ARS US Wheat & Barley Scab Initiative (USWBSI)

Funding Status and Priorities
NO BARLEY

NO BEER!
US Barley Acreage

Million Acres

US Barley Use

<table>
<thead>
<tr>
<th>Year</th>
<th>Malting</th>
<th>Feed</th>
<th>Exports</th>
<th>Seed</th>
<th>Food</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>21.8%</td>
<td>51.1%</td>
<td>22.7%</td>
<td>3.1%</td>
<td>1.3%</td>
</tr>
<tr>
<td>2012</td>
<td>57.3%</td>
<td>30.7%</td>
<td>4.6%</td>
<td>3.8%</td>
<td>3.6%</td>
</tr>
</tbody>
</table>
Why Has Barley Acreage Declined?

Static domestic malt use, limited barley & malt exports

Decline in use for feed = primary secondary use
*Abundant supplies of corn and dried distillers grain (DDGs) a significant factor*

Static & limited food use – although has FDA Healthy Heart Claim
*USDA Barley Health Benefits Project – Stakeholder lobbying*

High risk crop – many chances for failure in making malting grade
Good return as malting, low or no return as feed
*Risks – Fusarium Head Blight, drought, heat stress*

Competition with other crops – GROWERS HAVE OTHER OPTIONS
Corn, soybeans, canola = growing markets
Substantial investment by biotech seed companies including GM varieties
*and now wheat – first GM wheat = 6 years (current estimate)*
Why Has Barley Acreage Declined?

Barley research & variety development primarily in public sector
State and provincial universities; USDA-ARS and Agriculture & Agri-Food Canada

Limited and declining public sector investment

Limited private sector investment in variety development
Two brewers, one maltster, one private sector company – all traditional breeding
- depend on public sector for other research needs

Little or no interest by biotech seed companies in barley
Low acreage compared to other major crops
Substantial cost to commercialize a GM variety
## USDA FY2014 RESEARCH BUDGET

**April, 2013**

*(October 1, 2013 to September 30, 2014)*

### Agriculture Appropriations Process

<table>
<thead>
<tr>
<th></th>
<th>Proposed FY2010</th>
<th>Proposed FY2013</th>
<th>Change</th>
<th>% Change</th>
<th>President FY2014</th>
<th>Change From FY2013</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARS</td>
<td>$1.180 B*</td>
<td>$1.016 B</td>
<td>($164 Million)</td>
<td>(13.9%)</td>
<td>$1.124 B</td>
<td>$108 Million</td>
<td>10.6%</td>
</tr>
<tr>
<td>NIFA</td>
<td>$1.351 B</td>
<td>$1.147 B</td>
<td>($204 Million)</td>
<td>(15.1%)</td>
<td>$1.294 B</td>
<td>$147 Million</td>
<td>12.8%</td>
</tr>
</tbody>
</table>

President’s FY2014 budget proposed elimination of most all ARS extramural funding, including $4.643 million for the US Wheat & Barley Scab Initiative (USWBS), with redirection of extramural funding to so called “higher priority” ARS intramural research areas.
The Committee does not concur with the President’s budget request regarding the termination of extramural research, reallocation of funds, or closure of six research locations. The Committee expects extramural research to be funded without the reductions assessed in fiscal years 2012 and 2013.

Wheat and Barley Scab Initiative.—The Committee expresses support for this initiative and directs the agency to continue research on wheat and barley scab and related issues.
Congressional Authorization in Farm Bill

Barley and wheat stakeholder lobbying has resulted in reauthorization of scab funding in both the House and Senate versions of the Farm Bill currently under consideration.

Support for Research Regarding Diseases of Wheat, Triticale, and Barley Caused by Fusarium Graminearum or by Tilletia Indica

- **House** = $7.5 million/year for each of fiscal years 2014 through 2018
- **Senate** = $10 million/year for each of fiscal years 2014 through 2018
Future = New Growing Areas

Current major growing areas will continue as primary source
Idaho, Montana, North Dakota = 70% US barley production (2012 & 2013)
FHB problem not solved in Dakotas & Minnesota
FHB moving west

Increased demand for beer & whiskey made with “Local” barley
Serviced by existing large malting companies if logistically feasible
For some states, not economical to ship barley to plant and malt back

