

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

**MISSISSIPPI VALLEY REGIONAL SPRING BARLEY NURSERY
2007 Crop**

Preliminary Quality Report

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Detailed Data:

Morris, MN

Sidney, MT

Appendix:

Methods

Criteria for Quality Score

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

This report includes data furnished by the Agricultural Research Service and by the State Agricultural Experiment Stations. The report is not intended for publication and should not be referred to in literature citations nor quoted in publicity or advertising. Use of the data may be granted for certain purposes upon written request to the agency or agencies involved.

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

June 2008
CCRU-MWA-127

Mississippi Valley Regional Spring Barley Nursery – 2007 Crop

Nursery samples were received for malting quality evaluation from two experimental stations located in Minnesota and Montana. The parentages of the nursery entries are listed in Table 1. Thirteen of the forty entries were new in this year's nursery.

These samples were germinated for four days in Joe White micro-malters under conditions that should generate malts having modification levels similar to those produced by industry. Detailed descriptions of the malting conditions and analytical methods employed are listed in Appendix A. The criteria and value assignments, based upon AMBA guidelines (<http://www.ambainc.org/ni/Guidelines%202004.pdf>) used to calculate quality scores are listed in Appendix B.

A change of note was the replacement of the 6/64" sizing screen. It was brought to our attention that our plumpness values were generally lower in a comparative test. We obtained a new screen and confirmed this observation, concluding that our "old" screen was worn. In general, very plump samples generated similar results on the two screens, while plumps in the 70 – 80% on the "new screen were being underestimated on the worn screen by 5 – 15% and those lines that were even thinner, by as much as 20%. As such, the "old" screen was too stringent on barley submissions from past years, underestimating their plump values.

Individual station data are reported in Tables 2 and 3. Evaluations of data from the individual locations are presented below. Statistical analyses were not performed on the nursery since submissions came from only two locations.

The barleys grown in Morris, MN (Table 2) were very plump and nearly all had good protein contents. Extract values were very good, except as would be expected, that of Barbless. Most viscosities, free amino nitrogen (FAN) values and fine – coarse (F-C) differences were good. Only two lines had unacceptably low soluble protein values, probably due to their lower total protein contents. The S/T ratios varied from eight that were too low to eight that exceeded the desired

limit. Amylolytic values were generally good, with only four lines having unacceptably low diastatic power levels. Fourteen β -glucan levels exceeded the upper desired limit, while only three turbidities were too high to be considered “ideal”. Lines ND20448, SR412 and 6B02-3120 had the highest possible quality score of 65, indicating all quality parameters were within an “ideal” range. Other lines scoring very well and higher than the Morex and Conlon experimental checks were ND20666, Lacey, Stellar-ND, M124, ND22421, 6B03-4478, Legacy, 2ND21867, SR417, 6B01-2218, 6B01-2513, M128 M133 and SR420. These lines deviated only slightly from the “ideal” on one or two quality parameters. All of the above lines show great potential for yielding commercial quality malt.

The barleys from Sidney, MT (Table 3) were very plump and most had good protein contents. Extract values were very good, averaging 80% and only three F-C differences were too high. The soluble protein and FAN values were generally good. S/T ratios ranged from ten that were unacceptably low, to nine that exceeded the upper limit. Seven diastatic power values were unacceptably low, while all α -amylase values were good. Seven turbidities and fourteen β -glucan levels exceeded the desired limits. The best performers were Lacey, SR412, ND22421, 2ND22927, M128, M133, 6B01-2218, Legacy, M124, 6B02-3435, Stellar-ND, 6B01-2513, and SR410.

The submissions from both locations performed very well, with quality scores averaging over 50. The barleys were generally very plump, with good protein contents. The extract, soluble protein, FAN, turbidity, and α -amylase values were consistently very good. The indicators of carbohydrate modification, F-C and β -glucan content, yielded conflicting information. Only 12% of the F-C differences exceeded desired levels, while 40% of the β -glucan levels were too high. In each case, the exceeded limits suggest poor modification.

