In the beginning there was *Hordeum spontaneum*

Now there are beverages, foods, feeds, and more *Hordeum vulgare* *

2n = 2x = 14

5.3 Gbp

~ 30,000 genes

Self-pollinated (hermaphroditic)

* Technically speaking *spontaneum* and *vulgare* are both subspecies of *H. vulgare*
What domestication hath wrought….

<table>
<thead>
<tr>
<th>Spontaneum</th>
<th>Vulgare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shattering (brittle rachis)</td>
<td>Shattering resistant (non-brittle rachis)</td>
</tr>
<tr>
<td>2-row</td>
<td>2-row, 6-row</td>
</tr>
<tr>
<td>Adhering hulls</td>
<td>Adhering, non-adhering (naked)</td>
</tr>
<tr>
<td>Winter annual</td>
<td>Winter, facultative, and spring annual</td>
</tr>
</tbody>
</table>

Apparent diversity

Apparent diversity
Domestication and evolutionary bottlenecks

<table>
<thead>
<tr>
<th>Spontaneum and exotic/landrace accessions</th>
<th>Current varieties</th>
</tr>
</thead>
</table>

The imperative for conservation and characterization of genetic resources
Domestication – why?

Food and pleasure
From domestication to migration

1 mile per year (?)
Migration and specialization

Europe

Beer

• Hulls, spring growth habit, 2-row

Feed (food and some beer)

• Hulls, spring/winter/facultative, 6-row

“The decree known as the Reinheitsgebot, issued in Ingolstadt in 1516, had three aims: to protect drinkers from high prices; to ban the use of wheat in beer so more bread could be made; and to stop unscrupulous brewers from adding dubious toxic and even hallucinogenic ingredients as preservatives or flavourings.”
Migration and specialization

Central/East Asia – food
• Naked, spring, 6-row
Migration and specialization

Americas (17\textsuperscript{th} century - )

North and Meso

- Hulls, spring growth habit, 2-row malt – Europe
- Hulls, spring growth habit, 6-row malt – Europe/Asia
- Hulls, spring/winter/facultative 6-row feed – Iberian peninsula/North Africa
The 2017 barley report

---------- Forwarded message ----------
From: Morning Agriculture <morningagriculture@politicocom>
Date: Mon, Sep 18, 2017 at 8:02 AM
Subject: POLITICO's Morning Agriculture: Montana barley growers look to Mexico — NYT highlights Big Food's role in obesity crisis abroad — Pork warns of 'financial apocalypse' if NAFTA 2.0 bombs
To: EatWellatSchool@gmail.com

By John Lauinger | 09/18/2017 10:00 AM EDT

With help from Sabrina Rodriguez, Christine Haughney, Megan Cassella, Catherine Boudreau and Helena Bottemiller Evich

MONTANA BARLEY GROWERS LOOK TO MEXICO: The craft beer sector in Mexico is expanding rapidly, and Montana barley growers want in on the action. Pro Ag's Catherine Boudreau traveled to Montana in June and witnessed how the U.S. Grains Council used funding from two controversial export-promotion initiatives - the Market Access Program and Foreign Market Development - in a bid to entice Mexican craft brewers into making deals.

Montana farmer Mark Lacher noted how earlier this year industry heavyweights AB-InBev and MillerCoors - which purchase nearly two-thirds of the barley grown in north-central Montana - announced they were reducing the number and size of production contracts with area farmers by anywhere from 20 percent to 60 percent due to oversupply. "The doors are open," Lacher said, referring to potential for new export arrangements.
Breeding barley at a Land Grant University: The OSU Barley Project

Facultative 2-row malting; Facultative 2 (6) row multi-use naked

<table>
<thead>
<tr>
<th>Locus/alleles</th>
<th>Phenotype</th>
<th>Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vrn1, Vrn2, Vrn3</td>
<td>Growth habit</td>
<td>Loss of function deletions</td>
</tr>
<tr>
<td>Ppd1, Ppd2</td>
<td>Flowering time</td>
<td>Loss of function deletions</td>
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</tbody>
</table>

![Diagram of Vrn and Ppd alleles](image-url)
The OSU Barley Project

Crossing

Doubled haploids

Genetics and Breeding

Publication, Variety/Germplasm release

Effects of Barley (*Hordeum vulgare* L.) Variety and Growing Environment on Beer Flavor


**ABSTRACT**

J. Am. Soc. Brew. Chem. 75(4):000-000, 2017

This research tested the hypothesis that barley genotype can affect beer flavor and assessed the relative contributions of genotype and location to beer sensory descriptors. Golden Promise, Full Pint, 34 of their is placed on the suitability of barley cultivars for malting, rather

New barley varieties are rigorously tested for malting suitability through programs set by bodies such as the American Malting Barley Association (AMBA) (www.ambainc.org), the Brewing

and Malting Barley Research Institute (www.bmbri.ca), Barley
The OSU malt house
Certificates of analysis
Barley World Malts
Buy ‘em all at Corvallis Brewing Supply

