

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

**WESTERN REGIONAL SPRING BARLEY NURSERY  
2017 Crop**

**Malting Quality Data**

\*Cereal Crops Research Unit Staff

Detailed Data:

Aberdeen, ID  
Bozeman, MT

Appendix:

Methods  
Criteria for Quality Score

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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.

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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.

## Western Regional 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	<b>42.6 a</b>	<b>96.7 a</b>	<b>77.9 b</b>	<b>82.6 a</b>	<b>2.2 a</b>	<b>11.0 b</b>	<b>5.21 b</b>	<b>49.9 a</b>	<b>109 b</b>	<b>91.5 a</b>	<b>194 b</b>	<b>256 a</b>
Bozeman, MT	<b>40.7 b</b>	<b>92.3 b</b>	<b>96.0 a</b>	<b>80.4 b</b>	<b>1.6 b</b>	<b>13.2 a</b>	<b>5.46 a</b>	<b>43.2 b</b>	<b>164 a</b>	<b>82.8 b</b>	<b>228 a</b>	<b>226 b</b>

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

\*\*Harrington, AC Metcalfe, 2B10-4162, 2B10-4378, 2B11-4949, 2B11-5166, 2B12-5582, 08ARS028-20, 08ARS112-75, 07ARS116-91, 10ARS191-308, ARS028-20, MT124112, MT124128, MT124134, MT124677, MT090190, 11WA-107.58, 11WA-107.43, 12WA-120.14, 10WA-106.18, 10WA-117.17, CDC Bow, CDC Fraser, 2ND32529, 2ND33760

