

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

**MISSISSIPPI VALLEY SPRING BARLEY NURSERY
2017 Crop**

Malting Quality Data

*Cereal Crops Research Unit Staff

Detailed Data:

Aberdeen, ID
Osnabrock, ND

Appendix:

Methods
Criteria for Quality Score

These are preliminary data that have not been sufficiently confirmed to justify general release. Confirmed results will be published through established channels. These data are a primarily tool available to cooperators and their official staffs and for those persons who are interested in the development of improved barleys.

These data are 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

*Staff Contributors: Chris Martens, Biological Science Technician; Bryan Lemmenes, Biological Science Technician; Michael Marinac, Physical Science Technician, Andy Standish, U. of Wisconsin Research Specialist, and Laura Oesterlie, Biological Science Technician.

Mississippi Valley Spring Barley Nursery - 2017 Crop

Table 2 - Station Means* of Barley and Malt Quality Factors for 29 Varieties or Selections**

LOCATION	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha- amylase (20°DU)	Beta- glucan (ppm)	FAN (ppm)
Aberdeen, ID	38.1 a	95.9 a	88 a	82.3 a	2.4 b	10.3 b	5.40 b	56.4 a	115 b	73.2 b	111 b	223 b
Osnabrock, ND	34.7 b	88.7 b	28 b	80.8 b	3.3 a	12.9 a	5.84 a	46.9 b	152 a	93.4 a	292 a	236 a

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

**Morex, Robust, Legacy, Lacey, Tradition, ND Genesis, 2ND28065, ABI Balster, ABI Growler, S6M164, S6M166, 2ND32184, S6M168, 2ND32529, 2ND32829, ND32889, ND32920, ND33325, 2B10-4162, 2B10-4378, 2ND32657, 2ND33710, 2ND33821, ND34306, ND34316, ND34318, S6M171, S6M172, S6M173

