high in the Pullman entry. This line appears to modify quickly and may have been overmodified with our malting schedule, resulting in the low β -glucan levels and higher soluble protein and FAN contents. BCD 47 has been in this nursery since 1999 and has performed well in the past. Once again, the Pullman submission had an excellent quality score with good amylolytic, soluble protein, β -glucan and FAN values. The submission from Idaho Falls did not do as well, mainly due to the thinness and high protein content of the barley and the development of high diastatic power levels in the malt. ND15422 had the best quality score of

the barleys submitted from Pullman and also performed well at Idaho Falls. This line tended to be a bit thin, had elevated diastatic power levels and its wort turbidities tended to be higher than desired. TR166 was new in this year's nursery and performed very well at Idaho Falls and pretty good at Pullman. This line appears to have a solid malt quality profile and would have scored even higher with a bit more plumpness and higher kernel weight. 98AB-12362 was also new in this year's nursery and performed reasonably well at both locations, however this line yielded slightly hazy worts and the resultant unacceptably high turbidities.

Entries in the Western Regional Spring Barley Nursery - 2002 Crop

Table 1

Entry No.	New Entry	Cultivar or Selection	Rowed	Parentage	Source
1		MOREX	6	Cree/Bonanza	St. Paul, MN
2		STANDER	6	Robust 2*/3/Cree/Bonanza//Manker/4/Robust/Bumper	St. Paul, MN
3		HARRINGTON	2	Klages/3/Gazelle/Betzes//Centenial	Saskatoon, SK
4		BCD 47 (OR2967102)	2	Harrington/Orca//D172(Shyri/Galena)	Corvallis, OR
5		MT960099	2	Manley/Baronesse	Bozeman, MT
6		MT970116	2	Klages/Baronesse	Bozeman, MT
7		ND15422	6	ND9712//ND11646/Stander	Fargo, ND - Horsley
8		CDC COPELAND (TR150)	2	WM861-5/TR118	Saskatoon, SK
9		CDC SELECT	2		CDC(1)
10	X	TR166 (SM97179)	2	BM8802-78/SM92252	CDC(1)
11	X	TR169 (SM98014)	2	TR247/SM93085	CDC(1)
12		WA8682-96	2	A308/Baronesse	Pullman, WA
13	X	WA8792-96	2		Pullman, WA
14	X	2B97-4004	2	2B91-4947/TR129	BARI (2)
15		2B97-4299	2	2B91-4947/2B91-4450	BARI (2)
16	X	2B98-5312	2	B1215/TR226/Baronesse	BARI (2)
17	X	6B98-9339	6	B1614/B1614/M75	BARI (2)
18	X	6B98-9940	6	6B92-7166/Stander	BARI (2)
19	X	94AB13449	6	Russel/M64	Aberdeen, ID
20	X	98AB12362	6	90Ab852/Excel	Aberdeen, ID
21	X	98AB12905	6	88Y315/82Ab519	Aberdeen, ID
22		95SR149C	2	Bancroft/Harrington	Aberdeen, ID
23		95SR316A	2	Bancroft/Crystal	Aberdeen, ID
24	X	97ID1269B	6	Stander*4/PI366450	Aberdeen, ID
25	X	98ID242	2	Baronesse/3/Crystal/Klages*3/PI366450	Aberdeen, ID
26	X	98-NZ015	2	Caminant{ant28-484(Grit)/Blenheim}/Baronesse	WSU, Wettstein
27	X	98-NZ223	2	Mut. Pant-667 in Harrington/Baronesse	WSU, Wettstein