## Western Regional 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)
Harrington	39.1 ijk	93.6 abcd	90 abc	80.8 efgh	1.7 defgh	12.8 abc	5.36 abc	42.2 bcde	157 abcd	89.1 bcdefgh	246 bcdef	250 cdefghi
AC Metcalfe	39.5 hijk	95.5 abcd	94 a	81.3 cdefg	1.7 defgh	12.1 abc	5.70 ab	49.7 ab	157 abcd	98.7 abc	137 ghi	232 ghi
2B10-4162	38.9 ijk	90.4 cd	89 abc	81.3 cdefg	1.8 defgh	12.2 abc	5.53 ab	48.4 ab	155 abcd	94.8 abcde	145 fghi	240 fghi
2B10-4378	40.1 ghijk	95.2 abcd	77 c	82.0 abcde	1.9 bcde	12.2 abc	5.62 ab	49.8 ab	182 a	109.1 ab	123 ghi	248 cdefghi
2B11-4949	38.3 jk	92.8 abcd	83 abc	82.6 abc	2.1 abcd	12.9 abc	5.83 a	48.0 abc	180 a	90.2 bcdefg	105 i	281 a
2B11-5166	38.0 k	91.5 abcd	89 abc	82.5 abc	2.2 ab	11.6 abc	5.77 ab	51.8 a	150 abcde	107.7 ab	93 i	270 abcde
2B12-5582	39.8 hijk	93.8 abcd	86 abc	82.2 abcde	2.0 abcd	13.4 a	5.68 ab	46.1 abcde	166 ab	88.5 cdefgh	167 fghi	275 abc
08ARS028-20	41.7 cdefgh	95.2 abcd	82 abc	80.9 defgh	1.9 bcdef	11.8 abc	5.36 abc	48.2 ab	149 abcdef	91.5 abcdef	223 defgh	222 i
08ARS112-75	39.5 hijk	90.8 cd	85 abc	81.4 bcdefg	1.9 bcdef	12.0 abc	5.60 ab	48.4 ab	160 abc	104.2 ab	293 abcde	261 abcdef
08ARS116-91	39.3 hijk	94.8 abcd	87 abc	81.9 abcde	2.0 abcd	12.0 abc	5.70 ab	48.3 ab	160 abc	75.4 defgh	115 hi	270 abcde
10ARS191-308	43.1 bcde	91.4 bcd	90 abc	81.0 defgh	1.9 bcdef	11.8 abc	5.43 abc	46.7 abcd	111 defg	80.9 cdefghi	229 cdefg	253 bcdefgh
MT124112	42.8 bcdef	96.7 abc	85 abc	82.6 abc	2.0 abcd	11.6 abc	5.55 ab	51.7 a	137 abcdef	113.6 a	127 ghi	258 abcdefg
MT124128	47.1 a	97.9 a	82 abc	83.0 a	2.3 a	11.2 bc	5.75 ab	51.8 a	118 cdef	104.6 ab	218 efgh	279 ab
MT124134	47.4 a	97.7 ab	78 bc	82.8 ab	2.4 a	11.6 abc	5.38 abc	49.8 ab	103 fg	96.6 abcd	247 bcdef	260 abcdef
MT124677	43.4 bcd	97.5 ab	84 abc	82.3 abcd	2.0 abcd	11.0 c	5.16 abcd	48.8 ab	118 cdef	108.7 ab	294 abcde	246 efghi
MT090190	42.6 bcdef	96.5 abcd	87 abc	80.8 efgh	1.8 cdefg	11.8 abc	5.01 bcd	44.0 abcde	144 abcdef	77.5 cdefghi	277 abcde	228 hi
11WA-107.58	43.9 bc	97.6 ab	89 abc	80.5 fgh	1.5 gh	13.0 ab	4.72 cd	38.3 e	103 efg	68.0 ghi	333 abc	197 j
11WA-107.43	42.3 bcdefg	96.6 abc	90 abc	81.6 abcdef	1.4 h	12.3 abc	4.57 d	38.9 de	94 g	65.6 hi	345 ab	188 j
12WA-120.14	44.3 b	94.8 abcd	92 ab	80.4 fgh	1.9 bcdef	13.3 a	5.33 abc	42.8 bcde	147 abcdef	72.3 efghi	275 abcde	243 efghi
10WA-106.18	41.1 defghi	90.1 d	91 abc	80.1 gh	1.5 fgh	12.3 abc	4.56 d	38.3 e	106 efg	61.7 i	368 a	190 j
10WA-117.17	38.9 ijk	94.1 abcd	92 ab	79.8 h	1.5 fgh	12.0 abc	4.50 d	40.2 cde	105 efg	71.3 fghi	331 abcd	173 j
CDC Bow	40.9 efghi	93.8 abcd	93 a	80.9 defgh	2.4 a	12.1 abc	5.59 ab	48.0 abc	133 bcdef	91.9 abcdef	126 ghi	272 abcd
CDC Fraser	40.5 fghij	95.3 abcd	86 abc	81.0 defgh	2.2 abc	12.7 abc	5.56 ab	47.8 abc	147 abcdef	70 fghi	96 i	253 bcdefgh
2ND32529	42.7 bcdef	93.7 abcd	94 a	81.8 abcdef	2.2 abc	11.5 abc	5.20 abcd	49.0 ab	146 abcdef	71.8 efghi	116 hi	240 fghi
2ND33760	44.3 b	95.4 abcd	91 abc	81.3 cdefg	1.6 efgh	12.5 abc	5.04 bcd	41.9 bcde	113 cdef	77 cdefghi	247 bcdef	233 ghi

