

**Release of “Oregon Promise” Two-row Spring Malting Barley**

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“Oregon Promise” is a two-row, spring malting barley (*Hordeum vulgare* subsp. *vulgare*) developed by Oregon State University (OSU). The variety is proposed for release based on the flavor properties it contributes to beer, its glycosidic nitrile (GN) non-producing phenotype, its unique malting quality profile, and its agronomic performance under irrigated conditions.

Tested under the designator, DH120285, the proposed name is “Oregon Promise”, recognizing its membership in the Oregon Promise Mapping population, a genetics resource for assessing the contributions of barley to beer flavor (Herb et al. 2017a, 2017b; Bettenhausen et al. 2020). The proposed name also capitalizes on Oregon’s leading role in innovative craft brewing and the distilling, while at the same time recognizing the essential role of its heirloom parent variety “Golden Promise”.

Oregon Promise is a rough-awned, two-row spring semi-dwarf barley with long rachilla hairs. The parents of Oregon Promise are “Golden Promise” and “Full Pint”. Golden Promise is an iconic two-row spring semi-dwarf malting barley developed by the Miln Marsters seed company (now part of Limagrain Cereal Seeds) in the 1960s. It was a popular malting barley in the UK in the 1970s and 1980s (Oliver, 2012). Small quantities are still grown and marketed as a premium specialty barley. It is one of the few barley varieties that brewers and distillers know by name (Mallett, 2014). Full Pint is a two-row spring semi-dwarf malting barley released by Oregon State University in 2014 [originally released as germplasm BCD47, PI659444 (Verhoeven et al. 2011)]. Full Pint was derived from a molecular marker-assisted selection program designed to pyramid multiple stripe rust resistance genes in a malting quality background. According to some brewers and maltsters, Full Pint makes unique contributions to beer flavor (reviewed by Mallett, 2014), and it has figured prominently in the branding of Mecca Grade Estate Malt (<https://www.meccagrade.com/>).

The cross between Golden Promise and Full Pint was made in 2011, doubled haploids were produced in 2012, and field trials began in 2013. Oregon Promise was grown as part of the Oregon Promise mapping population for two years before selections were made from this population and advanced to statewide and nationwide yield trials as potential varieties. Selections were based on agronomic performance, malting quality, and nano-scale beer flavor assessment. The top three lines from the population were chosen for pilot scale assessment of

beer and compared to the check “Copeland”. Sensory panels found that the beers made from these four barleys had distinct flavor profiles. Oregon Promise was described as having the most desirable flavor for a light ale/lager style of beer by a consumer sensory panel (Bettenhausen et al., 2020).

### **Malting Quality & Flavor**

Malting quality data are presented in Tables 1-3. Due to the customary lack of replication of malt analyses within environments, ANOVAs were performed using locations as replications and mean separation tests were based on LSD ( $P = 0.05$ ).

Due to its unique attributes, Oregon Promise may have a role in all malt brewing & distilling as well as adjunct brewing and grain distilling. The most comprehensive set of malting quality data are provided in Table 1, where Copeland and Full Pint were used as checks. In eight micro-malting tests, the malting quality of Oregon Promise was competitive with both checks - but with some key differences (Table 1). The kernel plumpness was comparable for the three varieties but slightly better for Oregon Promise. This difference, however, was not significant. Malt extracts were not significantly different, although Oregon Promise was ~1% lower than Copeland. In this regard, Oregon Promise still meets the benchmark for grain distilling. Malt protein was significantly higher for Oregon Promise than for Copeland, falling within specification for all malt brewing and distilling as well as adjunct brewing, and just below the grain distilling specification. There were no significant differences in wort protein; all three varieties met specifications for all end-uses except grain distilling, where all were ~1% below the specification. Soluble/total protein (S/T) and diastatic power (DP) are within range for adjunct brewing but slightly high for all malt brewing/distilling and low for grain distilling. There were no significant differences for the S/T ratio. Both Oregon Promise and Full Pint were significantly higher in DP than Copeland. Oregon Promise is very similar in alpha amylase to Copeland and significantly lower than Full Pint. All of three varieties meet adjunct and grain distillers’ specifications for these enzyme traits, and are slightly high for all malt brewing and distilling. The wort beta glucan meets specification, being comparable to Copeland and significantly lower than Full Pint. All three varieties have >200 ppm in free amino nitrogen (FAN), with no significant differences. A more limited set of malt quality data are provided in Table 2, where

Golden Promise is included as a check. In these tests, Golden Promise had a significantly lower percentage of plump kernels malt extract and S/T, and a significantly higher wort beta glucan.