(1) Busch Agricultural Resources, Inc. - Ft Collins, CO

(2) Canadian Development Corporation

2002 WESTERN REGIONAL SPRING BARLEY NURSERY - IDAHO FALLS, ID

Table 2

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agron)	Barley Protein (%)	Malt Extract (%)	F-C (%)	Wort Color	Turbidity (Hach)	Wort Clarity	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Quality Score	Overall Rank
4519	STANDER	6	35.0	83.9	80	12.3	80.2	1.2	1.7	6.2	1	5.61	48.2	146	69.5	116	258	60	1
4520	HARRINGTON	2	37.4	84.3	85	13.0	79.8	0.5	1.2	4.8	1	5.43	44.8	131	59.7	120	210	52	3
4521	BCD 47 (OR2967102)	2	40.6	76.3	76	14.3	78.3	1.4	1.5	4.1	1	5.68	42.6	186	72.4	123	226	32	19
4523	MT960099	2	40.7	55.8	83	13.1	79.4	1.8	1.6	3.8	1	5.84	46.0	133	69.8	119	230	44	9
4524	MT970116	2	40.7	85.9	81	12.3	78.5	1.9	1.1	7.2	1	4.29	36.0	105	41.5	267	112	31	21
4525	ND15422	6	33.9	69.8	86	12.6	78.8	0.6	1.2	12.1	1	5.01	41.8	185	53.4	93	204	45	8
4526	CDC COPELAND (TR150)	2	38.3	74.7	85	13.2	79.1	0.8	1.0	6.2	1	5.40	42.4	124	55.9	92	200	46	7
4527	CDC SELECT	2	35.8	81.8	82	13.4	80.2	1.1	1.1	6.5	1	5.76	44.2	135	64.0	65	229	39	14
4528	TR166 (SM97179)	2	36.9	86.6	79	12.9	79.2	1.6	1.2	5.7	1	5.36	43.0	138	68.4	104	218	52	3
4529	TR169 (SM98014)	2	37.4	78.1	83	12.7	80.6	1.0	1.3	5.9	1	6.23	50.3	125	78.8	123	251	40	11
4530	WA8682-96	2	37.5	77.6	81	13.2	77.8	2.2	1.4	18.1	1	4.73	37.4	94	48.7	345	164	17	31
4531	WA8792-96	2	41.3	86.8	81	13.8	76.8	1.8	1.3	22.0	1	4.63	34.3	83	45.0	269	149	19	29
4532	2B97-4004	2	35.3	64.4	76	13.4	80.4	1.6	1.4	5.3	1	6.54	52.4	137	67.2	77	259	31	21
4533	2B97-4299	2	38.0	82.6	76	13.3	79.9	0.8	1.3	4.8	1	5.95	46.7	149	72.0	69	231	39	14
4534	2B98-5312	2	37.0	64.4	79	12.1	80.0	0.5	1.4	4.2	1	5.40	48.1	119	79.0	65	238	40	11
4535	6B98-9339	6	34.0	80.3	76	13.7	79.7	0.5	1.6	7.1	1	6.01	47.0	135	68.4	20	308	38	17
4536	6B98-9940	6	35.7	72.1	80	13.0	79.4	0.9	1.2	5.2	1	5.42	43.0	177	53.1	34	235	53	2
4537	94AB13449	6	35.8	79.4	76	11.6	79.7	1.2	n.d.	36.0	3	5.11	47.3	127	45.6	98	194	49	6
4538	98AB12362	6	34.2	74.0	91	12.0	78.8	0.9	1.7	27.0	2	5.04	44.6	152	46.7	188	175	51	5
4539	98AB12905	6	35.6	76.1	79	11.5	81.3	1.7	1.5	5.4	1	6.13	56.4	106	66.4	217	264	32	19
4540	95SR149C	2	37.9	85.6	82	12.5	79.5	2.5	1.0	7.5	1	4.58	37.7	111	46.3	197	160	39	14
4541	95SR316A	2	40.8	89.7	83	12.6	80.4	1.7	1.1	6.1	1	4.88	40.6	118	60.8	168	179	43	10
4542	971D1269B	6	36.6	83.6	80	13.4	78.1	1.5	1.4	14.2	1	5.00	38.3	133	53.2	258	204	40	11
4543	981D242	2	40.9	79.3	82	13.4	77.9	1.7	1.0	5.2	1	4.20	33.3	106	53.9	207	167	22	25
4544	98-NZ015	2	37.3	74.8	68	13.7	76.5	2.4	n.d.	41.0	3	4.49	34.1	57	33.6	439	142	0	35
4545	98-NZ223	2	39.0	69.9	77	12.3	78.2	2.3	0.9	3.5	1	4.04	33.2	80	50.6	264	146	25	23
4546	STEPTOE	6	39.1	82.4	78	11.6	73.2	2.1	n.d.	*49.0	3	3.17	28.2	54	26.3	*767	100	20	27
4547	BARONESSE	2	37.8	74.6	86	13.7	74.0	2.1	n.d.	39.0	3	3.61	27.1	70	34.4	435	107	0	35
4548	BZ594-20	2	41.1	85.4	78	12.6	76.4	1.9	0.8	6.5	1	3.71	29.6	86	34.9	354	111	19	29
4549	BZ596-117	2	40.7	84.4	78	13.2	76.3	1.7	1.2	8.0	1	4.34	34.4	96	40.2	421	134	15	32