\*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; Bozeman, MT

## 2017 Spring Barley Aberdeen, ID WRSBN

Table 055

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
5927	Steptoe	2	39.7	93.5	68	*77.0	3.0	2	11.1	4.38	42.5	90	51.2	*546	174	33	32	32	17
5928	Baronesse	2	42.5	97.7	84	79.9	n.d.	3	10.8	4.73	44.7	102	73.4	165	199	44	26	36	10
5929	Harrington	2	40.8	96.7	83	82.4	1.9	1	11.1	5.34	46.6	124	93.4	235	250	62	1	28	27
5930	AC Metcalfe	2	40.9	98.0	89	82.8	2.2	1	11.0	5.35	52.5	142	107.9	104	256	55	10	31	21
5931	2B10-4162	2	39.2	*90.2	82	82.5	2.3	1	10.1	5.07	52.6	114	98.0	103	267	50	16	41	4
5932	2B10-4378	2	40.5	95.9	73	82.8	2.2	1	11.1	5.36	52.2	150	110.8	115	258	60	3	31	21
5933	2B11-4949	2	39.5	96.8	77	83.7	2.3	1	10.9	5.23	51.3	125	90.7	87	276	57	7	33	15
5934	2B11-5166	2	39.3	94.4	78	83.2	2.6	1	10.2	5.47	55.5	115	112.8	74	278	54	12	45	1
5935	2B12-5582	2	41.1	97.7	79	83.5	2.4	1	12.1	5.42	49.2	123	95.2	143	299	60	3	26	30
5936	2Ab09-X06F058HL-31	2	38.4	93.2	*50	84.9	n.d.	3	*13.2	4.76	37.8	67	60.5	*886	186	35	31	23	32
5937	08ARS112-75	2	41.1	95.9	73	82.5	2.2	1	10.8	5.32	50.1	123	108.4	291	274	52	13	28	27
5938	08ARS116-91	2	40.6	96.9	75	82.3	2.3	1	11.6	5.44	47.3	134	81.1	120	281	60	3	26	30
5939	08ARS028-20	2	42.5	96.7	69	81.9	2.1	1	11.1	5.31	50.7	131	97.2	141	237	61	2	32	17
5940	10ARS191-3	2	44.4	96.2	85	82.2	2.1	1	11.7	5.33	46.3	99	87.1	193	272	56	8	27	29
5941	MT124112	2	43.4	97.8	70	83.4	2.3	1	10.0	5.20	55.8	100	120.2	129	266	49	19	40	7
5942	MT124128	2	46.9	97.5	63	83.2	2.7	1	10.5	5.44	52.7	84	105.9	247	291	46	22	34	12
5943	MT124134	2	47.0	97.6	61	83.4	2.8	1	10.6	5.17	52.0	71	99.9	292	266	46	22	29	24
5944	MT124677	2	43.3	98.0	67	82.7	2.3	1	11.0	5.17	48.0	95	109.3	319	257	46	22	29	24
5945	MT090190	2	43.2	97.6	79	81.9	2.2	1	10.8	5.10	48.4	116	85.9	262	252	50	16	32	17
5946	11WA-107.58	2	44.1	98.6	81	81.6	1.6	1	12.5	4.94	42.3	95	73.3	290	220	56	8	35	11
5947	11WA-107.43	2	42.5	97.3	81	82.6	1.6	1	11.1	4.70	44.1	85	69.1	316	200	50	16	41	4
5948	12WA-120.14	2	46.2	97.9	85	82.4	2.2	1	11.6	5.32	48.4	111	74.9	267	257	55	10	34	12
5949	10WA-106.18	2	43.4	95.4	80	81.8	1.7	1	10.9	4.75	44.1	99	66.7	291	220	47	21	38	9
5950	10WA-117.17	2	39.8	94.6	84	80.8	1.7	1	10.9	4.66	46.3	100	93.9	258	190	39	29	30	23
5951	CDC Bow	2	42.9	98.7	88	82.1	2.7	1	11.3	5.48	48.8	114	94.5	116	294	58	6	39	8
5952	CDC Fraser	2	42.2	98.1	81	82.4	2.6	1	10.9	5.44	54.2	99	52.6	102	269	49	19	33	15
5953	UTSB10902-91	2	39.5	94.1	74	79.7	1.9	1	11.0	4.41	42.6	91	51.5	234	185	44	26	32	17
5954	UTSB10905-72	2	40.5	97.1	75	79.5	1.8	1	10.8	4.30	41.4	106	83.8	392	184	45	25	43	2
5955	2ND32529	2	43.8	97.8	87	83.4	2.6	2	9.7	5.15	56.9	111	69.1	128	252	52	13	41	4
5956	2ND33760	2	44.6	95.6	83	82.3	1.7	1	11.3	5.22	47.6	85	90.9	225	259	51	15	29	24

