**USDA-ARS/**
**U.S. Wheat and Barley Scab Initiative**
**FY07 Final Performance Report (approx. May 07 – April 08)**
**July 15, 2008**

# Cover Page

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| **Fiscal Year:** | 2007 |
| **USDA-ARS Agreement ID:** | 59-0790-6-073 |
| **USDA-ARS Agreement Title:** | Evaluation of Hordeum Germplasm for Resistance to Fusarium Head Blight. |
| **FY07 ARS Award Amount:** | $ 49,638 |

**USWBSI Individual Project(s)**

| USWBSI Research Area* | Project Title | ARS Adjusted Award Amount |
|---|---|---|
| HGR | Accelerated Screening of Hordeum Germplasm for FHB Resistance. | $33,540 |
| IIR | Development of Digital Disease Diagrams for Assessing FHB of Barley. | $ 16,098 |
| | **Total Award Amount** | **$ 49,638** |

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Principal Investigator Date

* CBCC – Chemical, Biological & Cultural Control
EEDF – Etiology, Epidemiology & Disease Forecasting
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GET – Genetic Engineering & Transformation
HGR – Host Genetics Resources
HGG – Host Genetics & Genomics
IIR – Integrated/Interdisciplinary Research
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

**Project 1:** *Accelerated Screening of Hordeum Germplasm for FHB Resistance.*

**1. What major problem or issue is being resolved and how are you resolving it?**

FHB threatens the existence of the barley industry in the Upper Midwest. Deployment of resistant cultivars is the most effective and environmentally sound means of managing this disease; however, sources with high levels of resistance to *Fusarium graminearum* and its toxins are lacking. Thus, the primary objective of this research is to identify *Hordeum* germplasm with the highest level of FHB resistance possible. Our specific activities also involve the sourcing of unique *Hordeum* germplasm from foreign genebanks.

Our USWBSI research program is an ongoing effort to systematically evaluate unique *Hordeum* germplasm from USDA and foreign genebanks for resistance to FHB in the Upper Midwest and also off-season nurseries in China. The screening of the entire six-rowed spring and winter barley collection from the USDA National Small Grains Collection (NSGC) is complete. Additionally, we have evaluated over 1,233 wild barley (*Hordeum vulgare* subsp. *spontaneum*) accessions from the NSGC. We have essentially completed evaluations of six-rowed and wild barley germplasm from the NSGC, but are also sourcing unique *Hordeum* accessions from other gene banks around the world, including the N. I. Vavilov All-Russian Scientific Research Institute of Plant Industry (VIR) in St. Petersburg, Russia, the Station federale de recherches en production vegetale de Changins (SFRSPP) in Nyon, Switzerland, the Nordic Gene Bank (NGB) in Alnarp, Sweden, the Institute for Cereal Crops Improvement (ICCI) in Tel Aviv, Israel, Plant Genetic Resources of Canada (PGRC), Saskatoon, Canada, and International Center for Agriculture in the Dry Areas (ICARDA), Aleppo, Syria.

**2. List the most important accomplishment and its impact (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):**

**Accomplishment:**

Additional sources of resistance to FHB are needed in breeding programs. We have procured nearly 11,070 additional accessions from various genebanks and evaluated them in FHB nurseries in the Upper Midwest and/or China. From these evaluations, we have identified accessions with resistance levels comparable to the resistant six-rowed check Chevron. Five hundred and ninety-four of these accessions came from the NSGC, 43 from the VIR, 11 from the SFRSPP, 3 from the NGB, 3 from the ICCI, 9 from the PGRC, and 0 from ICARDA.

**Impact:**

We have discovered new and diverse sources of FHB resistance in barley that are likely different from those already reported. The identification of resistant germplasm is the first step in developing barley cultivars with enhanced resistance to FHB and the accumulation of toxins. Accessions identified as resistant in our initial screening nurseries are immediately distributed to barley breeders for crossing within their FHB resistance-breeding program. In FY07, we

provided four more sources of FHB resistance to barley breeders. These sources have already been crossed to adapted material and are now in the breeding pipeline.

**As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?:**

Our program provides breeders with the germplasm needed to pyramid additional FHB resistance loci into their lines and enhance resistance to the pathogen. Introgression of resistance alleles from these sources into advanced barley cultivars will reduce the detrimental impact of the FHB pathogen and its associated toxins. In the Minnesota and North Dakota barley breeding programs, several advanced lines with partial resistance to FHB are in pilot and plant scale testing. These advanced lines were bred with sources of partial FHB resistance identified from our screening of NSGC germplasm. These lines, pending American Malting Barley Association approval, may be available to growers within the next few years.

**Project 2:** *Development of Digital Disease Diagrams for Assessing FHB of Barley.*

**1. What major problem or issue is being resolved and how are you resolving it?**

Many projects funded by the USWBSI on barley require a reliable and efficient method for assessing FHB severity. This includes studies of resistance in raw germplasm accessions, breeding lines, and segregating populations; effectiveness of various residue management treatments in reducing pathogen inoculum; efficacy of chemicals and biologicals in controlling FHB; and various epidemiological parameters affecting disease spread. In the barley improvement programs, the time required for disease assessment is a serious bottleneck as over 12,000 lines are evaluated each summer--often times in the span of just a few day's time. To reduce the time required for assessing FHB in barley, we initiated a project to develop prototype disease diagrams based on digital images of actual infected spikes from the field. Archetypal healthy and diseased spikelets were selected and digitally cut from these spike images, and then used as "building blocks" to create idealized two-rowed and six-rowed spikes exhibiting various disease severities. Prototypes of fourteen standard digital spike images exhibiting disease severities from 1-100% were developed for both two-rowed and six-rowed barley. The objectives of this study were to 1) develop a refined and comprehensive set of digital disease images for estimating FHB severity in both six-rowed and two-rowed barley, and 2) assess the accuracy, reproducibility, and efficiency of using these disease images for estimating FHB severity in various applications.

**2. List the most important accomplishment and its impact (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):**

**Accomplishment:**

We developed and refined a set of 14 standard digital spike images exhibiting disease severities from 1-100% for both two-rowed and six-rowed barley. Twelve novice, intermediate, and experienced FHB researchers utilized the digital diagrams to assess its accuracy and efficiency for rating FHB severity in barley spikes collected from the field. All raters under-estimated the true severity level of six-rowed spikes at disease levels of 35% and above. Using the digital images, the savings in rating time ranged from 37 seconds to 12 minutes, 35 seconds. With the two-rowed spikes, all raters under-estimated the true severity level at disease levels of 25% and above. The use of the rating scale did not result in a time savings in all cases; in fact, some raters required 3 minutes longer to complete the assessments using the rating scale over performing actual diseased kernel counts. However, other raters saved up to 10 minutes using the digital images.

**Impact:**

To our knowledge, this is the first set of digital images developed to assess FHB severity in both two-rowed and six-rowed barley. The digital images may provide a more efficient means of evaluating barley for FHB severity under some applications, such as the disease resistance evaluations.

**As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?:**

The digital disease images developed and validated for rating FHB severity in two- and six-rowed barley will provide a sufficiently accurate assessment of disease, but with greater efficiency (i.e. accuracy plus speed) than the spikelet count method. This will be a tremendous benefit to the breeding programs where thousands of lines need to be evaluated within a very short period of time.

**Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.**

None.