Table 2

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Barley Protein (%)	Malt Extract (%)	F-C (%)	Wort Color	Turbidity (Hach)	Wort Clarity	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Quality Score	Overall Rank
4550	MT960228	2	39.3	71.5	82	14.0	75.8	2.6	1.3	14.9	1	4.18	31.1	106	37.9	381	112	12	33
4551	PB1-95-2R-522	2	41.2	80.7	81	12.2	77.7	2.1	1.3	6.9	1	4.10	34.9	67	38.5	501	136	20	27
4552	PB1-97-2R-7090	2	42.4	85.2	78	13.8	79.5	1.2	1.3	2.7	1	5.19	39.2	128	54.1	242	214	38	17
4553	UT95B1216-4087	6	33.5	66.3	78	12.8	75.6	2.9	1.3	5.4	1	4.11	34.2	90	41.9	531	147	21	26
4554	UT97B1480-1632	6	39.3	76.7	67	13.2	76.2	2.1	1.4	5.6	1	4.50	35.0	103	42.4	420	160	24	24
4555	WA10147-96	2	36.1	76.8	78	13.6	75.4	3.6	*2.2	27.0	2	4.18	31.3	60	36.9	433	125	5	34
4518	HARRINGTON MALT CHECK	2	40.1	94.5	74	11.3	81.9	0.9	1.6	3.8	1	5.70	54.8	112	71.1	52	280	43	
4522	HARRINGTON MALT CHECK	2	39.6	94.4	73	11.5	81.6	0.6	1.6	4.6	1	5.66	53.7	107	66.7	73	224	46	
Minima			33.5	55.8	67	11.5	73.2	0.5	0.8	2.7		3.17	27.1	54	26.3	20	100	0	
Maxima			42.4	89.7	91	14.3	81.3	3.6	1.7	41.0		6.54	56.4	186	79.0	531	308	60	
Means			37.9	77.8	80	12.9	78.3	1.6	1.3	11.2		4.94	40.0	115	53.1	224	186	32	
Standard Deviations			2.5	7.6	5	0.7	2.0	0.7	0.2	10.6		0.82	7.2	34	14.1	148	53	15	
Coefficients of Variation			6.5	9.7	6	5.5	2.5	44.8	16.5	94.5		16.51	18.0	29	26.5	66	29	48	

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics

For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by D. B. Cooper, BARI - Ft. Collins, CO

