

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

**MISSISSIPPI VALLEY 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

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2018 MVBN -- 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
6122	MOREX	6	37.6	96.0	87	81.2	1.4	1	11.5	4.87	46.3	178	67.7	137	200	55	13	N/A	N/A
6123	ROBUST	6	38.3	97.9	87	80.8	1.4	1	11.6	5.18	46.6	176	65.0	148	220	62	2	N/A	N/A
6124	LEGACY	6	36.7	94.9	87	81.4	1.5	1	10.1	5.08	52.5	170	81.8	149	219	52	18	N/A	N/A
6125	LACEY	6	39.9	96.8	83	81.0	1.6	1	11.4	5.24	49.5	169	70.8	94	208	58	6	N/A	N/A
6126	TRADITION	6	38.1	98.4	87	79.9	1.8	1	11.5	4.85	44.9	187	71.1	118	184	56	12	N/A	N/A
6127	ND Genesis (2ND25276)	2	44.1	97.6	87	81.0	1.4	1	11.2	4.88	46.6	123	72.9	169	178	58	6	34	11
6128	2B05-0811 (ABI Balster)	2	44.8	97.5	87	82.7	2.0	1	10.7	5.24	50.5	137	81.4	165	228	53	15	29	14
6129	2B09-3425 (ABI Growler)	2	45.4	97.8	87	81.0	2.1	1	11.2	5.37	50.8	132	76.6	132	229	58	6	27	15
6130	S6M168	6	39.9	98.5	87	79.9	1.4	1	11.4	4.87	46.8	170	68.4	145	186	52	18	N/A	N/A
6131	2ND32529	2	45.3	98.3	87	82.7	2.2	1	11.1	4.89	46.2	126	69.6	141	197	64	1	38	6
6132	2ND32829	2	48.8	97.5	87	82.3	1.8	1	10.3	5.08	51.6	105	65.1	85	211	57	11	51	1
6133	ND32889	6	39.8	96.5	87	81.6	1.7	1	10.3	5.37	54.5	162	71.3	76	228	60	4	N/A	N/A
6134	2ND32657	2	47.0	97.4	84	83.0	1.8	1	10.2	4.76	48.6	101	79.2	158	197	44	27	44	3
6135	ND32898	6	38.6	97.1	87	81.0	1.9	1	10.9	5.08	46.6	161	63.6	96	210	61	3	N/A	N/A
6136	ND34118	6	40.4	97.3	84	82.3	*3.1	2	10.2	4.91	49.2	106	65.8	164	211	44	27	N/A	N/A
6137	ND35204	6	37.6	97.0	84	80.8	1.7	1	11.3	5.27	48.3	173	67.3	88	222	60	4	N/A	N/A
6138	ND35207	6	37.3	96.2	86	81.4	1.7	1	10.1	5.15	54.4	138	68.3	94	224	53	15	N/A	N/A
6140	ND35210	6	36.8	96.8	88	81.5	1.9	1	10.2	5.15	53.2	159	64.9	170	217	52	18	N/A	N/A
6141	2ND34634	2	51.1	99.1	81	82.5	2.7	2	10.6	5.43	53.6	113	69.0	303	251	49	23	38	6
6142	2ND34697	2	49.9	98.2	87	81.5	2.2	1	10.7	5.22	52.9	114	69.0	315	239	50	22	34	11
6143	2ND34954	2	46.4	99.2	85	81.7	1.9	1	10.5	4.77	50.4	141	61.3	289	187	47	24	35	10
6144	S6M175	2	39.0	94.1	87	81.1	1.6	1	11.2	5.14	49.0	181	64.4	174	193	53	15	22	16
6145	S6M176	6	39.0	97.8	84	82.2	1.8	1	10.2	4.79	51.8	112	65.4	302	193	37	29	N/A	N/A
6146	S2M178	6	46.1	99.1	87	82.6	1.7	1	10.8	4.78	47.7	108	54.8	193	177	34	30	N/A	N/A
6147	S2M179	2	50.1	98.6	87	82.7	1.6	1	11.9	5.20	45.8	101	61.1	*523	173	55	13	36	9
6148	2IK14-8371	2	42.7	97.3	87	81.9	1.3	1	10.8	4.97	47.6	106	67.1	286	179	45	26	46	2
6149	2IK14-8413	2	46.3	98.9	86	81.8	1.1	1	11.7	5.01	45.7	133	69.1	322	174	58	6	34	11
6150	2IK16-0899	2	43.1	97.8	80	81.0	1.3	1	11.2	4.72	42.9	108	53.1	337	162	51	21	41	4
6151	AcMetcalfe	2	43.4	96.9	87	81.6	1.2	1	11.6	4.93	42.7	138	74.3	270	171	58	6	39	5
6152	Merit57	2	41.0	94.2	87	82.7	1.3	1	10.6	4.90	51.0	127	74.1	255	174	47	24	38	6
6139	LACEY MALT CHECK		31.0	86.6	49	80.2	2.7	1	13.2	6.32	51.2	171	76.8	123	270	48		N/A	

Minima	36.7	94.1	80	79.9	1.1	10.1	4.72	42.7	101	53.1	76	162
Maxima	51.1	99.2	88	83.0	2.7	11.9	5.43	54.5	187	81.8	337	251
Means	42.5	97.4	86	81.6	1.7	10.9	5.04	48.9	139	68.4	185	201
Standard Deviations	4.4	1.3	2	0.8	0.4	0.5	0.20	3.3	28	6.6	83	23
Coefficients of Variation	10.4	1.3	2	1.0	21.0	5.0	4.03	6.7	20	9.7	45	11

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	29.3	93.4	80	79.2	0.6	9.3	4.43	39.2	54	48.6	-64	132
Pos Std Dev	55.7	101.3	92	84.1	2.7	12.5	5.65	58.7	223	88.3	435	271

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