

Barley Variety Trial Field Day

Ground to Glass: Evaluation of unique barley varieties for western Washington craft malting, brewing and distilling

Program

4 to 4:30	Sign in, refreshments
4:45 to 5	Opening comments: brief background on study objectives and research
5 to 5:20	Walk to field
5:20 to 6	Field walk; variety by variety information in quick overview; work from handout with varietal information
6-6:30	Series of 5 min (with 3-5 min Q&A) in-field updates
	Tom & Layton compound flavor analysis
	Brian & Bill barley production and end-use options for the farmer
	John Bourdon regional barley varieties for distilling
	Kevin & Stephen grain breeding and trials for value-added products

Question: do unique flavors exist among breeding lines in the WSU barley breeding program? These could be of interest to craft maltsters, brewers and distillers.

Goal: 50-100% of barley used by regional breweries and distilleries is purchased from regional farmers in Thurston, Lewis, and Grays Harbor Counties

What makes for a good general malting barley?¹

- Pure lot of an acceptable variety
- Germination of 95% or higher
- Protein content ranging between 9.5% to 12.5% (dry basis)
- Moisture content below 13.5%
- Plump and uniform kernels
- Free of disease and low DON content
- Less than 5% of peeled, broken, or damaged kernels
- Clean and free of insects, admixtures, ergot or foreign material

What do craft brewers seek for all-malt barley malts?

- Distinctive flavors and aromas
- Lower free amino nitrogen ("FAN")
- Lower Total Protein
- Lower Diastatic Power ("DP")
- Lower Kolbach Index (ratio of Soluble Protein to Total Protein, or "S/T")

¹ MacLeod, Aaron. *Decoding Malting Barley Quality*. Hartwick College Center for Craft Food and Beverage.

<http://www.hort.cornell.edu/expo/proceedings/2016/Hops%20and%20Grains.Decoding%20Malting%20Barley%20Quality.pdf>

2017 GRAIN QUALITY ANALYSIS

Entry	Yield (t/ac)	Protein (%)	Moist. (%)	Test weight (lbs/bu)	Plump (>6/64 %)	Thin (<5/64 %)	Germ. (Energy, 4mL %)	Germ. (Energy, 8mL %)	RVA
Copeland	n/a	9.8	14.9	51.8	99.1	0.1	100	90	202
Havener* (hulless)	0.615	10.8	15.6	53.2	98.1	0.1	85	61	169
Muir	1.096	9.2	15.0	58.4	92.1	0.4	100	83	128
10WA-107.8* (hulless)	0.709	9.9	14.9	50.1	98.4	0.3	100	82	200
10WA-117.17	1.326	10.0	14.6	50.7	99.0	0.1	96	60	165
10WA-117.24	1.168	10.0	15.0	52.9	99.1	0.1	97	80	160
11WA-107.43	1.206	10.6	15.5	52.4	98.9	0.1	97	71	201
11WA-107.58	0.870	10.1	15.4	50.6	98.7	0.3	96	90	180
12WA-120.14	1.216	10.3	16.9	49.7	99.1	0.1	97	87	176
12WA-120.17	1.251	10.3	13.4	48.9	99.6	0.0	100	91	140

2017 MALT QUALITY ANALYSIS

Description	Malt Moist. (%)	Fria-bility (%)	Fine Extract (% DB)	Wort color (*SRM)	Beta-Glucan (ppm)	Soluble Protein (%)	S/T (%)	FAN (mg/L)	Diastatic Power (°L.)	Alpha Amylase (D.U.)
Copeland	3.7	94.9	81.9	2.44	75	5.14	49.9	232	131	58.5
Havener*	4.0	63.8	89.1	1.60	726	4.02	41.9	149	67	30.5
Muir	3.9	82.0	80.3	2.10	216	4.05	41.3	153	101	41.9
10WA 107.8*	4.3	70.1	83.6	1.82	622	4.47	41.4	171	76	36.4
10WA 117.17	3.8	84.5	80.6	1.60	340	4.03	40.7	156	94	31.0
10WA 117.24	3.5	70.9	78.8	1.69	730	3.75	37.5	138	90	25.3
11WA 107.43	4.0	73.2	82.4	1.57	471	4.08	40.8	157	86	33.9
11WA 107.58	4.0	69.8	80.3	1.71	483	4.15	39.2	164	87	36.1
12WA 120.14	3.8	82.0	81.7	2.49	195	4.80	47.5	217	98	46.1
12WA 120.17	3.7	81.8	81.1	2.39	228	4.64	45.0	202	95	39.0

Gray: varieties advanced in 2018 trials

Orange: control, target high quality

Yellow: 2nd highest quality

Green: 3rd highest quality

ANALYTICAL WORK

- Malt evaluation: Hartwick Center for Craft Brewing and Distilling
- Flavor analysis: distillation at Sandstone Distillery, gas chromatography-mass spectrometry (GC-MS) and sensory evaluation using a tasting panel at the WSU Wine Science Center
- Micro-malting: Oregon State University Micromalter for small lot testing. In 2018 barley will go to a commercial malthouse, and then brewer for full-scale evaluation.