Growing craft malting industry to supply craft brewers & distillers

Increase in craft brewers & distillers doing in-house malting
Future = New Growing Areas

Roadblocks

Varieties adapted to new growing areas = quality & agronomics

Climatic Conditions

High moisture, rainfall = more disease (e.g. Fusarium head blight aka Scab) = East
Hot, dry conditions = Southwest (e.g. Texas)

Solutions being pursued by AMBA & collaborating research programs

Variety Trials

Development of best management practices

Breeding to develop adapted varieties
Harvested Barley Acres By County

Northeast US

2007 USDA Census of Agriculture

Data not disclosed to avoid identifying an individual operation. Typically means only a single barley farm in the county.
Harvested Barley Acres By County

Southeast US

2007 USDA Census of Agriculture

- Undisclosed*
- 1-100
- 100-200
- 200-500
- 500-1,000
- 1,000-2,000
- 2,000-5,000
- 5,000-10,000
- 10,000-20,000
- 20,000-50,000
- > 50,000

*Data not disclosed to avoid identifying an individual operation. Typically means only a single barley farm in the county.
Recommended FY2014
US Wheat & Barley Scab Initiative (USWBSI)
$4.643 Million ($5 Million Post-Sequester)
<table>
<thead>
<tr>
<th>State</th>
<th>EC FY14 Recommended Amt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas</td>
<td>$ 78,851</td>
</tr>
<tr>
<td>Delaware</td>
<td>$ 7,443</td>
</tr>
<tr>
<td>Georgia</td>
<td>$ 43,245</td>
</tr>
<tr>
<td>Idaho</td>
<td>$ 30,000</td>
</tr>
<tr>
<td>Illinois</td>
<td>$ 127,626</td>
</tr>
<tr>
<td>Indiana</td>
<td>$ 178,085</td>
</tr>
<tr>
<td>Kansas</td>
<td>$ 368,491</td>
</tr>
<tr>
<td>Kentucky</td>
<td>$ 303,196</td>
</tr>
<tr>
<td>Louisiana</td>
<td>$ 43,242</td>
</tr>
<tr>
<td>Maryland</td>
<td>$ 55,186</td>
</tr>
<tr>
<td>Michigan</td>
<td>$ 226,918</td>
</tr>
<tr>
<td>Minnesota</td>
<td>$ 841,117</td>
</tr>
<tr>
<td>Missouri</td>
<td>$ 93,914</td>
</tr>
<tr>
<td>North Carolina</td>
<td>$ 99,030</td>
</tr>
<tr>
<td>North Dakota</td>
<td>$ 1,010,041</td>
</tr>
<tr>
<td>Nebraska</td>
<td>$ 57,006</td>
</tr>
<tr>
<td>New Jersey</td>
<td>$ 67,000</td>
</tr>
<tr>
<td>New York</td>
<td>$ 69,180</td>
</tr>
<tr>
<td>Ohio</td>
<td>$ 271,072</td>
</tr>
<tr>
<td>South Dakota</td>
<td>$ 209,799</td>
</tr>
<tr>
<td>Texas</td>
<td>$ 45,000</td>
</tr>
<tr>
<td>Vermont</td>
<td>$ 15,000</td>
</tr>
<tr>
<td>Virginia</td>
<td>$ 261,215</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>$ 13,536</td>
</tr>
<tr>
<td>Washington, DC (NASS)</td>
<td>$ 93,940</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>$ 4,609,133</strong></td>
</tr>
<tr>
<td><strong>Unallocated</strong></td>
<td><strong>$ 34,037</strong></td>
</tr>
<tr>
<td><strong>FY14 ARS/USWBSI Projected Budget</strong></td>
<td><strong>$ 4,643,170</strong></td>
</tr>
</tbody>
</table>

- USDA-ARS $ 307,138
- North Dakota State University $ 942,700
- University of Minnesota $ 791,520
- University of Kentucky $ 303,196
- Ohio State University $ 271,072
- Kansas State University $ 265,291
- Virginia Polytechnic Institute and State University $ 261,215
- Michigan State University $ 226,918
- South Dakota State University $ 209,799
ESTIMATE - USWBSI Recommended Barley Specific Research