In summary, although Oregon Promise does not always fall within specifications for the American Malting Barley Association (AMBA) malting barley breeding guidelines, it is generally not too far out of range. While malt quality attributes are inherent to the barley genotype, many of these quality attributes can be manipulated with management practices in the field and malthouse. For example, with an increase in protein (field) and an increase in modification (malthouse) it may be possible to meet the specifications for grain distillers. For brewers/distillers interested in Golden Promise qualities, Oregon Promise may be an interesting option, as it consistently has a superior malting quality profile compared to its 1960's vintage parent.

Oregon Promise has unique end-use qualities related to brewing and distilling. Compared to Copeland and two other lines from the mapping population, beer brewed from Oregon Promise malt was given the highest score for overall liking by a consumer sensory panel, and this beer was described as being less bitter, more citrus, and more crisp than the other lines in the panel (Bettenhausen et al. 2020). The malting quality data for Oregon Promise, Copeland, and Full Pint from this flavor study are provided in Table 3. Oregon Promise is a GN non-producer. AMBA guidelines specify that for all-malt distilling, a malt must contain less than  $<0.5$  g/MT of glycosidic nitrile. Otherwise, under certain distillation conditions ethyl carbamate (a carcinogen) formation can occur. A limited number of other non-producing GN barleys exist, including "LCS Genie", with most of them being developed for the UK market.

Oregon Promise is not in the AMBA approval pipeline, as this agency has limited capacity to test new potential malting varieties and therefore restricts its testing to potential varieties whose development it has funded. In the case of OSU, AMBA funding is directed at the development of winter and facultative two-row malting barley. Funding for the development and testing of Oregon Promise was provided by the Flavor Pack and the Brewers Association.

Table 1. Malt quality <sup>1</sup> of Oregon Promise and check cultivars/parents using data from analyses of barley samples grown at multiple locations in Oregon (2015-2018).

Entry	Plump Kernels <sup>2</sup> (%)	Malt Extract (%)	Malt Protein (%)	Wort Protein (%)	S/T (%)	DP ( <sup>0</sup> ASBC)	Alpha Amylase (20°DU)	Beta Glucan (ppm)	FAN (ppm)
<i>Station yrs.</i>	8	8	8	8	8	8	8	8	8
Oregon Promise	94.5 a	80.4 a	11.3 a	5.2 a	46.3 a	163 a	79 b	84 b	227 a
Full Pint	92.9 a	80.5 a	10.9 ab	5.0 a	47.0 a	156 a	92 a	160 a	214 a
Copeland	91.0 a	81.4 a	10.1 b	5.0 a	50.2 a	109 b	81 b	53 b	208 a

<sup>1</sup>Data courtesy of the USDA-ARS Cereal Crops Research Unit, Madison, WI and Rahr Malting Co., Shakopee, MN.

<sup>2</sup>Data collected at Oregon State University.

Table 2. Malt quality <sup>1</sup> of Oregon Promise and check cultivars/parents using data from analyses of barley samples grown at multiple locations in Oregon (2015-2017).

Entry	Plump Kernels <sup>2</sup> (%)	Malt Extract (%)	Malt Protein (%)	Wort Protein (%)	S/T (%)	DP ( <sup>0</sup> ASBC)	Alpha Amylase (20°DU)	Beta Glucan (ppm)	FAN (ppm)
<i>Station yrs.</i>	5	5	5	5	5	5	5	5	5
Oregon Promise	94.2 a	80.3 ab	11.5 a	4.9 a	42.9 ab	170 a	81 a	95 bc	226 a
Full Pint	92.2 a	79.8 ab	11.4 a	4.9 a	42.8 b	158 a	93 a	157 b	214 a
Golden Promise	77.6 b	78.0 b	10.9 a	3.9 b	36.1 c	114 b	49 b	403 a	135 b
Copeland	89.2 a	80.8 a	10.3 a	4.8 a	46.9 a	110 b	81 a	52 c	209 a

<sup>1</sup>Data courtesy of the USDA-ARS Cereal Crops Research Unit, Madison, WI and Rahr Malting Co., Shakopee, MN.