Mississippi Valley Spring Barley Nursery - 2017 Crop

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

Variety or Selection	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)
MOREX	31.3 j	86.4 def	59 abc	80.2 j	2.6 abcd	12.0 abcd	5.72 abcd	50.8 bedef	149 bedef	79.9 efghi	177 bcd	241 abc
ROBUST	34.2 defghi	91.2 abcdef	57 abc	80.2 j	2.4 abcd	12.4 a	5.80 abcd	49.5 bedef	155 abcde	66.5 hi	267 abcd	235 abcd
LEGACY	33.2 ghij	92.6 abcdef	64 ab	80.9 efghij	2.9 abcd	12.1 abc	5.89 ab	53.0 abcde	151 abcdef	88.0 bcdefgh	274 abc	246 ab
LACEY	35.2 defghij	93.6 abcde	58 abc	81.2 defghij	2.5 abcd	11.9 abcd	5.72 abcd	51.1 abcdef	158 abcd	76.4 fghi	147 bcd	235 abc
TRADITION	33.6 ghij	92.5 abcdef	68 a	80.4 hij	2.3 abcd	12.4 ab	5.41 bede	47.0 ef	176 ab	78.3 fghi	203 abcd	219 abcde
ND Genesis (2ND25276)	41.0 bc	96.9 ab	53 bc	83.6 ab	2.67 abcd	10.4 d	5.47 bede	57.1 a	112 fgh	91.5 abcdefg	172 bcd	222 abcde
2ND28065	37.7 cdef	91.2 abcdef	53 bc	81.9 bcdefghij	2.3 bcd	11.7 abcd	5.41 bede	50.0 bedef	107 gh	68.7 hi	205 abcd	213 bcde
2B05-0811 (ABI Balster)	36.9 defg	88.6 bedef	57 abc	82.7 abcde	3.2 abcd	11.9 abcd	5.81 abc	52.7 abcde	118 defgh	100.9 abcde	258 abcd	252 a
2B09-3425 (ABI Growler)	38.0 cde	91.5 abcdef	55 abc	81.4 cdefghij	3.0 abcd	11.8 abcd	5.80 abc	51.7 abcde	149 bedef	104.3 abc	154 bcd	247 ab
S6M164	33.9 fghij	96.3 abc	62 abc	81.3 cdefghij	2.3 abcd	12.4 ab	5.68 abc	48.8 cdef	190 a	82.8 cdefghi	186 bcd	223 abcde
S6M166	32.2 ij	89.9 abcdef	61 abc	81.4 cdefghij	2.7 abcd	11.5 abcd	5.74 abcd	52.3 abcde	164 abc	86.9 bcdefgh	199 abcd	244 abc
2ND32184	41.5 bc	96.0 abc	48 c	82.5 abcdef	2.4 abcd	10.7 cd	5.29 de	50.7 bedef	96 hi	90.9 abcdefg	78 d	197 de
S6M168	35.1 defghij	93.3 abcde	61 abc	80.2 ij	2.2 cd	12.2 abc	5.54 bede	47.9 def	154 abcde	81.5 defghi	303 ab	206 cde
2ND32529	42.2 b	96.1 abc	60 abc	83.1 abc	2.9 abcd	10.8 bcd	5.46 bcde	54.8 abc	115 efgh	96.5 abcdef	101 cd	219 abcde
2ND32829	43.1 ab	91.6 abcdef	53 bc	81.5 cdefghij	2.8 abcd	11.2 abcd	5.66 abcd	53.5 abcd	101 hi	95.8 abcdef	107 cd	227 abcde
ND32889	34.2 defghij	90.9 abcdef	62 abc	81.0 defghij	3.0 abcd	11.4 abcd	5.77 abcd	52.0 abcde	134 cdefgh	83.4 cdefghi	144 bcd	234 abcd
ND32920	33.7 fghij	92.7 abcdef	62 abc	80.5 ghij	2.7 abcd	11.8 abcd	5.79 abc	53.7 abcd	154 abcde	83.5 cdefghi	174 bcd	227 abcde
ND33325	33.1 ghij	93.8 abcde	61 abc	81.3 cdefghij	2.9 abcd	11.7 abcd	5.33 cde	48.7 cdef	125 cdefgh	81.2 defghi	161 bcd	218 abcde
2B10-4162	36.2 defghi	84.6 f	60 abc	82.4 abcdefg	2.9 abcd	11.0 abcd	5.57 abcde	54.1 abc	106 gh	102.7 abcd	188 bcd	237 abc
2B10-4378	36.8 defg	89.7 abcdef	55 abc	82.1 bcdefghi	3.4 abcd	11.5 abcd	5.70 abcd	53.9 abcd	124 cdefgh	110.6 a	176 bcd	240 abc
2ND32657	42.5 fb	93.7 abcde	61 abc	83.8 a	2.9 abcd	10.8 bcd	5.56 abcde	55.4 ab	106 gh	107.2 ab	174 bcd	237 abc
2ND33710	38.1 cd	91.9 abcdef	54 abc	82.3 abcdefg	2.0 d	12.0 abcd	5.16 e	45.2 f	118 defgh	61.9 i	204 abcd	194 e
2ND33821	46.4 a	98.1 a	52 bc	82.8 abcd	2.8 abcd	10.6 cd	5.41 bede	53.5 abcd	67 i	62.3 i	262 abcd	229 abcde
ND34306	32.7 hij	85.2 ef	58 abc	80.1 j	3.8 a	11.3 abcd	5.64 abcde	53.3 abcd	152 abcdef	73.3 ghi	112 cd	227 abcde
ND34316	33.3 ghij	91.8 abcdef	58 abc	80.6 fghij	2.9 abcd	11.4 abcd	5.65 abcd	52.6 abcde	118 defgh	74.8 fghi	187 bcd	228 abcde
ND34318	35.7 defghi	95.2 abc	61 abc	81.6 cdefghij	3.6 abc	11.6 abcd	5.61 abcde	51.5 abcde	126 cdefgh	70.1 ghi	205 abcd	244 abc
S6M171	33.7 fghij	87.7 cdef	61 abc	80.7 fghij	3.6 abc	12.4 a	6.04 a	51.1 abcdef	149 bedef	71.8 ghi	333 ab	258 a
S6M172	36.5 defgh	94.9 abcd	54 abc	81.6 cdefghij	3.7 ab	12.1 abc	5.89 ab	51.0 bedef	161 abc	75.1 fghi	376 a	239 abc
S6M174	34.0 efghij	93.4 abcde	62 abc	81.2 defghij	3.5 abc	12.0 abcd	5.59 abcde	51.3 abcde	143 bcdefg	68.6 hi	323 ab	228 abcde