$629,763 Barley Coordinated Project (Breeding, genetics, pathology, basic research)
181,269 DON Testing @ North Dakota State University & University of Minnesota
15,842 Food Safety & Toxicology – P. Schwarz, NDSU – DON-Glucoside formation during malting
49,654 Management studies
33,595 Gene Discovery and Engineering Resistance
23,925 Pathogen Biology and Genetics (PBG)

$934,047 TOTAL

23.1% of Estimated barley & wheat specific research
5.8% planted barley as % of combined wheat & barley acreage

Wheat Specific Research

$3,112,183 Wheat Coordinated Projects by wheat class (5) e.g. Northern Soft Winter Wheat;
DON testing; management; basic research

Total Estimated Barley & Wheat commodity specific research
$4,046,231

Research & National Facilitation Office benefiting both barley & wheat
$ 596,940

$4,643,170 Grant Total for FY2014
FY2014 USWBSI RECOMMENDED

Barley Coordinated Project

Coordination of the North American Barley Scab Evaluation Nursery
Robert Brueggeman, North Dakota State University
screening for western states being added, winter barley screening being initiated

Crossing and Field Tests of Transgenic Barley
Lynn Dahleen, USDA-ARS, Fargo, ND
distinct transgenes crossed into adapted lines Conlon, Quest and ND20448

Variety Development, Selection, and Characterization of Resistance to FHB and DON in Winter Barley
Carl Griffey, Virginia Tech

Developing 6- and 2-Rowed Malting Barley Cultivars with Enhanced FHB Resistance and Reduced DON Accumulation
Richard Horsley, North Dakota State University

Developing Six-rowed Malting Barley Varieties with FHB Resistance and Low DON
Kevin Smith, University of Minnesota
FY2014 USWBSI RECOMMENDED
Barley Coordinated Project

Genomic Selection for FHB Resistance in Midwest Six-row Barley
Kevin Smith, University of Minnesota
Genome wide selection for FHB resistance using marker and phenotype data to predict the phenotype of lines using only marker data to decrease variety development time

Molecular Genetics Approaches to Developing Scab Resistant Barley
Gary Muehlbauer, University of Minnesota
Fine mapping & characterization of chromosome 6H bin 7 QTL to develop SNP markers & determine if FHB resistance and grain protein content QTL are controlled by distinct loci;
Over expression of barley UDP-glucosyltranferase to confer high level of FHB resistance

Mapping Loci Conferring Resistance to FHB and DON Accumulation in Barley
Brian Steffenson, University of Minnesota
accessions possessing novel QTL for FHB resistance, advanced backcross QTL approach to map resistance to deploy in barley breeding programs

Development of Transgenic Barley for Control of Scab
Frances Trail, Michigan State University
Fungus sheds protective cell wall coating to squeeze through tight spaces during infection leaving it in a vulnerable state - determine fungal genes expressed to identify target genes for silencing via host induced gene silencing (HIGS)
### Food Safety & Toxicology

| Paul Schwarz | North Dakota State University | Formation of Deoxynivalenol-3-Glucoside during Malting. |
| Paul Schwarz | North Dakota State University | Malting Barley Deoxynivalenol Diagnostic Services. |
| Yanhong Dong | University of Minnesota | Diagnostic services for DON. |

### Management

| Randy Weisz | North Carolina State University | Integrated Barley Management Studies |
| Heather Darby | University of Vermont | Integrated Barley Management Studies |
| Gary Bergstrom | Cornell University | Integrated Wheat & Barley Management Studies |
| Ruth Dill-Macky | University of Minnesota | Integrated Wheat & Barley Management Studies |
| Andrew Friskop | North Dakota State University | Integrated Wheat & Barley Management Studies |
| Andrew Friskop | North Dakota State University | Uniform Fungicide Trials |
| Madeleine Smith | University of Minnesota | Uniform Fungicide Trials |

### Gene Discovery & Engineering Resistance

| Phil Bregitzer | USDA-ARS | Down with DON: Stable Expression of Proven Genes in a Marker-free Background. |
| Ruth Dill-Macky | University of Minnesota | A Field Nursery for Testing Transgenic Spring Wheat and Barley from the USWBSI. |

### Pathogen Biology & Genetics

| Frances Trail | Michigan State University | Use of Genes Important to Penetration for Control of FHB in Wheat and Barley. |

New or Barley add-on
MISSION: The primary purpose of AMBA is to encourage and support an adequate supply of high quality malting barley for the malting and brewing industry and increase our understanding of malting barley.