The best performing lines in the Mississippi Valley Nursery were SR412, Lacey, ND22421, ND20448, 2ND21867, M124, Stellar-ND, 6B01-2218 and M133. SR412 averaged the maximum score of 65. This line was plump, with excellent extract values and a good protein profile. The enzyme levels were high and similar to Legacy. SR412 had excellent viscosity, turbidity, FAN and β -

glucan values. Lacey had excellent malt quality and would also have gotten a maximum score, except for a slightly elevated β -glucan level of 128ppm in the wort from the Morris location. ND22421 showed excellent quality. This line's amyolytic activity was lower than that of the Morex check, though still acceptable. ND20448 performed very well at Morris and quite well at Sidney, however its S/T ratio at Sidney was a bit low. 2ND21867 showed very good malt quality, except that total protein content was about 0.5% less than Conlon and probably due to this, its enzyme package was lower than the experimental check. M124 had good malting quality, except for slightly elevated β -glucan levels when malted with our standard protocol. Stellar-ND had a low soluble protein value at Sidney, which resulted in a low S/T ratio. This variety had ample enzyme activity. 6B01-2218 showed excellent malt quality, but was the thinnest submission at Morris and had a slightly depressed S/T ratio at Sidney. This line has an enzyme package similar to that of Tradition. M133 performed very well, but the submission from Morris had a low S/T ratio caused by a slightly depressed soluble protein value.

The quality results of this year's nursery were very good; certainly the best in the last decade. Some of the higher scoring could be attributed to the change in plumpness measurement, however most other parameters were very good, suggesting balanced modification for most of these lines.

2007 MISSISSIPPI VALLEY UNIFORM REGIONAL BARLEY NURSERY

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 613603	Lacey	M78/M79
6.	North Dakota	Conlon	Bowman*2/Brigitta mutant//ND10232
7.	Busch Ag. Res.	Tradition	6B89-2126/ND10981
8.	North Dakota	Stellar-ND	Foster//ND12200/6B88-3213
9.	North Dakota	ND20299	ND16924/ND17082
10.	North Dakota	ND20448	ND16918/C98-10-155-3
11.	North Dakota	Pinnacle (2ND21863)	ND1872/ND19130
12.	Busch Ag. Res.	6B01-2218	6B94-7378 // B2027 / M84
13.	Busch Ag. Res.	6B01-2513	LEGACY / 6B95-6311
14.	Minnesota	M128	FEG26-50 / FEG18-27
15.	Minnesota	M129	FEG59-09 / M110
16.	North Dakota	ND20666	ND17008 / ND17239
17.	North Dakota	ND21306	DRUMMOND*2 / FEG4-66L
18.	North Dakota	2ND21867	ND18172 / ND19130
19.	North Dakota	2ND22927	Rawson sib / ND19931
20.	Saskatchewan	SR410 (SM03152)	BT471 / SM98231
21.	Saskatchewan	SR412 (SM03219)	BT459 / BT941
22.	Minnesota	M124	M96-186 / M109
23.	Minnesota	M130	FEG26-50 / FEG18-27
24.	Minnesota	M132	M96-203 / FEG55-14
25.	Minnesota	M133	Sep2-02 / M112
26.	North Dakota	ND22421	ND18546 / ND19656
27.	North Dakota	ND23311	ND19656 / ND19718
28.	North Dakota	ND22182	ND18413 / ND19134 // ND19164
29.	Busch Ag. Res.	6B02-3120	6B94-7378 // 6B94-7378 / 6B95-2089
30.	Busch Ag. Res.	6B02-3200	6B94-8253 // LEGACY / 6B95-2201
31.	Busch Ag. Res.	6B02-3435	6B97-2262 / 6B96-3286
32.	Busch Ag. Res.	6B03-4478	6B98-9438 / 6B97-2311
33.	Saskatchewan	SR 417 (SM04166)	SM99250 / SM99142
34.	Saskatchewan	SR 420 (SM04175)	SM99748 / SM99153

*Entries 22-34 are new for 2007.