Table 055

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
5957	BZ512-220	2	40.0	93.3	88	82.9	2.2	1	10.4	5.21	51.4	93	72.1	182	248	43	28	34	12
5958	BZ512-282	2	40.0	95.0	77	81.9	1.8	2	10.8	4.49	50.5	103	35.0	141	188	36	30	43	2
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			38.4	93.2	61	79.5	1.6		9.7	4.30	37.8	67	35.0	74	174				
Maxima			47.0	98.7	89	84.9	3.0		12.5	5.48	56.9	150	120.2	392	299				
Means			42.0	96.5	78	82.3	2.2		10.9	5.08	48.6	106	84.9	199	244				
Standard Deviations			2.3	1.6	7	1.2	0.4		0.6	0.36	4.6	19	20.9	86	37				
Coefficients of Variation			5.5	1.7	9	1.4	17.1		5.2	7.00	9.5	18	24.6	43	15				

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, Aberdeen, ID

Neg Std Dev			35.0	91.7	56	78.9	1.1		9.2	4.02	34.8	48	22.2	-59	133				
Pos Std Dev			48.9	101.3	100	85.8	3.3		12.7	6.15	62.4	164	147.6	456	355				

5929	Harrington	2	40.8	96.7	83	82.4	1.9	1	11.1	5.34	46.6	124	93.4	235	250				
5924	3 - Harrington_BWD	2	37.4	90.5	98	79.2	1.4	1	14.4	5.38	37.8	191	84.7	257	250				
			39.1	93.6	90.4	80.8	1.7		12.8	5.36	42.2	157	89.1	246	250				