*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; Osnabrock, ND

2017 MVBN Aberdeen ID

Table 056

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)	FAN (ppm)	Adjunct Quality Score	Adjunct Overall Rank	All Malt Quality Score	All Malt Overall Rank
5960	MOREX	6	33.6	94.6	88	81.6	2.5	1	11.1	5.63	54.0	147	77.8	116	250	57	3	N/A	N/A
5961	ROBUST	6	35.1	93.6	89	81.5	2.2	1	11.1	5.64	54.7	146	66.2	207	243	50	19	N/A	N/A
5962	LEGACY	6	34.4	95.1	99	81.9	2.6	1	10.0	5.48	60.7	127	84.4	161	237	53	8	N/A	N/A
5963	LACEY	6	36.4	94.9	88	82.6	2.5	1	10.1	5.56	59.0	132	76.0	70	246	57	3	N/A	N/A
5964	TRADITION	6	35.6	95.2	100	81.7	2.3	1	10.5	5.38	54.9	161	80.1	92	231	60	1	N/A	N/A
5965	ND Genesis (2ND25276)	2	40.8	97.1	77	83.2	2.6	1	9.9	5.48	61.1	101	85.8	112	233	52	14	43	2
5966	2ND28065	2	39.2	97.0	80	82.3	2.1	1	10.8	5.33	55.7	93	65.3	122	221	46	27	32	11
5967	2B05-0811 (ABI Balster)	2	39.4	94.8	83	83.9	2.6	1	10.7	5.46	56.3	112	89.8	112	244	50	19	36	8
5968	2B09-3425 (ABI Growler)	2	40.8	97.2	82	82.4	2.5	1	10.2	5.47	55.8	129	86.1	79	229	59	2	40	6
5969	S6M164	6	34.7	96.1	95	81.8	2.3	1	11.1	5.74	54.7	166	73.6	82	232	56	6	N/A	N/A
5970	S6M166	6	34.4	94.9	96	82.6	2.6	1	10.1	5.63	57.8	139	77.4	76	241	57	3	N/A	N/A
5971	2ND32184	2	42.2	97.0	77	82.3	2.2	1	10.1	5.18	52.3	87	77.7	59	192	51	17	44	1
5972	S6M168	6	36.5	96.6	92	80.7	2.0	1	11.4	5.43	52.0	140	75.8	182	206	48	25	N/A	N/A
5973	2ND32529	2	42.6	97.2	90	83.5	2.8	1	9.7	5.32	60.5	97	82.6	70	216	53	8	39	7
5974	2ND32829	2	47.5	97.5	75	82.4	2.6	1	9.6	5.39	60.3	74	77.1	67	214	53	8	36	8
5975	ND32889	6	36.2	94.3	93	81.4	2.8	2	10.5	5.41	53.3	131	71.3	149	215	52	14	N/A	N/A
5976	ND32920	6	36.3	98.2	95	81.5	2.2	1	10.5	5.62	58.5	131	73.7	126	220	53	8	N/A	N/A
5977	ND33325	6	34.1	95.1	95	81.9	2.6	1	9.6	5.07	55.4	94	74.4	50	203	47	26	N/A	N/A
5978	2B10-4162	2	38.8	*89.9	87	83.1	2.4	1	9.9	5.23	58.0	101	83.9	70	213	52	14	43	2
5979	2B10-4378	2	38.8	94.6	81	82.9	2.5	1	10.1	5.22	56.9	110	88.4	110	213	50	19	41	4
5980	2ND32657	2	45.1	96.1	83	83.5	2.5	1	9.9	5.31	59.7	82	85.2	160	225	46	27	34	10
5981	2ND33710	2	39.6	97.6	78	82.4	1.7	1	11.4	5.05	47.5	104	45.8	93	185	54	7	41	4
5982	2ND33821	2	46.1	98.0	78	83.0	2.6	1	9.6	5.27	58.5	66	49.5	195	221	43	29	27	12
5983	ND34306	6	35.6	94.1	90	81.8	3.0	2	9.6	5.30	60.2	119	62.4	58	206	50	19	N/A	N/A
5984	ND34316	6	34.6	93.3	92	81.8	2.7	1	9.7	5.34	58.3	95	62.7	96	222	53	8	N/A	N/A
5985	ND34318	6	36.0	96.4	98	82.4	2.4	1	10.2	5.32	54.8	94	58.1	85	236	53	8	N/A	N/A
5986	S6M171	6	34.4	*87.4	89	80.7	2.2	1	11.5	5.79	54.5	145	60.4	198	247	51	17	N/A	N/A
5987	S6M172	6	41.4	97.3	79	83.0	2.5	1	10.1	5.51	54.9	106	69.1	151	226	49	23	N/A	N/A
5988	S6M174	6	35.4	96.8	98	81.8	2.0	1	10.0	5.12	56.4	113	60.9	87	211	49	23	N/A	N/A