2007 MISSISSIPPI VALLEY REGIONAL SPRING BARLEY NURSERY - MORRIS, MN

Table 2

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Viscosity	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN	Turbidity	pH	Quality Score	Overall Rank
5323	Barbless	6	35.6	90.5	51	*76.1	1.4	1.47	1.8	1	13.1	4.89	37.7	156	55.4	296	289	5.0	5.98	39	32
5324	Morex	6	32.1	82.8	54	79.6	1.0	1.46	1.7	1	12.8	5.10	42.2	169	76.6	177	336	3.8	6.01	54	19
5325	Robust	6	35.1	91.2	54	79.3	0.6	1.45	1.7	1	12.7	5.12	41.2	177	63.3	221	276	3.6	5.98	49	28
5326	Legacy	6	32.7	89.5	59	79.3	0.8	1.46	1.9	1	12.5	5.59	46.2	177	84.6	302	388	3.5	5.95	58	10
5327	Lacey	6	35.7	94.5	53	79.7	0.8	1.43	1.8	1	13.0	5.24	43.1	165	70.4	128	272	4.9	5.97	61	5
5328	Conlon	2	43.8	97.6	53	80.2	0.8	1.44	1.7	1	12.9	4.94	40.1	131	69.2	213	244	3.7	5.96	55	18
5329	Tradition	6	35.1	91.2	65	78.8	0.9	1.47	1.6	1	13.0	5.11	39.8	198	70.1	151	344	3.7	6.00	49	28
5330	Stellar ND	6	35.9	97.4	65	79.6	0.4	1.47	2.0	1	12.7	5.31	42.2	192	75.0	121	282	4.3	5.93	61	5
5331	ND20299	6	34.9	95.8	66	79.4	1.3	1.50	1.9	1	12.1	4.84	42.5	163	67.2	225	218	7.6	5.97	54	19
5332	ND20448	6	35.7	95.8	70	79.2	0.7	1.47	1.9	1	12.1	5.29	45.1	163	75.1	93	246	4.5	5.93	65	1
5333	Pinnacle	6	42.5	93.1	60	80.9	0.6	1.49	1.6	1	*10.5	4.32	42.9	98	60.2	187	184	3.2	5.98	39	32
5334	6B01-2218	6	29.0	*78.9	63	78.9	1.2	1.44	1.8	1	13.1	5.43	43.3	191	75.4	98	245	5.0	5.95	57	13
5335	6B01-2513	6	33.6	90.6	64	79.0	0.8	1.43	2.0	1	12.7	5.58	47.1	183	86.0	80	258	4.0	5.92	57	13
5336	M128	6	34.8	86.4	63	80.1	0.9	1.46	2.1	1	12.2	5.41	47.8	174	72.6	152	253	4.5	5.97	56	15
5337	M129	6	37.4	97.2	58	80.5	1.1	1.45	2.4	1	12.7	5.84	47.6	148	72.5	165	305	4.1	5.87	52	25
5338	ND20666	6	37.8	97.8	53	78.6	0.8	1.48	1.9	1	12.7	5.28	43.4	161	72.0	109	241	4.6	5.95	62	4
5339	ND21306	6	33.3	89.2	59	79.2	1.6	1.51	1.8	1	12.7	4.95	41.6	155	62.0	280	224	4.3	6.00	49	28
5342	2ND21867	2	45.5	97.3	58	81.0	1.1	1.44	1.5	1	12.2	4.94	41.5	121	53.9	143	213	2.5	5.92	58	10
5343	2ND22927	2	46.7	96.1	53	81.4	1.1	1.50	2.5	2	11.7	5.22	45.3	84	60.2	372	256	*17.2	5.92	50	27
5344	SR410	6	37.0	92.3	61	79.4	0.8	1.47	2.2	1	12.2	5.46	47.5	155	78.4	211	269	2.5	5.91	53	21
5345	SR412	6	35.0	92.2	60	80.5	0.9	1.44	2.0	1	11.9	5.33	46.9	171	82.9	101	276	2.6	5.91	65	1
5346	M124	6	36.1	92.6	57	80.4	0.8	1.47	1.8	1	12.5	5.39	46.8	188	71.0	162	257	3.8	5.99	61	5
5347	M130	6	35.7	91.6	63	79.5	1.0	1.48	2.1	1	12.3	5.37	47.4	157	72.8	262	262	4.5	5.98	53	21
5348	M132	6	37.0	99.0	62	80.1	1.2	1.48	1.9	1	11.5	5.52	48.2	174	74.8	294	281	2.8	5.91	53	21
5349	M133	6	33.7	93.1	61	79.9	0.6	1.45	1.8	1	12.3	4.94	41.4	157	64.1	116	226	4.5	6.01	56	15
5350	ND22421	6	37.3	94.6	57	79.5	0.7	1.48	1.9	1	12.5	5.16	43.2	151	64.6	112	241	6.0	5.96	61	5
5351	ND23311	6	36.4	93.9	51	81.1	1.8	1.53	2.6	1	*10.3	4.70	48.9	54	59.8	396	233	*13.8	5.91	34	34
5352	2ND22182	2	49.3	94.8	51	80.6	0.8	1.47	2.3	2	12.3	4.68	39.5	73	59.4	190	216	*20	5.93	42	31
5353	6B02-3120	6	36.2	97.9	61	79.5	0.6	1.45	1.8	1	12.3	5.27	43.8	153	71.3	96	242	3.9	5.94	65	1
5354	6B02-3200	6	38.6	95.7	59	78.7	0.6	1.45	2.0	1	13.8	5.67	41.5	194	70.9	63	295	4.8	5.92	52	25