**The hulless lines will typically have higher protein and higher beta glucan, which will need to be considered when malting/brewing/distilling. Also have a higher test weight and % malt extract.*

Malting Barley Characteristics for Craft Brewers²

<i>Trait/topic</i>	<i>Consensus Target</i>	<i>Collected Comments</i>
Grain moisture	< 13%	16-18% Moisture- consider heated drying 14-15% Moisture- needs drying 12-13% Moisture- is stable
Flavor	The most commonly cited attribute	Survey Respondents placed the most emphasis on flavor, calling it priority one. Respondents agreed that recent 10- to 25-year trend towards ever increasing flavor neutrality must be reversed. At the same time brewers recognize that this is the most difficult trait to evaluate & communicate.
Friability	< 85%	How readily a malt crumbles when crushed
Fine extract	> 80%	Better brewing yield, but flavor may justify lower efficiency. One Spokane brewer: "I want efficiency of flavor"
Beta Glucan	<140 ppm	A measure of residual cell wall, indicating degree availability of starch for brewing. Better cell wall breakdown during malting improves brewing performance. Respondents favored lower Beta Glucan levels in general. Respondents also called for development of a more sensitive assay for Beta Glucan.
Protein Modification (S/T)	34% - 45%	Ratio of soluble to total protein. Achieved via varietal change, not by pushing germination moistures lower on existing varieties. Most group members favored 42% maximum; a few favored 45% maximum. Keep moisture levels elevated (43%-44%) towards end of germination.
Protein content	10.5% ideal max 9.5% - 12.5% is an ok range	Many craft brewers acknowledge that protein, DP and FAN are coupled to some extent, and to lower FAN especially, lower protein levels are far more favorable. Some brewers also noted the difficulty in developing malt color if proteins were too low. Ie all-malt grists contain ample enzyme, respondents generally encouraged pushing heat at Break Through during malting to develop color and flavor even if this results in the loss of some enzyme.
FAN	<150 ppm	Free amino nitrogen. Generally want lower than suite of current varieties to promote biological and flavor stability of finished beer. One brewer favored 125-150 range FAN as ideal, but indicated 140 or 150 would work. Another indicated that 140 < FAN < 200 was critical, favoring especially <200 as a maximum.
RVA	>120 good 50-120 ok	A measure of in-field sprouting. RVA numbers between 50-120 (moderate pre-germ) may have sound germination capability, but reduced shelf-life.
Diastatic Power	< 150 Lintner	In all-malt beer production, the primary concern noted was too much enzyme, or an enzyme package that is "too hot." One surveyed brewer favored very modest change here, citing under-attenuation as a potential concern with too low DP.

² Malting Barley Characteristics for Craft Brewers: <https://www.brewersassociation.org/best-practices/malt/malting-barley-characteristics/>

Notes from Past Barley Breeding Program Trials

		BSR	LR %	LR S/R	Notes
1	10WA-117.17	R	70	S	Low wort protein, high malt clarity, moderate % malt extract, FAN=130ppm
3	12WA-120.17	R	45		Very promising. Stripe rust resistant, not much lodging, low protein, not too tall, and yields well.
4	12WA-120.14	30	35		

*BSR: Barley stripe rust (*S* = susceptible, *R* = resistant)

**LR%: % impact of Leaf Rust

***LR S/R: *S* = susceptible, *r* = resistant

2016 Mt Vernon Field Trial Results

	Heading	Height	Leaf rust	Barley stripe rust	Mildew	Lodging	Ag score	Protein	Test weight	Yield
10WA-117.17	156	37	70	0	40	20	4	8.1	51	5105
Muir	155	38	40	0	70	43	3.5	8.3	52	4573
12WA-120.17	155	35	45	0	55	3	3	7.7	52	6512
12WA-120.14	154	35	35	30	45	25	2.5	7.3	52	5701
Havener (hulless)	160	34	65	12.5	70	8	3	12.1	56	3616
10WA-107.8 (hulless)										
11WA-107.58	154	34	45	35	60	10	3	7.6	52	5498
11WA-107.43	154	33	45	12.5	55	0	3	8.3	52	6037
10WA-117.24	156	39	50	0	35	30	3.5	8.6	50	4898
CDC Copeland	157	43	55	0	60	15	3.5	7.9	50	5373

Selected Barley Resources

WSU barley breeding:

- <http://css.wsu.edu/people/faculty/kevin-murphy/>
- <http://css.wsu.edu/people/faculty/steven-e-ullrich/building-better-barley/>

OSU Barley Program:

- <http://barleyworld.org/>

City of Tumwater Craft Brewing and Distilling

- <http://www.ci.tumwater.wa.us/doing-business/craft-brewing-and-distilling-center>

SPSCC Craft Brewing and Distilling

- <https://spscc.edu/brewing>

Brewers Association

- <https://www.brewersassociation.org/>

American Craft Spirits Association

- <http://www.americancraftspirits.org/>