<sup>2</sup>Data collected at Oregon State University.

Table 3. Malt quality <sup>1</sup> of Oregon Promise and check cultivars/parents using data from analyses of barley samples (n=1) grown at Lebanon, OR in 2017 and malted in the OSU pilot mini-malter.

Entry	Plump Kernels <sup>2</sup> (%)	Malt Extract (%)	Malt Protein (%)	Wort Protein (%)	S/T (%)	DP ( <sup>0</sup> ASBC)	Alpha Amylase (20°DU)	Beta Glucan (ppm)	FAN (ppm)
Oregon Promise	97.6	80.4	10.5	5.0	47.5	168	64	58	205
Full Pint	97.4	80.5	10.8	4.8	44.6	178	90	164	196
Copeland <sup>3</sup>	97.5	82.1	10.8	4.8	44.8	146	59	74	195

<sup>1</sup>Data courtesy of the Hartwick Center for Craft Food and Beverage, Oneonta, NY.

<sup>2</sup>Data collected at Oregon State University.

<sup>3</sup>Copeland grain was sourced from Great Western Malting.

## **Agronomic Performance**

Agronomic data are presented in Tables 4-9. Due to the imbalance inherent in analysis of multi-environment agronomic trait data, unless otherwise indicated, ANOVAs were performed using locations as replications and mean separation tests were based on LSD ( $P = 0.05$ ).

Agronomic data across all station years are summarized in Table 4. The table is comprised of data from across the U.S. over three years. Oregon Promise was significantly lower yielding and lower in test weight than Full Pint; differences with other varieties were not significant. Heading dates were comparable for all varieties. Copeland was significantly taller, but there were no significant differences for lodging. Oregon Promise had significantly less brackling than Full Pint. Only Copeland had a significantly lower grain protein. Golden Promise had a significantly lower percentage of plump seed. There was one instance of pre-harvest sprouting (PHS) observed, which was quantified using rapid visco analysis (RVA). In this test, Oregon Promise was moderately pre-germinated, Full Pint was significantly pre-germinated, and both Golden Promise and Copeland would be considered to have produced sound grain. Therefore, in the event of late season rains, the grain quality of Oregon Promise should be assessed for PHS.

Grown west of the Cascades in breeding program trials without irrigation (Table 5), Oregon Promise was not significantly different from the other varieties for grain yield, test weight, or heading date. Copeland was significantly taller, and Oregon Promise had significantly less lodging. Oregon Promise had significantly less brackling than Full Pint. Oregon Promise and Full Pint had significantly higher grain protein and were significantly more plump than Golden Promise.

Oregon Promise has also been grown in Oregon and Idaho extension trials under irrigated and dryland conditions. LCS Genie was included as a check in the Idaho trials, as it is a widely grown spring 2-row malting barley; Full Pint was not included in these trials. Oregon Promise performed well under irrigated conditions in Idaho (Table 6), although Genie had a significant

yield advantage over Copeland and Oregon Promise, and both Genie and Copeland had significantly higher test weights. Oregon Promise was significantly shorter than Copeland and Genie, but there were no significant differences in lodging. Data from only one irrigated Extension trial are available from Oregon (Table 7). In this trial, there were no significant differences except for protein, where Oregon Promise was significantly higher than Genie.

In dryland Extension trials in Oregon and Idaho, there were no significant differences between varieties (Table 8).

Based on these data, Oregon Promise is recommended for production under irrigation, where its short stature can be an advantage. Under dryland conditions, shorter varieties are at a disadvantage in terms of weed competition and they can be problematic for harvesting.

Table 4. Agronomic performance of Oregon Promise compared to check cultivars/parents. Average of 2015-2017 trials across the U.S.