2017 WRSBN Bozeman, Montana  
Table

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
5900	4 - Metcalfe_BWD	2	38.0	93.0	99	79.8	1.2	1	13.2	6.05	46.9	171	89.5	169	208	41	20	12	24
5901	5 - 2B10-4162_BWD	2	38.5	90.6	95	80.0	1.2	1	14.3	5.99	44.1	196	91.5	186	213	43	15	19	16
5902	6 - 2B10-4378_BWD	2	39.7	94.4	*80	81.1	1.6	1	13.2	5.87	47.3	213	107.4	130	238	49	11	19	16
5903	7 - 2B11-4949_BWD	2	37.1	88.7	89	81.5	1.8	1	14.8	6.42	44.8	234	89.7	122	286	42	18	18	19
5904	8 - 2B11-5166_BWD	2	36.6	88.6	99	81.7	1.8	1	12.9	6.06	48.1	185	102.5	112	262	47	13	20	13
5905	9 - 2B12-5582_BWD	2	38.4	89.9	92	80.8	1.6	1	14.6	5.94	43.0	209	81.8	190	251	41	20	19	16
5906	11 - 08ARS112-75_BWD	2	37.8	85.7	97	80.3	1.5	1	13.1	5.87	46.8	196	100.0	294	247	44	14	12	24
5907	12 - 08ARS116-91_BWD	2	38.0	92.6	98	81.5	1.7	1	12.4	5.96	49.3	185	69.7	109	258	54	5	22	12
5908	13 - 08ARS028-20_BWD	2	40.9	93.7	95	79.9	1.6	1	12.5	5.41	45.8	167	85.7	305	206	57	3	16	22
5909	14 - 10ARS191-3_BWD	2	41.7	86.6	94	79.7	1.6	1	11.8	5.53	47.2	123	74.7	265	234	52	6	17	20
5910	15 - MT124112_BWD	2	42.2	95.6	99	81.7	1.7	1	13.1	5.89	47.6	173	106.9	124	250	52	6	27	6
5911	16 - MT124128_BWD	2	47.2	98.2	100	82.8	1.9	1	11.9	6.05	50.9	151	103.2	188	266	51	9	24	9
5912	17 - MT124134_BWD	2	47.7	97.7	94	82.2	1.9	1	12.6	5.59	47.7	134	93.2	202	254	58	1	24	9
5913	18 - MT124677_BWD	2	43.5	97.0	100	81.9	1.7	1	11.0	5.14	49.6	141	108.0	268	235	58	1	29	4
5914	19 - MT090190_BWD	2	41.9	95.3	95	79.7	1.4	1	12.7	4.91	39.6	171	69.1	291	204	52	6	24	9
5915	20 - 11WA-107.58_BWD	2	43.6	96.6	97	79.3	1.3	1	13.4	4.50	34.3	111	62.7	376	173	35	24	36	2
5916	21 - 11WA-107.43_BWD	2	42.1	95.8	98	80.6	1.2	1	13.4	4.44	33.7	102	62.0	373	175	38	22	41	1
5917	22 - 12WA-120.14_BWD	2	42.4	91.6	98	78.4	1.5	1	14.9	5.33	37.2	183	69.7	283	229	42	18	20	13
5918	23 - 10WA-106.18_BWD	2	38.8	84.8	100	78.4	1.3	1	13.7	4.36	32.6	112	56.7	445	159	22	26	28	5
5919	24 - 10WA-117.17_BWD	2	37.9	93.5	100	78.8	1.3	1	13.0	4.33	34.0	110	48.7	404	156	27	25	31	3
5920	25 - Bow_BWD	2	38.8	88.9	98	79.7	2.0	1	12.8	5.69	47.2	151	89.2	135	249	49	11	15	23
5921	26 - Fraser_BWD	2	38.8	92.4	90	79.6	1.7	1	14.5	5.68	41.4	195	87.4	90	237	50	10	26	8
5922	29 - 2ND32529_BWD	2	41.6	89.6	100	80.2	1.7	1	13.3	5.25	41.1	180	74.5	104	228	55	4	27	6
5923	30 - 2ND33760_BWD	2	43.9	95.2	98	80.3	1.4	1	13.7	4.85	36.3	141	63.1	268	207	43	15	20	13
5924	3 - Harrington_BWD	2	37.4	90.5	98	79.2	1.4	1	14.4	5.38	37.8	191	84.7	257	250	37	23	12	24
5926	33 - Hockett_BWD	2	39.8	89.6	100	80.4	1.2	1	13.2	4.96	37.8	191	87.7	275	209	43	15	17	20
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		26	
Minima			36.6	84.8	89	78.4	1.2		11.0	4.33	32.6	102	48.7	90	156				
Maxima			47.7	98.2	100	82.8	2.0		14.9	6.42	50.9	234	108.0	445	286				
Means			40.6	92.2	97	80.4	1.5		13.2	5.44	42.8	166	83.1	229	226				
Standard Deviations			3.0	3.7	3	1.2	0.2		1.0	0.60	5.7	36	16.8	101	34				

Coefficients of Variation	7.4	4.1	3	1.5	15.2	7.2	10.98	13.3	21	20.2	44	15
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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. Jamie Sherman, Montana State University

Neg Std Dev	31.6	80.9	87	76.9	0.8	10.4	3.65	25.7	59	32.7	-75	126
Pos Std Dev	49.5	103.4	107	83.9	2.2	16.1	7.23	59.9	273	133.4	533	327

# 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%
<b>Barley Factors</b>				
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%
<b>Malt Factors</b>				
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
<b>Measures of Malt Modification</b>				
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	
<b>Congress Wort</b>				
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
<b>Malt Enzymes</b>				
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