Table 2

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Viscosity	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN	Turbidity	pH	Quality Score	Overall Rank
5355	6B02-3435	6	33.1	89.6	62	78.8	0.6	1.46	1.8	1	13.4	5.17	39.7	214	79.5	62	319	5.4	5.97	53	21
5356	6B03-4478	6	36.0	90.6	56	79.4	0.3	1.44	2.0	1	13.4	5.42	42.9	174	70.2	132	258	4.4	5.93	61	5
5357	SR417	6	38.2	91.4	57	78.6	0.6	1.44	2.2	1	12.5	5.32	43.9	141	65.2	153	269	4.6	5.93	58	10
5358	SR420	6	35.8	90.3	61	80.6	0.3	1.44	2.3	1	12.5	5.60	47.4	141	77.7	145	398	4.3	5.90	56	15
5340	HARRINGTON MALT CHECK	2	37.6	95.1	80	81.0	1.0	1.50	1.9	1	12.7	5.40	43.0	127	73.2	136	236	6.2	5.94	56	
5341	MOREX MALT CHECK	6	35.3	96.2	81	80.3	1.1	1.50	2.4	1	12.5	5.68	49.0	133	63.0	112	273	6.3	5.87	57	
Minima			29.0	82.8	51	78.6	0.3	1.43	1.5		11.5	4.32	37.7	54	53.9	62	184	2.5	5.87	34	
Maxima			49.3	99.0	70	81.4	1.8	1.53	2.6		13.8	5.84	48.9	214	86.0	396	398	7.6	6.01	65	
Means			36.8	93.1	59	79.7	0.9	1.46	1.9		12.6	5.22	43.8	156	70.1	177	268	4.2	5.95	54	
Standard Deviations			4.2	3.6	5	0.8	0.3	0.02	0.3		0.5	0.32	3.0	35	8.0	85	47	1.0	0.03	7	
Coefficients of Variation			11.5	3.9	8	1.0	38.8	1.60	13.6		3.9	6.09	6.8	23	11.4	48	17	24.5	0.59	14	