Entry	Yield (lbs/acre)	Test Weight (lbs/bu)	Heading (DOY)	Plant Height (in)	Lodging (%)	Brackling (%) <sup>1</sup>	Protein (%)	Plump (% on 6/64)	RVA (RVU) <sup>2</sup>
<i>Station yrs.</i>	<i>15</i>	<i>15</i>	<i>2</i>	<i>14</i>	<i>6</i>	<i>1</i>	<i>15</i>	<i>15</i>	<i>1</i>
Oregon Promise	5081 b	50.0 b	136 a	68 b	15 a	8 b	12.5 a	85.7 a	90
Full Pint	5768 a	51.5 a	137 a	67 b	14 a	23 a	12.0 a	87.4 a	24
Golden Promise	5263 ab	50.6 ab	140 a	67 b	41 a	18 ab	12.2 a	77.8 b	124
Copeland	5457 ab	50.7 ab	138 a	96 a	43 a	15 ab	11.1 b	89.0 a	146

<sup>1</sup>ANOVA and means separation were done across 2 reps.

<sup>2</sup>Data from 1 rep.

Table 5. Agronomic performance of Oregon Promise compared to check cultivars/parents. Average of 2015-2017 trials west of the Cascades (non-irrigated).

Entry	Yield (lbs/acre)	Test Weight (lbs/bu)	Heading (DOY)	Plant Height (in)	Lodging (%) <sup>1</sup>	Brackling (%) <sup>1</sup>	Protein (%)	Plump (% on 6/64)
<i>Station yrs.</i>	5	5	2	5	1	1	5	5
Oregon Promise	5206 a	52.0 a	136 a	71 b	0 b	8 b	11.2 a	93.6 a
Full Pint	6140 a	54.1 a	137 a	67 b	8 a	23 a	11.0 a	92.2 a
Golden Promise	6172 a	52.7 a	140 a	71 b	5 a	18 ab	9.8 b	82.2 b
Copeland	5979 a	52.1 a	138 a	101 a	5 a	15 ab	9.2 b	88.2 ab

<sup>1</sup>ANOVA and means separation were done across 2 reps.

Table 6. Agronomic performance of Oregon Promise compared to check cultivars. Average of 2018-2019 Idaho Extension trials under irrigated conditions.

Entry	Yield (lbs/acre)	Test Weight (lbs/bu)	Heading (DOY)	Plant Height (in)	Lodging (%)
<i>Station yrs.</i>	6	6	5	5	5
Oregon Promise	5656 b	46.5 b	176 a	28 c	31 a
Copeland	5416 b	48.5 a	176 a	40 a	43 a
LCS Genie	6240 a	49.0 a	176 a	31 b	22 a

Table 7. Agronomic performance of Oregon Promise compared to check cultivars. 2018 Oregon Extension trial under irrigated conditions in Madras, OR.\*

Entry	Yield (lbs/acre)	Test Weight (lbs/bu)	Plant Height (in)	Protein (%)
<i>Station yrs.</i>	1	1	1	1
Oregon Promise	5607 a	53.8 a	26 a	14.0 a
Full Pint	6363 a	54.6 a	26 a	13.7 ab
LCS Genie	6098 a	54.3 a	29 a	12.5 b

\*Mean separation provided by OSU Extension.



Table 8. Agronomic performance of Oregon Promise compared to check cultivars. Average of 2018 Idaho Extension trials under dryland conditions.

Entry	Yield (lbs/acre)	Test Weight (lbs/bu)	Heading (DOY)	Plant Height (in)	Lodging (%)	Plump (% on 6/64)
<i>Station yrs.</i>	2	2	2	2	2	2
Oregon Promise	2856 a	50.3 a	182 a	24 a	0 a	88.5 a
Copeland	3456 a	50.7 a	186 a	32 a	5 a	92.0 a
LCS Genie	3480 a	51.4 a	185 a	26 a	3 a	95.5 a

Table 9. Agronomic performance of Oregon Promise compared to check cultivars. Average of 2018-2019 Oregon Extension trials under dryland conditions.

