Barley Genetics and Improvement for Abiotic Stress Tolerance
MSU Barley Breeding, Genetics and Quality

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http://www.montana.edu/barleybreeding
facebook @MSUBarleyMaltQualityLab
With thanks to cooperators

• Jim Berg
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Abiotic Stress Resistance

- Root Development
  - Drought
  - Acid Soils
  - Salt
- Cold Tolerance
  - Winter
- Forage
- Malt Quality Stability
  - Buzz
    - Low protein and stable plumps
  - Preharvest Sprouting
    - Dormancy vs Speed of hydration
Barley pushing into more marginal environments.

- Production has moved west
- Montanans plant more barley acres than any state
- Important part of rotation to manage pests
- Many end-uses providing multiple markets for growers
- About 50% of total grain and 90% of feed exported as a commodity
- Value added - Malt, forage
Goal: Improve Barley to provide a benefit

<table>
<thead>
<tr>
<th>Breeding Goals</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
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<tbody>
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<td>High yield, high quality malt or feed</td>
<td>90</td>
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<td>Heirloom malt</td>
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<td>Forage</td>
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<td>Lodging resistance</td>
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<td>FHB resistance</td>
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<td>Extended grain-fill</td>
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<th>Season</th>
<th>2015</th>
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<td>Malt</td>
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Diversity in root development

- Speed of root growth
- Lateral root development
- Changes in roots during development

Jessica Williams
Stages of root development

- 6 days
- 12 days
- 24 days
Rhizotron-underground view at maturity

Maryse Bourgault, NARC
<table>
<thead>
<tr>
<th>Line</th>
<th>Days from Planting to Sampling</th>
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<tr>
<td>MT16M01404 MT100120/ND24260</td>
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![Graphs showing root length vs. days to sampling for different lines.](image-url)
Length of Roots
Acid/Normal
Sustainable barley - Winter
Winter barley more sustainable?

Advantages
• Rotational Tool
• Ground cover
• Take advantage of spring moisture
• Earlier harvest
• Higher yields

Problems
• Cold tolerance
• Adaptation to Montana
  • Heading date
  • Maturity date
• Quality issues
• Weed issues
No-Till Winter Survival
Sustainable Forages
Biomass
Quality

Traci Hoogland
**Population** – 260 Diverse lines from GRIN  
+ 4 checks  
**Design** - Augmented with replicated checks RCB (10 blocks)  
**Location** – Post Farm, 2016 and 2017  
**Environments** - Dry and Irrigated  
**Traits** – Phenology, Yield, Quality
Longer grainfill improves quality

**days_to_head effect plot**

- ADF vs. days_to_head

**days_to_soft effect plot**

- ADF vs. days_to_soft
Can we increase biomass and improve quality?
Sustainable barley – Stable Malt Quality
Why Buzz?

**Agronomic Strengths**
- Low grain protein
- Stable plumps

**Quality Strengths**
- High Malt Extract
- Low DP value
- Low Beta glucan
- Faster hydration
- More stable quality

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Tom Blake
Protein across dry and irrigated environments

Protein with increasing N

Speed of Hydration
Resistance to Preharvest Sprouting

Joe Jensen
Preharvest Sprouting – If sprouted already, won’t malt.
Hydration of endosperm
Malt Quality = Speed of Hydration
Dormancy vs Hydration (MT124128 X MT124148)

<table>
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<tr>
<th>MT124128X MT124148</th>
<th>Days after Harvest to Break Dormancy</th>
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<td>113</td>
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<td>Hockett</td>
<td>3</td>
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<td>5</td>
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Improving Barley Grower to Glass

Questions?

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