Table 056

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)	FAN (ppm)	Adjunct Quality Score	Adjunct Overall Rank	All Malt Quality Score	All Malt Overall Rank
5959	CONRAD MALT CHECK	2	40.5	97.7	55	81.5	2.8	2	12.2	6.04	52.2	132	75.1	190	253	49		22	

Minima	33.6	93.3	75	80.7	1.7	9.6	5.05	47.5	66	45.8	50	185
Maxima	47.5	98.2	100	83.9	3.0	11.5	5.79	61.1	166	89.8	207	250
Means	38.1	95.9	88	82.3	2.4	10.3	5.40	56.4	115	73.2	111	223
Standard Deviations	3.8	1.4	8	0.8	0.3	0.6	0.19	3.1	26	11.4	46	16
Coefficients of Variation	10.1	1.5	9	1.0	11.4	5.8	3.51	5.5	22	15.6	41	7

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 Dr. Gongshe Hu, USDA ARS, Aberdeen, ID

Neg Std Dev	26.6	91.7	65	79.9	1.6	8.5	4.83	47.1	38	38.8	-26	174
Pos Std Dev	49.7	100.2	111	84.7	3.3	12.1	5.97	65.8	193	107.5	249	273

2017 Osnabrock Experiment 6 - Mississippi Valley Barley Nursery

Table 125

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)	FAN (ppm)	Adjunct Quality Score	Adjunct Overall Rank	All Malt Quality Score	All Malt Overall Rank
6061	MOREX	6	29.0	78.1	29	78.7	2.7	1	12.9	5.82	47.7	152	81.9	239	231	46	19	N/A	N/A
6062	ROBUST	6	33.2	88.7	24	78.8	2.6	1	13.8	5.91	44.3	164	66.9	326	226	46	19	N/A	N/A
6063	LEGACY	6	32.0	90.1	28	79.9	3.2	1	14.3	6.29	45.4	175	91.6	386	256	46	19	N/A	N/A
6064	LACEY	6	34.0	92.2	27	79.8	2.6	1	13.7	5.89	43.2	184	76.8	225	225	49	16	N/A	N/A
6065	TRADITION	6	31.6	89.7	36	79.1	2.4	1	14.2	5.44	39.0	191	76.5	313	207	45	24	N/A	N/A
6066	ND GENESIS	2	41.2	96.6	28	84.0	2.7	1	11.0	5.46	53.2	122	97.2	233	212	52	11	28	2
6067	2ND28065	2	36.3	85.4	26	81.4	2.4	1	12.6	5.48	44.2	122	72.0	288	205	54	5	18	8
6068	ABI BALSTER	2	34.4	82.3	30	81.6	3.9	1	13.1	6.16	49.2	124	111.9	404	261	36	28	14	10
6069	ABI GROWLER	2	35.1	85.7	27	80.3	3.5	1	13.4	6.13	47.5	169	122.5	230	265	36	28	12	11
6070	S6M164	6	33.0	96.4	29	80.7	2.3	1	13.7	5.63	42.9	215	92.0	289	213	53	10	N/A	N/A
6071	S6M166	6	29.9	84.9	25	80.3	2.8	1	12.8	5.85	46.8	188	96.3	322	246	56	4	N/A	N/A
6072	2ND32184	2	40.8	95.0	19	82.7	2.6	1	11.3	5.40	49.2	105	104.1	96	201	59	3	42	1
6073	S6M168	6	33.7	90.0	29	79.7	2.4	1	13.0	5.64	43.7	167	87.2	424	206	61	1	N/A	N/A