<table>
<thead>
<tr>
<th>Date</th>
<th>LAB ID</th>
<th>Description</th>
<th>Moisture %</th>
<th>Friability %</th>
<th>Extract %</th>
<th>Color °SRM</th>
<th>β-glucan mg/L</th>
<th>Soluble %</th>
<th>Protein %</th>
<th>S/T %</th>
<th>FAN mg/L</th>
<th>DP °L</th>
<th>Alpha Amylase</th>
<th>Filtration Time</th>
<th>Clarity</th>
<th>pH</th>
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<tbody>
<tr>
<td>16-Sep</td>
<td>ML-16-854</td>
<td>OSU Malt 2015-3</td>
<td>6.8</td>
<td>92.3</td>
<td>80.8</td>
<td>2.67</td>
<td>76</td>
<td>4.6</td>
<td>9.7</td>
<td>47.4</td>
<td>140</td>
<td>72</td>
<td>44.7</td>
<td>normal</td>
<td>hazy</td>
<td>5.91</td>
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<tr>
<td></td>
<td>ML-16-855</td>
<td>OSU Malt 2015-5</td>
<td>4.2</td>
<td>86.5</td>
<td>80.5</td>
<td>4.55</td>
<td>97</td>
<td>4.8</td>
<td>9.7</td>
<td>49.5</td>
<td>180</td>
<td>75</td>
<td>53.0</td>
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<tr>
<td>6-Oct</td>
<td>ML-16-926</td>
<td>Batch 2016-6 Full Pint</td>
<td>3.4</td>
<td>79.3</td>
<td>80.0</td>
<td>4.47</td>
<td>146</td>
<td>4.8</td>
<td>10.1</td>
<td>47.5</td>
<td>193</td>
<td>110</td>
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<td>27-Oct</td>
<td>ML-16-1015</td>
<td>Batch 2016-7 Buck Hull</td>
<td>4.0</td>
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<td>2.08</td>
<td>427</td>
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<tr>
<td>30-Nov</td>
<td>ML-16-1149</td>
<td>OSU Batch 2016-8, Copel</td>
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<td>89.0</td>
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<td>199</td>
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<td>46.8</td>
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<tr>
<td>2-May</td>
<td>ML-17-505</td>
<td>Copeland Batch 2017-5</td>
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<td>95.8</td>
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<td>22-May</td>
<td>ML-17-506</td>
<td>Copeland Batch 2017-6</td>
<td>5.1</td>
<td>86.1</td>
<td>81.1</td>
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<td>152</td>
<td>61.4</td>
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<tr>
<td>22-May</td>
<td>ML-17-574</td>
<td>Copeland Batch 2017-7</td>
<td>5.5</td>
<td>86.4</td>
<td>81.8</td>
<td>1.28</td>
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<td>4.79</td>
<td>11.6</td>
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<td>155</td>
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<td>31-Aug</td>
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<td>Buck Batch 2017-12</td>
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<td>4.12</td>
<td>9.9</td>
<td>41.6</td>
<td>161</td>
<td>75</td>
<td>37.9</td>
<td>normal</td>
<td>hazy</td>
<td>5.86</td>
</tr>
</tbody>
</table>
Bringing it all back home to Central Oregon

Mecca Grade Estate Malt, Full Pint, and Next Pint
The hull – so divisive!

Is it time for barley to go naked after 10,000 years?

Multi-use naked barley for malt/food/feed: NIFA-OREI

Larry Sidor, Crux Fermentation project + breeders, growers, food processors, maltsters from around the US
Crossing, selection (phenotypic, genetic/genomic), **mutants**, GMOs, and CRISPR

*Golden Promise*
*(gamma irradiation of Maythorpe, ari-e, 1968)*

**Mechanism**

<table>
<thead>
<tr>
<th>LOX</th>
<th>Loss of function deletions</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMS</td>
<td></td>
</tr>
</tbody>
</table>
www.barleyworld.org

Variety Showcase: October 2, 2017
Portland, OR

Cascadia Grain Conference: January 19/20, 2018
Olympia, WA

Barley Day: May/June ?, 2018
Corvallis, OR
Breed your own!

- **The Oregon Naked Barley Blend**
- ~753 different naked doubled haploids from 20 different crosses
- 2-row, 6-row; spring, facultative, winter; white, brown, blue, purple
- **Your opportunity for natural and/or artificial selection**
- 1 envelope plants 100 – 200 square feet
Thanks!
The Oregon Barley Project crew – past and present

Brought to you by
Your Oregon and Federal tax dollars, USDA-NIFA grants, USDA-ARS, American Malting Barley Association, Great Western Malting, The Flavor7-Pack, Mecca Grade Estate Malt