Executive Summary: Significant progress has been achieved within each market class – feed, malting, and food – of barley. Havener, the first hulless food barley release by the WSU Barley Breeding Program which addresses a need for higher yielding hulless varieties with an elevated β-glucan (a heart-healthy soluble dietary fiber) content, continued to perform well. Developed specifically for human consumption, Havener contains 50 to 75% higher β-glucan than common Washington-grown varieties Lyon, Muir, Champion, Bob and Baronesse. Havener has higher yields and test weights across all eastern Washington rainfall zones than the hulless variety Meresse. In addition to Havener, we identified a hulless breeding line, X05013-T1, with even higher β-glucan (~7.5%) than Meresse or Havener (~6.0%), and high yields across a broad spectrum of environments. It is our intention to put this up for full release in February 2017 at the WSU Cereal Release Committee meeting.

Our continued field trials of the imidazolinone (IMI) herbicide tolerant feed barley germplasm also are coming to fruition. Of the five advanced IMI-tolerant spring barley lines in the Bob background we to the WSU Variety Testing Program in 2015, we selected one, 07M-203, to submit for full release in February 2017. This line is similar in grain yield to Bob, but with added benefit of herbicide tolerance. This has been a major goal of our breeding program over the past several years, and our work here is beginning to pay off. Our continued breeding efforts for an IMI-tolerant spring barley include the development of hundreds of advanced feed, food and malt lines through extensive crossing and utilization of double haploid technology when appropriate to speed the breeding process. Our backcrossed and top-crossed lines continue to show promise and will be the focus of our breeding program to expedite the release of an additional IMI-tolerant barley variety in the near future.

Finally, low protein, high-yielding breeding lines that showed excellent potential for future release of malting barley lines were identified. Several high yielding breeding lines had low protein (6.3 to 9.5%) and significantly higher yields than both Champion and Baronesse and favorable malting quality traits. Several of these were included in the WSU Variety Testing program, marking the first time in many years where a malting line included in variety testing. They performed well, and are in their third to fourth year of malting quality evaluations. They will also be tested by larger scale micro-maltsters as well as by craft breweries and distilleries in 2017. Our goal is to release the first malting variety in three decades within the next two years. With our industry partnerships and research collaborations, this goal is certainly achievable.

Impact: As relatively newly released varieties, Havener, Muir and Lyon have yet to impact the market. Havener however, due to its enhanced β-glucan content and increased yield for a hulless barley, farmers and distributors has attracted interest from farmers and industry. Seed of Havener should be available to growers in 2018. Though not a big market class, the hulless food types are sparking interest and have the potential to meet niche markets in the U.S. and abroad. Prices for
food barley are often approximately $70/ton higher than feed barley and $20/ton higher than malting barley. Lyon is just starting to be grown on limited acreage, and along with Muir, is attracting attention from growers at field days and meetings, and both varieties are anticipated to make a positive impact on the market in the near future.

Additionally, at present, considerable winter wheat acreage is devoted to the planting of IMI-resistant varieties, which severely hinders spring barley production due to residual herbicide damage and associated plant back restrictions. Our herbicide resistant breeding lines with the potential for varietal release in the near future would have a significant positive impact on barley acreage and production.

**Outputs and Outcomes:**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Deliverable</th>
<th>Progress</th>
<th>Timeline</th>
<th>Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 1. Continue to develop and release high yielding, spring, two-row feed barley varieties with improved disease resistance, high protein and test weight, and excellent agronomic characteristics.</strong></td>
<td>Development of disease resistant and high yielding feed barley varieties designed to improve upon Lyon and Muir continues to progress.</td>
<td>Muir and Lyon continue to perform well. Lyon topped the 5-location Intermediate Precipitation Zone for yield in 2015 and Muir continues to perform well in low rainfall locations and sets the standard for stripe rust resistance. Experimental lines in our breeding program show potential improvements over these two varieties in terms of yield, test weight and/or protein content, and show excellent promise for future release.</td>
<td>2018 or 2019 for future release or pre-release of a new 2-row, hulled feed variety. 2017 proposed release of a new herbicide tolerant feed variety (see objective 2).</td>
<td>Talks and presentations at multiple field days; WSCIA annual meeting; Cascadia Grains annual conference; distribution of informative variety rack cards.</td>
</tr>
<tr>
<td><strong>Objective 2. Continue to expedite the continued release of one IMI-resistant barley variety during the 2016/17 winter.</strong></td>
<td>Release one IMI-resistant barley variety during the 2016/17 winter.</td>
<td>2016 pre-release approved in February 2016. Two acres of</td>
<td>2017 anticipated release of the first WSU barley variety with</td>
<td>Talks and presentations at multiple field days.</td>
</tr>
</tbody>
</table>
Variety Release Proposal Committee Meeting.

our proposed February 2017 release were grown in Othello by Crop Improvement in 2016.

herbicide tolerance

**Objective 3. Capitalize on the leveraged funding from the American Malting Barley Association (AMBA) for malting barley research by focusing on the development of varieties that set new standards for malting quality.**

| a) Development of malting quality genetics;  
| b) Potential release of a malting barley cultivar | We are finalizing our genome wide association mapping project with malting quality traits. This will be beneficial for the identification and use of markers to select for malting quality traits for both all-malt and adjunct malt market classes. | 2017 for GWAS results  
2019 for malting barley cultivar release | Talks and presentations at multiple field days, including the inaugural 'Know Barley Know Beer' field and brewery day with farmers, brewers, breeders and maltsters. |

2015 release of a hulless food barley, Havener, with significantly higher beta glucan, protein and test weight compared to hulled feed varieties and higher yields and test weight than other hulless varieties.

The food barley market class is in its infancy and very small compared to the malt and feed market classes. We will continue to test over 600 lines each year for beta glucan and are currently conducting a genome wide association study for beta glucan content.

2017 for potential new hulless food barley with high b-glucan release.

Talks and presentations at multiple field days, development of a rack card for Havener. Wheat life article.

**Objective 4. Evaluate, select and develop high-yielding, hulless, heart-healthy food barley varieties with elevated levels of beta glucan, protein, test weight, minerals and antioxidants.**

| 2015 release of a hulless food barley, Havener, with significantly higher beta glucan, protein and test weight compared to hulled feed varieties and higher yields and test weight than other hulless varieties. | The food barley market class is in its infancy and very small compared to the malt and feed market classes. We will continue to test over 600 lines each year for beta glucan and are currently conducting a genome wide association study for beta glucan content. | 2017 for potential new hulless food barley with high b-glucan release. | Talks and presentations at multiple field days, development of a rack card for Havener. Wheat life article. |