2002 WESTERN REGIONAL SPRING BARLEY NURSERY - PULLMAN, WA
Table 3

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agron)	Barley Protein (%)	Malt Extract (%)	F-C (%)	Wort Color	Turbidity (Hach)	Wort Clarity	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Quality Score	Overall Rank
4430	MOREX	6	30.8	59.1	89	13.4	77.6	0.4	1.6	6.5	1	5.45	42.3	160	57.9	120	166	49	3
4431	STANDER	6	35.0	86.4	83	11.7	80.3	0.9	2.0	3.1	1	6.11	56.2	129	72.6	163	294	46	5
4432	HARRINGTON	2	34.3	69.5	86	13.6	77.7	1.4	1.5	3.9	1	5.36	39.7	124	67.6	210	206	23	24
4433	BCD 47	2	39.0	78.3	82	12.6	78.4	1.4	1.5	3.5	1	5.33	44.4	150	71.5	115	220	51	2
4434	MT960099	2	37.0	74.3	81	11.6	79.1	1.5	1.7	3.7	1	5.16	46.8	98	68.0	199	230	38	13
4435	MT970116	2	40.5	92.1	79	11.7	79.0	1.7	1.8	10.6	1	4.71	41.3	82	52.9	275	201	35	19
4436	ND 15422	6	33.7	71.9	87	12.3	78.9	1.4	1.9	14.4	1	5.47	47.8	174	56.1	100	295	52	1
4437	CDC COPELAND	2	37.8	86.2	82	12.6	79.3	0.9	1.5	3.5	1	5.37	45.0	119	72.6	62	163	45	6
4438	CDC SELECT	2	35.6	83.5	81	14.9	78.3	1.4	1.5	4.7	1	6.35	44.8	152	79.0	105	216	32	20
4439	TR 166	2	34.4	82.5	89	11.7	79.0	1.0	1.6	4.9	1	5.44	48.2	116	79.5	94	232	41	11
4440	TR 169	2	34.6	74.9	84	13.4	78.2	1.9	1.7	5.2	1	5.94	45.2	111	84.2	240	263	27	22
4441	BOB (WA 8682-96)	2	37.7	79.2	84	10.8	78.5	2.1	2.9	*46.0	2	4.76	44.3	74	52.7	375	174	25	23
4442	WA 8792-96	2	40.0	89.8	84	12.8	77.1	1.4	1.9	20.0	1	4.58	38.3	78	49.0	249	163	29	21
4443	2B97-4004	2	37.7	82.3	81	12.4	79.1	1.4	1.6	8.1	1	4.94	41.6	128	72.6	247	149	37	15
4444	2B97-4299	2	37.2	85.7	80	10.9	80.4	1.2	1.4	5.3	1	4.65	43.1	118	73.6	237	180	36	17
4445	2B98-5312	2	33.2	42.6	83	12.5	77.9	1.5	1.6	4.2	1	5.31	43.9	121	79.5	229	275	38	13
4446	6B98-9339	6	32.0	70.4	85	13.0	78.9	0.4	1.9	4.5	1	5.88	46.2	135	73.3	69	388	45	6
4447	6B98-9940	6	31.5	54.7	88	11.9	78.2	1.3	1.9	4.7	1	5.71	48.2	151	54.3	89	326	47	4
4448	94AB13449	6	33.5	75.4	75	10.6	80.2	1.0	2.7	28.0	2	5.07	50.3	107	54.7	67	195	37	15
4449	98AB12362	6	36.8	90.9	85	11.0	79.6	0.6	3.2	*50.0	2	5.17	49.8	129	54.3	164	272	43	10
4451	98AB12905	6	34.9	89.6	74	11.0	81.0	0.7	2.2	6.4	1	5.95	54.8	123	70.2	285	246	41	11
4452	95SR149C	2	30.4	59.2	88	14.3	74.7	2.2	1.5	10.2	1	4.54	31.8	107	49.1	345	139	16	27
4453	95SR316A	2	37.2	85.5	87	12.0	80.1	1.9	1.7	6.7	1	4.93	42.2	107	66.3	334	160	45	6
4454	97ID1269B	6	30.1	51.1	91	12.8	76.4	0.8	2.3	7.1	1	5.44	43.6	147	57.6	190	241	45	6
4455	98ID242	2	41.0	86.5	90	11.1	80.5	1.5	1.9	5.5	1	4.63	45.9	94	57.8	242	167	36	17
4456	98NZ015	2	36.0	85.4	72	11.5	78.0	2.5	2.9	25.0	2	4.53	41.6	45	39.7	448	148	21	25
4457	98NZ223	2	32.6	61.1	85	10.3	79.3	0.9	1.8	6.6	1	3.90	38.8	76	58.1	191	139	21	25
4450	HARRINGTON MALT CHECK	2	38.7	94.3	75	11.6	82.0	1.5	1.9	5.7	1	5.76	52.0	100	65.1	81	278	50	
Minima			30.1	42.6	72	10.3	74.7	0.4	1.4	3.1		3.90	31.8	45	39.7	62	139	16	
Maxima			41.0	92.1	91	14.9	81.0	2.5	3.2	28.0		6.35	56.2	174	84.2	448	388	52	
Means			35.3	75.9	84	12.2	78.7	1.3	1.9	8.3		5.21	44.7	117	63.9	202	220	37	
Standard Deviations			3.1	13.4	5	1.1	1.4	0.5	0.5	6.7		0.57	5.0	30	11.5	101	62	10	
Coefficients of Variation			8.6	17.7	6	9.4	1.7	40.3	25.0	81.0		10.96	11.2	25	18.0	50	28	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

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 Agron M45-D 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 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 roll mill that was adjusted so that 75% of the grist remained on a 525 μm sieve. Ground malts for moisture, protein and amyolytic 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 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 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).

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

2002 Crop Year

Quality Score Parameters for 2- and 6-rowed barleys

Quality parameter	2-rowed		6-rowed	
	condition	score	condition	score
Kernel Weight (mg)	> 42.0	5	> 32.0	5
	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 (% db)	≥ 81.0	10	≥ 79.0	10
	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=hazy 2=slightly hazy 1=clear	= 3	0	= 3	0
	= 2	1	= 2	1
	= 1	2	= 1	2
Barley Protein (% db)	≥ 13.5	0	≥ 14.0	0
	13.0–13.5	5	13.5–13.9	5
	11.5–13.0	10	11.5–13.5	10
	≤ 11.5	5	≤ 11.5	5
Wort Protein (% db)	> 6.0	0	> 6.0	0
	5.6–6.0	3	5.7–6.0	3
	4.9–5.6	7	5.2–5.7	7
	4.5–4.9	3	4.8–5.2	3
	< 4.5	0	< 4.8	0
S/T (Soluble/Total Protein, % db)	> 47	0	> 47	0
	42–47	5	42–47	5
	< 42	0	< 42	0
DP (Diastatic Power, ° ASBC)	> 180	0	> 200	0
	160–180	4	180–200	4
	120–160	7	140–180	7
	100–120	4	120–140	4
	< 100	0	< 120	0
Alpha-amylase (20° DU)	> 90	0	> 90	0
	80–90	4	80–90	4
	45–80	7	45–80	7
	35–45	4	35–40	4
	< 35	0	< 35	0
Beta-glucan (ppm)	< 40	0	< 40	0
	40–60	3	40–80	3
	60–115	7	80–140	7
	115–200	3	140–200	3
	> 200	0	> 200	0