

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

**WESTERN REGIONAL SPRING BARLEY NURSERY
2018 Crop**

Malting Quality Data

*Cereal Crops Research Unit Staff

Detailed Data:

Aberdeen, ID

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: Jason Walling, Research Geneticist (Plants); 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.

2018 WRSBN -- Aberdeen, ID

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
6091	Stepoe	2	44.3	97.7	87	78.2	n.d.	3	11.0	4.46	43.9	71	27.1	749	127	27	28	25	22
6092	Baronesse	2	45.6	96.8	82	79.1	n.d.	3	11.5	4.54	40.7	104	46.9	375	113	40	26	25	22
6093	Harrington	2	44.3	97.2	87	81.9	1.6	1	12.1	5.68	50.9	142	48.5	322	204	49	18	22	27
6094	AC Metcalfe	2	43.3	98.2	87	82.6	2.1	1	12.0	5.70	49.8	161	67.6	179	191	52	15	30	14
6095	08ARS116-91	2	42.7	96.5	87	82.9	1.7	1	11.0	5.54	51.3	146	61.6	175	204	56	9	27	21
6096	08ARS028-20	2	44.3	97.5	83	81.5	1.7	1	11.2	5.29	47.8	135	55.3	246	170	53	12	34	5
6097	10ARS191-3	2	46.0	95.4	87	81.9	1.9	1	11.4	5.28	47.0	106	65.7	320	194	53	12	42	1
6098	11ARS162-4	2	43.7	95.5	87	82.1	1.6	1	11.8	5.30	48.6	153	57.1	202	166	53	12	29	16
6099	11WA-107.58	2	46.8	96.9	87	80.7	1.5	1	11.4	4.66	43.2	100	47.5	501	133	41	24	34	5
6100	11WA-107.43	2	45.0	97.6	87	82.3	1.3	1	11.3	4.64	41.5	96	45.9	477	138	44	22	41	2
6101	13WAM-101.2	2	42.1	96.6	80	78.9	2.2	1	11.6	4.44	40.1	112	47.0	545	120	42	23	31	10
6102	13WAM-149.2	2	45.5	96.8	87	80.8	1.7	1	11.9	4.89	41.6	147	52.1	319	151	55	11	29	16
6103	13WAM-135.26	2	48.6	97.8	84	80.4	1.8	1	11.7	4.61	40.5	95	43.7	619	135	41	24	28	18
6104	HO515-510	2	43.4	96.2	87	81.0	1.4	1	10.8	4.20	38.9	102	45.4	463	115	35	27	39	4
6106	HO515-555	2	42.3	96.6	86	80.4	1.7	1	11.1	4.64	44.5	132	49.8	429	145	48	19	31	10
6107	2B11-4949	2	40.5	96.9	87	83.3	1.7	1	12.0	5.53	48.2	172	56.8	97	213	64	3	28	18
6108	2B13-6991	2	43.2	96.5	85	82.1	1.7	1	11.7	5.15	45.3	166	93.8	208	246	63	4	24	25
6109	2IM14-7765	2	43.5	97.1	86	81.2	2.5	1	11.4	5.17	47.0	140	81.0	161	245	58	7	24	25
6110	2IM14-7830	2	40.8	94.6	87	81.7	1.5	1	11.4	4.91	46.6	151	84.7	204	214	62	6	28	18
6111	2IM14-8212	2	43.2	95.6	80	81.1	2.0	1	11.8	5.24	48.2	177	92.3	158	268	58	7	19	28
6112	CDC Bow	2	43.5	96.4	86	80.7	1.6	1	11.9	5.27	44.9	149	86.8	143	230	63	4	25	22
6113	CDC Fraser	2	44.4	97.3	80	81.5	2.0	1	11.9	5.18	43.8	133	80.2	145	236	66	1	30	14
6114	2ND32529	2	46.3	97.2	87	82.8	2.0	1	10.1	4.65	47.7	137	69.1	172	200	47	20	40	3
6115	2ND32829	2	49.5	96.5	87	81.3	1.7	1	11.2	5.29	50.0	121	75.4	63	222	65	2	31	10
6116	MT124112	2	47.6	99.1	86	82.5	1.8	1	10.8	5.34	54.0	122	92.2	134	237	56	9	32	8
6117	MT124128	2	51.6	98.2	84	82.7	2.0	1	11.6	5.62	51.4	104	87.8	163	263	51	16	31	10
6118	MT124069	2	46.8	98.3	81	81.3	2.1	1	10.7	5.17	51.6	109	68.9	242	221	50	17	34	5
6119	MT124134	2	51.0	98.2	83	82.9	2.2	1	11.0	5.47	52.0	95	84.9	227	253	46	21	32	8
6120	UTSB10905-72	6	44.2	97.7	81	78.6	1.9	1	11.0	4.03	38.5	82	38.0	447	141	24	30	N/A	N/A
6121	UTSB11301-1	6	40.6	94.6	84	77.5	1.4	1	10.9	3.83	36.4	124	40.7	464	116	25	29	N/A	N/A
6105	CONRAD MALT CHECK	2	40.5	96.0	71	81.8	2.3	1	12.8	5.72	46.2	147	57.8	343	227	58		21	

Minima	40.5	94.6	80	77.5	1.3	10.1	3.83	36.4	71	27.1	63	113
Maxima	51.6	99.1	87	83.3	2.5	12.1	5.70	54.0	177	93.8	749	268
Means	44.8	96.9	85	81.2	1.8	11.4	4.99	45.9	126	63.1	298	187
Standard Deviations	2.8	1.1	3	1.5	0.3	0.5	0.50	4.6	27	19.0	171	50
Coefficients of Variation	6.2	1.1	3	1.8	14.8	4.1	10.04	10.1	22	30.1	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 Dr. Gongshe Hu, USDA ARS, Aberdeen, ID

Neg Std Dev	36.4	93.7	77	76.7	1.0	10.0	3.49	32.0	44	6.2	-215	37
Pos Std Dev	53.2	100.1	93	85.7	2.6	12.8	6.50	59.7	209	120.1	812	337

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.

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