6074	2ND32529	2	41.9	95.0	30	82.8	3.0	1	11.9	5.59	49.1	133	110.3	132	221	60	2	26	3
6075	2ND32829	2	38.7	85.7	31	80.7	3.0	1	12.8	5.93	46.7	127	114.5	147	239	54	5	17	9
6076	ND32889	6	32.2	87.5	30	80.6	3.1	1	12.3	6.13	50.6	138	95.6	140	254	51	12	N/A	N/A
6077	ND32920	6	31.2	87.1	29	79.6	3.1	1	13.0	5.97	49.0	177	93.4	221	235	48	17	N/A	N/A
6078	ND33325	6	32.0	92.4	27	80.7	3.3	2	13.8	5.58	41.9	156	87.9	272	234	47	18	N/A	N/A
6079	2B10-4162	2	33.6	79.2	33	81.6	3.5	1	12.2	5.91	50.2	111	121.6	306	261	41	25	21	6
6080	2B10-4378	2	34.9	84.7	29	81.3	4.3	1	12.9	6.18	50.9	138	132.7	242	267	41	25	9	12
6081	2ND32657	2	39.9	91.2	39	84.1	3.2	1	11.7	5.80	51.0	129	129.1	188	248	51	12	21	6
6082	2ND33710	2	36.6	86.2	29	82.1	2.2	1	12.6	5.27	42.8	132	78.0	315	204	54	5	22	5
6083	2ND33821	2	46.8	98.2	25	82.7	3.0	2	11.7	5.54	48.6	67	75.2	329	236	50	15	23	4
6084	ND34306	6	29.8	76.2	26	78.3	4.5	1	12.9	5.98	46.5	184	84.3	167	248	54	5	N/A	N/A
6085	ND34316	6	32.1	90.2	24	79.4	3.2	1	13.1	5.96	46.8	142	86.8	278	233	51	12	N/A	N/A
6086	ND34318	6	35.4	94.0	24	80.8	4.8	1	13.0	5.90	48.2	159	82.0	325	251	54	5	N/A	N/A
6087	S6M171	6	32.9	88.0	32	80.7	5.0	1	13.4	6.30	47.7	153	83.2	469	268	46	19	N/A	N/A
6088	S6M172	6	31.7	92.4	28	80.2	4.9	1	14.1	6.27	47.1	216	81.2	600	253	40	27	N/A	N/A
6089	S6M174	6	32.6	89.9	26	80.5	5.0	1	14.0	6.06	46.3	173	76.2	558	246	46	19	N/A	N/A

6090	LACEY MALT CHECK	6	32.9	88.6	41	79.4	4.8	1	12.8	6.09	49.4	161	88.6	103	271	58	N/A
Minima			29.0	76.2	19	78.3	2.2		11.0	5.27	39.0	67	66.9	96	201		
Maxima			46.8	98.2	39	84.1	5.0		14.3	6.30	53.2	216	132.7	600	268		
Means			34.7	88.7	28	80.8	3.3		12.9	5.84	46.9	152	93.4	292	236		
Standard Deviations			4.1	5.5	4	1.5	0.9		0.9	0.29	3.2	33	17.9	119	21		
Coefficients of Variation			11.9	6.2	14	1.8	26.0		6.7	4.96	6.8	22	19.2	41	9		

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 Dr. Richard Horsley, N.D.S.U.

Neg Std Dev			22.3	72.3	17	76.4	0.7		10.3	4.97	37.3	52	39.7	-66	173		
Pos Std Dev			47.1	105.2	40	85.2	5.8		15.5	6.71	56.4	253	147.1	650	299		

Appendix A:

METHODS

Cleaning All samples were cleaned on a Carter Dockage Tester and only grain between 5 and 7/64" was used.