Entry	Yield (lbs/acre)	Test Weight (lbs/bu)	Plant Height (in)	Protein (%)
<i>Station yrs.</i>	4	4	4	4
Oregon Promise	2640 b	51.8 b	19 b	12.1 a
Full Pint	3013 ab	53.5 a	19 b	11.7 a
LCS Genie	3161 a	53.1 a	20 a	10.1b

### Resistance to Biotic Stresses

Disease reaction data are reported for the few environments where disease was observed (Table 10). In the Pacific Northwest, especially west of the Cascades, barley stripe rust (incited by *Puccinia striiformis* f. sp. *hordei*) is the principal disease threatening barley. Depending on year and location, leaf rust (*Puccinia hordei*) and powdery mildew (*Blumeria graminis*) can also be diseases of concern. Oregon Promise and both parents (Full Pint & Golden Promise) displayed good resistance to barley stripe rust compared to Copeland, which was significantly more susceptible. Oregon Promise displayed a lower (although not significantly lower) level of leaf rust than Golden Promise. Full Pint had no disease reaction to leaf rust. In the trial where powdery mildew was observed, Golden Promise and Copeland both displayed significantly better resistance than Oregon Promise, which was similar to Full Pint. Oregon Promise was included in a stem rust nursery conducted in Africa by the USDA-ARS in 2018 (Table 11).

Oregon Promise and its parents had lower levels of disease than Copeland, although all four varieties had similar responses to race TTKSK and its local variants.

Based on the available data, Oregon Promise has acceptable levels of resistance to barley stripe rust and leaf rust. Powdery mildew would require monitoring and fungicide control if needed. Oregon Promise is not hyper-susceptible to race TTKSK at the adult plant stage.

Table 10. Disease response of Oregon Promise and check cultivars – west of Cascades.

Entry	Stripe Rust (%)	Leaf Rust (%) <sup>1</sup>	Powdery Mildew (%) <sup>2</sup>
<i>Station yrs.</i>	2	1	1
Oregon Promise	5 b	5 ab	23 a
Full Pint	4 b	0 b	25 a
Golden Promise	6 b	22.5 a	13 b
Copeland	40 a	-	0 c

<sup>1</sup>ANOVA and means separation were done across 2 reps.

<sup>2</sup>ANOVA and means separation were done across 3 reps.

Table 11. Stem rust severity (numerical %) and infection type from Africa in 2018. M= Moderately (a qualifier used for the ratings R = resistant and S = susceptible). Two of the same designators in series means the disease rating was intermediate between the two. For example, MRMS means the infection type was intermediate between Moderately Resistant and Moderately Susceptible.

Line	Stem Rust	
	Kenya	Ethiopia
Oregon Promise	10MS	15MS
Full Pint	10RMRMS	15SMS
Golden Promise	10RMR	15MSS
Copeland	15RMRMS	20SMS

## **Seed Production**

Breeder's seed was produced from head row purification blocks at Hyslop Agronomy Farm, Corvallis, OR USA in 2019 as well as from thoroughly rogued trial plots in Lebanon, OR USA in 2018. In spring 2020, 1.5 acres were planted for Foundation seed production at Washington State Crop Improvement facilities, Othello WA USA.

## **Licensing and Royalties**

Oregon Promise is recommended for release with non-exclusive licenses. There will be a one-time application fee of \$250 for each non-exclusive license. Those interested in a license should contact Denis Sather at the OSU Office of Commercialization and Corporate Development (denis.d.sather@oregonstate.edu). Oregon Promise can only be sold as a class of certified seed with a royalty of \$0.03/lb. The \$0.03/lb royalty will be paid on sale of this seed. All grain harvested must be disposed of by malting or feeding, unless permission is obtained - in writing - from OSU to use the seed for other purposes, including re-planting.

## **Variety Protection**

Plant Variety Protection will not be sought for Oregon Promise due to the special status of malting barley in the US, where the malting barley supply chain is based on sale of certified seed. By specifying that all seed sales must be a class of certified seed, we will ensure that growers will be purchasing seed from the seed dealers with non-exclusive licenses. There is not an open market in the US for malting barley that is not grown from a class of certified seed: the risk to the maltster is too great. The variety will be protected by Federal Seed Law and OSU recognized as the owner of the variety. Furthermore, Oregon, Idaho and Washington state trademarks will be applied for, which specify that the variety can only be sold under the name of "Oregon Promise".

## Notice of the release and deposition in seed repositories

A variety release for Oregon Promise will be submitted to the Journal of Plant Registrations and seed will be deposited with USDA collections, as required for such releases.

## Acknowledgements

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