Malt Check Data are Excluded from Rank Sorting and Statistics

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

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

Samples Submitted by K. Smith, University of Minnesota - St. Paul

2007 MISSISSIPPI VALLEY REGIONAL SPRING BARLEY NURSERY - SIDNEY, MT

Table 3

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Viscosity	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN	Turbidity	pH	Quality Score	Overall Rank
5274	Barbless	6	34.9	91.4	63	*75.3	1.7	1.45	1.9	2	15.1	4.74	32.0	135	45.8	317	233	15.5	5.92	22	34
5275	Morex	6	35.1	91.8	68	78.9	1.4	1.44	1.9	1	13.9	5.13	39.6	183	65.4	134	234	7.3	5.97	44	30
5276	Robust	6	35.3	93.9	70	79.4	0.9	1.44	2.7	1	14.0	5.38	39.3	170	51.6	158	289	8.1	5.87	46	25
5277	Legacy	6	33.7	92.6	73	79.8	1.0	1.44	2.0	1	13.2	5.62	45.4	190	80.7	171	368	5.1	5.90	58	7
5278	Lacey	6	37.4	96.9	73	79.8	0.4	1.43	2.0	1	13.4	5.43	42.8	171	69.5	84	330	7.9	5.90	65	1
5279	Conlon	2	46.0	97.9	62	79.6	0.8	1.44	1.9	1	13.5	5.25	38.9	151	67.1	120	301	6.8	5.89	43	31
5280	Tradition	6	35.3	91.9	73	79.0	0.8	1.46	2.0	2	13.6	5.01	38.2	201	68.3	112	301	19.5	5.97	47	24
5281	Stellar ND	6	35.3	93.7	71	79.3	0.9	1.45	1.9	1	12.8	4.91	40.0	197	70.6	57	289	14.8	5.95	56	11
5282	ND20299	6	36.2	96.0	72	79.6	1.2	1.48	n.d.	3	12.9	5.10	42.6	177	61.5	153	298	*67	5.94	55	15
5283	ND20448	6	35.0	96.1	75	78.9	0.7	1.46	1.9	1	13.5	5.36	40.9	176	66.3	113	309	9.0	5.87	57	8
5284	Pinnacle	2	46.8	98.0	64	81.4	0.5	1.49	2.1	1	11.8	4.84	41.6	96	55.4	163	275	9.8	5.85	51	17
5285	6B01-2218	6	33.6	94.7	69	79.7	0.5	1.43	1.9	1	13.4	5.54	41.5	191	72.9	70	334	6.4	5.87	60	6
5286	6B01-2513	6	34.9	92.8	73	79.2	0.5	1.42	2.1	1	13.8	5.87	42.9	189	78.5	73	369	7.6	5.88	56	11
5287	M128	6	38.0	92.6	70	80.2	0.8	1.45	2.1	1	13.0	5.66	45.1	176	69.7	130	311	7.6	5.90	56	11
5288	M129	6	37.2	94.0	69	80.9	0.3	1.43	2.5	1	12.4	6.05	49.0	150	78.5	110	448	6.4	5.85	53	16
5289	ND20666	6	36.4	95.9	70	78.5	0.1	1.46	2.1	1	13.6	5.12	38.8	162	75.8	54	248	5.4	5.87	48	22
5290	ND21306	6	33.9	92.9	73	79.5	1.0	1.47	1.8	1	12.6	4.84	39.3	147	60.9	176	283	9.4	5.94	49	19
5291	2ND21867	2	44.8	97.8	62	81.1	0.8	1.43	1.8	1	12.8	5.13	40.5	117	56.1	85	307	5.3	5.83	62	3
5292	2ND22927	2	46.8	97.7	68	82.2	0.6	1.50	2.8	2	11.1	5.25	49.9	72	60.0	194	369	*26	5.85	45	29
5293	SR410	6	37.4	94.8	71	80.3	0.7	1.43	2.1	1	11.9	5.35	48.6	154	80.5	122	376	4.7	5.88	56	11
5294	SR412	6	36.1	96.0	69	80.7	0.6	1.43	2.1	1	12.8	5.49	44.0	185	87.7	59	319	6.5	5.87	65	1
5297	M124	6	35.5	90.0	69	80.7	0.6	1.45	1.9	1	12.2	5.03	43.3	151	73.8	150	323	9.8	5.98	57	8
5298	M130	6	36.3	94.4	69	80.6	1.1	1.46	2.4	1	12.7	5.90	48.4	147	67.2	216	424	3.9	5.87	49	19
5299	M132	6	35.9	95.9	74	80.4	0.7	1.48	2.4	1	13.1	5.84	47.1	122	65.5	318	458	3.4	5.81	46	25
5300	M133	6	35.8	93.9	72	80.3	0.3	1.45	2.0	1	12.9	5.40	43.9	148	61.9	135	315	4.4	5.91	61	5
5301	ND22421	6	35.9	95.7	69	79.6	0.2	1.46	2.3	1	13.0	5.49	44.7	133	61.9	101	277	5.4	5.88	62	3
5302	ND23311	6	35.4	93.2	64	82.0	1.1	1.52	*3.7	2	10.8	5.03	51.4	56	56.8	*442	361	*32	5.80	36	33
5303	2ND22182	2	*50.8	97.7	*54	81.0	0.8	1.53	2.5	1	12.7	4.99	40.5	62	49.6	*424	245	19.6	5.88	48	22
5304	6B02-3120	6	35.6	95.5	72	80.7	1.1	1.48	2.3	1	13.0	5.56	46.4	119	56.3	184	286	5.8	5.86	51	17
5305	6B02-3200	6	38.8	97.4	65	79.6	0.8	1.48	2.7	1	13.7	5.90	44.3	152	58.3	174	238	5.0	5.79	49	19