PRIMARY OBJECTIVE: Develop six-row and two-row malting barley varieties broadly adapted for the barley production areas of North America with suitable agronomic, malting, and brewing performance.
AMBA
National Coordinator of Malting Barley Research

Facilities

Adequate & Effective National Public Sector Barley Research Infrastructure

Funding
AMBA, Federal, State, Growers

Direction

Personnel

AMBA lobbies Congress, Federal Agencies, and State Universities to positively impact all these research infrastructure components

AMBA also lobbies with barley growers for favorable federal farm program provisions (e.g. crop insurance)
<table>
<thead>
<tr>
<th>Year</th>
<th>MIDWEST</th>
<th>WEST</th>
<th>East</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>7.1</td>
<td>13.1</td>
<td>2.2</td>
</tr>
<tr>
<td>2004</td>
<td>10.2</td>
<td>26.7</td>
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</tr>
<tr>
<td>2012</td>
<td>14.0</td>
<td>26.3</td>
<td>0.0</td>
</tr>
<tr>
<td>2014</td>
<td>31.7</td>
<td>27.9</td>
<td>2.9</td>
</tr>
</tbody>
</table>

**Variety Development & Supporting Research**

<table>
<thead>
<tr>
<th>Year</th>
<th>MIDWEST</th>
<th>WEST</th>
<th>East</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>59.5</td>
<td>14.3</td>
<td>0.0</td>
</tr>
<tr>
<td>2004</td>
<td>49.6</td>
<td>7.8</td>
<td>0.0</td>
</tr>
<tr>
<td>2012</td>
<td>34.3</td>
<td>2.1</td>
<td>0.0</td>
</tr>
<tr>
<td>2014</td>
<td>13.5</td>
<td>0.1</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Winter (2&6)**

<table>
<thead>
<tr>
<th>Year</th>
<th>MIDWEST</th>
<th>WEST</th>
<th>East</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>1.4</td>
<td>1.1</td>
<td>0.0</td>
</tr>
<tr>
<td>2004</td>
<td>0.6</td>
<td>0.1</td>
<td>0.0</td>
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<tr>
<td>2012</td>
<td>66.6</td>
<td>56.6</td>
<td>0.0</td>
</tr>
<tr>
<td>2014</td>
<td>52.9</td>
<td>52.9</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Subtotal**

- **MIDWEST**: 54.2%
- **WEST**: 43.7%
- **East**: 2.1%

**Total Funding**

- **MIDWEST**: $192,558
- **WEST**: $155,000
- **East**: $7,500

**Total Funding**: $355,058

* 98.6% Weighted dues reported
American Malting Barley Association, Inc.

REGULAR MEMBERS (21)

AB-InBev
Bell’s Brewery
Boston Beer
Briess Malt & Ingredients
Brooklyn Brewery
Brown-Forman
Cargill Malt
Craft Brew Alliance
Deschutes Brewery
Dogfish Head Craft Brewery
Gambrinus Company
Great Western Malting
InteGrow Malt
Malteurop
MillerCoors
New Belgium Brewing
New Glarus Brewing
Rahr Malting
Schell’s Brewing
Sierra Nevada Brewing
Summit Brewing
American Malting Barley Association, Inc.

ASSOCIATE MEMBERS (36)

Abita Brewing
Alaskan Brewing
Allagash Brewing
Anchor Brewing
Avery Brewing
Bear Republic Brewing
Boulevard Brewing
Corsair Artisan Distillery
Firestone Walker Brewing
Flying Dog Brewery
Founders Brewing
Full Sail Brewing
Gambrinus Company
Harrpoon Brewery
Langunitas Brewing
Lakefront Brewery
Left Hand Brewing
Leopold Bros Distillery
Long Trail Brewing
Lost Coast Brewery
Madison River Brewing
Matt Brewing
Odell Brewing
Oskar Blues Brewery
Real Ale Brewing
Rogue Ales
Russian River Brewing
Saint Arnold Brewing
Schlafly Beer
Schell’s Brewing
Smuttynose Brewing
Stone Brewing
Urban Chestnut Brewing
Valley Malt
Victory Brewing
Wachusett Brewing