Barley Mill Ground barley was prepared with a Labconco Burr mill that was adjusted so that only 35% of the grist remained on a 525 µm sieve after 3 min of shaking and tapping.

Kernel Weight The number of kernels in a 20 g aliquot of each sample was counted electronically and the '1000 kernel weight' was calculated.

Plumpness Samples were sized on a Eureka-Niagra Barley Grader and the percentage of the seeds retained on a 6/64" screen was determined.

Barley Color The brightness of the grains was measured using an Agtron M45-D analyzer.

Barley Moisture Content (Barley 5B) Five g of ground sample was dried for 3 h at 104°C. The percentage of weight loss that occurred during this drying was calculated.

Barley Protein Content Total nitrogen values were obtained using an automated Dumas combustion procedure with a LECO FP-528 analyzer. Nitrogen values were converted to protein percentages by multiplication by 6.25.

Malting Conditions 170 g (db) aliquots of barley were processed in Joe White micro-malters. Samples were hydrated to 47% moisture via a 32 h steep at 19°C: 8 h wet, 8 h air, 5 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 1 and 3 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. Malts to be used for moisture, protein and amylolytic activity analyses were ground in a Labconco Burr mill (see Barley Mill).

Malt Moisture Content Determined by Malt 3 (Methods of Analysis of the ASBC, 8th ed, 1992) See Barley Moisture Content.

Malt Protein Content See Barley Protein Content.

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

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.

Viscosities were measured on an Anton Paar AMVn rolling ball viscometer. Relative viscosities were reported: flow time of mash extract over the flow time of distilled water.

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.



American Malting Barley Association, Inc.

MALTING BARLEY BREEDING GUIDELINES IDEAL COMMERCIAL MALT CRITERIA

	<u>Six-Row</u>	<u>Adjunct Two-Row</u>	<u>All Malt Two-Row</u>	<u>Distillers'</u>
AMBA Member Interest*	10%	61%	25%	4%
Barley Factors				
Plump Kernels (on 6/64)	> 80%	> 90%	> 90%	> 70%
Thin Kernels (thru 5/64)	< 3%	< 3%	< 3%	< 5%
Germination (4ml 72 hr. GE)	> 98%	> 98%	> 98%	> 98%
Protein	≤ 13.0%	≤ 13.0%	≤ 12.0%	11.5 -14.0%
Skinned & Broken Kernels	< 5%	< 5%	< 5%	< 5%
Malt Factors				
Total Protein	≤ 12.8%	≤ 12.8%	≤ 11.8%	11.0 - 13.5%
on 7/64 screen	> 60%	> 70%	> 75%	>50%
Glycosidic Nitrile (ppm)				< 1.5
Measures of Malt Modification				
Beta-Glucan (ppm)	< 120	< 100	< 100	
F/C Difference	< 1.2	< 1.2	< 1.2	
Soluble/Total Protein	42-47%	40-47%	38-45%	>48%
Turbidity (NTU)	< 10	< 10	< 10	
Viscosity (absolute cp)	< 1.50	< 1.50	< 1.50	
Congress Wort				
Soluble Protein	5.2-5.7%	4.8-5.6%	< 5.3%	>6.0%
Extract (FG db)	> 79.0%	> 81.0%	> 81.0%	> 79.0%
Color (°ASBC)	1.8-2.5	1.6-2.5	1.6-2.8	<4.0
FAN	> 210	> 210	140-190	>250
Malt Enzymes				
Diastatic Power (°ASBC)	> 150	> 120	110-150	>200
Alpha Amylase (DU)	> 50	> 50	40-70	>75

* Based on 2017 dues weighted survey of Regular members

General Comments

Barley should mature rapidly, break dormancy quickly without pregermination and germinate uniformly. The hull should be thin, bright and adhere tightly during harvesting, cleaning and malting.

Malted barley should exhibit a well-balanced, modification in a conventional malting schedule with four day germination.

Malted barley must provide desired beer flavor.

Distillers' Malt guidelines are designed to reflect how varieties perform when malted in the normal Brewers' cycles used for AMBA and CCRU variety trials.

April, 2017