Table 3

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Viscosity	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN	Turbidity	pH	Quality Score	Overall Rank
5306	6B02-3435	6	34.5	95.1	63	78.9	0.5	1.46	2.0	1	13.5	5.56	42.8	187	64.3	103	357	4.9	5.89	57	8
5307	6B03-4478	6	36.6	94.4	71	80.7	1.1	1.47	2.5	1	13.4	6.13	48.2	143	59.6	200	357	4.2	5.85	46	25
5308	SR417	6	37.6	93.2	69	79.6	1.1	1.45	2.8	1	12.0	5.60	48.3	112	58.3	195	277	6.3	5.87	46	25
5309	SR420	6	36.1	92.2	73	81.3	0.8	1.46	2.8	1	12.5	5.95	50.2	106	65.5	196	349	5.2	5.84	42	32
5295	HARRINGTON MALT CHECK	2	38.4	95.2	80	80.9	0.0	1.49	1.7	1	13.0	5.32	44.0	133	77.2	79	282	8.7	5.95	54	
5296	MOREX MALT CHECK	6	35.7	95.1	77	80.7	0.2	1.47	2.2	1	13.1	5.57	45.5	138	75.2	81	291	6.6	5.90	62	
5310	HARRINGTON MALT CHECK	2	36.4	95.3	79	81.2	0.7	1.48	2.1	1	13.5	5.58	43.5	105	70.7	106	298	6.2	5.93	48	
5311	MOREX MALT CHECK	6	36.0	95.6	79	80.8	0.8	1.49	2.7	1	12.3	5.83	49.9	109	65.9	135	350	6.4	5.91	45	
Minima			33.6	90.0	62	78.5	0.1	1.42	1.8		10.8	4.74	32.0	56	45.8	54	233	3.4	5.79	22	
Maxima			46.8	98.0	75	82.2	1.7	1.53	2.8		15.1	6.13	51.4	201	87.7	318	458	19.6	5.98	65	
Means			37.1	94.6	69	80.1	0.8	1.46	2.2		13.0	5.39	43.5	148	65.4	145	319	7.8	5.88	51	
Standard Deviations			3.6	2.1	4	0.9	0.3	0.03	0.3		0.8	0.38	4.3	38	9.5	65	57	4.2	0.05	9	
Coefficients of Variation			9.7	2.2	5	1.1	44.7	1.79	14.5		6.5	6.98	9.9	26	14.6	45	18	53.9	0.78	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. B. Cooper and C. Allen, Busch Ag. Resources, Inc., Ft. Collins, CO

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. **New screens were used**, resulting in higher plumpness values than in previous years.

Barley Color The brightness of the grains was measured using an Agron 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) aliquots of barley were processed in Joe White micro-malters. Samples were hydrated to 47% moisture via a 31 h steep at 19°C: 8 h wet, 8 h air, 4 h wet, 5 h air, 2 h wet, 2 h air, 2 h wet. (Larger barleys, > 42 mg/kernel, received a continuous, wet pre-steep (16°C) of between 2 and 7 h). The samples were germinated for 48 h (18°C), 24 h (17°C), and 24 h (16°C), with moisture adjustment to 47% at 0, 24, and 48 h. The samples received 4 full turns every 2 h. The germinated grain was kilned for 24h as follows: 49°C, 10 h; 54°C, 4 h; 60°C, 3 h; 68°C, 2 h; and 85°C, 3 h, with 30 min. ramps between stages. All stages received 40% total flow, with 0% recirculation for stages 1-3, 50% for stage 4, and 75% for stage 5.

Malt Mill Fine-grind malts were prepared with a Miag laboratory cone mill that was adjusted so that 10% of the grist remained on a 525 µm sieve after 3 min of shaking, with tapping. Coarse-grind malts were prepared with a corrugated roller mill that was adjusted so that 75% of the grist remained on a 525 µm sieve. Malts to be used for moisture, protein and amyolytic 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-6C (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

2007 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	0	= 3	0	
	3=hazy	= 2	1	= 2	1
	2=slightly hazy	= 1	2	= 1	2
	1=clear				
Barley Protein (% db)	≥ 13.5	0	≥ 14.0	0	
	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 (% db)	> 6.0	0	> 6.0	0	
	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 Protein, % db)	>47	0	>47	0	
	40–47	5	42–47	5	
	< 40	0	< 42	0	
DP (Diastatic Power, ° ASBC)	>120	7	>140	7	
	100–120	4	120–140	4	
	< 100	0	< 120	0	
Alpha-amylase (20° DU)	>45	7	>45	7	
	40–45	4	40–45	4	
	< 40	0	< 40	0	
Beta-glucan (ppm)	< 100	7	<120	7	
	100–150	3	120 – 170	3	
	> 150	0	> 170	0	