**U.S. Wheat and Barley Scab Initiative**
**Annual Progress Report**
**September 18, 2000**

## Cover Page

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| **Year:** | **FY2000** |
| **Grant Number:** | **59-0790-9-067** |
| **Grant Title:** | **Fusarium Head Blight Research** |
| **Amount Granted:** | **$94,220.00** |

## Project

| Program Area | Objective | Requested Amount |
|---|---|---|
| Epidemiology | Investigate the FHB host resistance genes in barley. | $37,960 |
| Germplasm | Maintain a germplasm Center. | $56,220 |
| | **Requested Total** | $94,180[1] |

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Principal Investigator Date

[1] Note: The Requested Total and the Amount Granted are not equal.

**Project 1: Investigate the FHB host resistance genes in barley.**

**1a) FHB host resistance genes in barley**

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. Sources of resistance to *Fusarium graminearum* and its toxin have been identified in barley; however, very little is known about the reaction of these resistance sources to other *Fusarium* species (*F. poae*, *F. avenaceum*, *F. sporotrichioides*, and *F. culmorum*) causing FHB on barley in the Midwest. To effectively manage FHB using host resistance, it is important that cultivars be bred with broad-based resistance against all potential FHB pathogens. Therefore, one of the objectives of this research was to evaluate *F. graminearum* resistant barley genotypes with the four other *Fusarium* species.

2. Please provide a comparison of the actual accomplishments with the objectives established.

We evaluated the FHB reaction of the resistance sources Chevron, CIho 4196, Zhedar 1, Imperial, and Svanhals to five species of *Fusarium* (*F. graminearum*, *F. poae*, *F. avenaceum*, *F. sporotrichioides*, and *F. culmorum*) in the greenhouse and field. Chevron exhibited the highest level of resistance against all five *Fusarium* species, followed by the two-rowed accessions of Zhedar 1, CIho 4196, and Svanhals, listed in descending order of resistance level. Imperial was relatively susceptible to *F. culmorum*, *F. avenaceum*, and *F. graminearum*, especially under greenhouse conditions. Mycotoxin production of different *Fusarium* species was determined after infection of the resistance sources in greenhouse experiments. The concentration of deoxynivalenol (DON) in spikes of Chevron infected with *F. culmorum* and *F. graminearum* was 6 ppm. The same species produced on Zhedar 1 and CIho 4196 DON levels of 0.9 ppm and 0.3 ppm (*F. culmorum*) and 1.5 ppm and 2.0 ppm (*F. graminearum*), respectively. In CIho 4196 spikes, *F. graminearum* also produced 15-acetyl DON (0.2 ppm) and *F. sporotrichioides* produced T-2 toxin (0.2 ppm) and HT-2 toxin (0.4 ppm). Higher values of DON were found in Svanhals and Imperial infected with *F. culmorum* (2.4 and 14.9 ppm) and *F. graminearum* (1.4 and 21 ppm). *F. sporotrichioides* produced in both cultivars less than 1.0 ppm of T-2 tetraol, T-2 toxin and HT-2 toxin.

Overall, *F. graminearum* exhibited the highest pathogenicity in the field, followed by *F. culmorum*, *F. avenaceum*, *F. sporotrichioides*, and *F. poae* listed in descending order of relative pathogenicity. Under greenhouse conditions, *F. culmorum* exhibited the highest pathogenicity, followed by *F. avenaceum*, *F. graminearum*, *F. sporotrichioides*, and *F. poae* listed in descending order of relative pathogenicity.

3. What were the reasons established objectives were not met? If applicable.

Mycotoxin assays for the 2000 field experiments have not been completed. These evaluations will be done in November 2000.

4. What were the most significant accomplishments this past year?

The six-rowed accession Chevron, as well as the two-rowed accessions Zhedar 1 and CIho 4196, were found to possess broad-based resistance against all five *Fusarium* species causing FHB in barley fields in the Upper Midwest region.

**1b) Pathogenicity comparisons between conidia and ascospore inoculum of *F. graminearum***

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

In assessing the resistance of barley to FHB, researchers use either conidia of *F. graminearum* or ascospores of the perfect stage *G. zeae* for inoculum. An important factor to consider in the choice of inoculum for these tests is whether the relative infectivity of conidia and ascospores is similar. Thus, the objective of this study was to assess the relative infectivity of *F. graminearum* conidia and *G. zeae* ascospores on susceptible barley genotypes under field and greenhouse conditions.

2. Please provide a comparison of the actual accomplishments with the objectives established.

The infectivity of conidia and ascospores of isolate KB176 on susceptible six-rowed (Stander) and two-rowed (CIho 5415) accessions was quantitatively similar in greenhouse and field trials.

3. What were the reasons established objectives were not met? If applicable.

Not applicable

4. What were the most significant accomplishments this past year?

No statistically significant differences were detected in the infectivity of conidia and ascospores on barley. Thus, the choice of spore type for inoculation may depend largely on the ease by which individual researchers can produce them. Moreover, this study suggests that relative comparisons can be made between experiments utilizing the different spore types for inoculum.

**Project 2: Maintain a germplasm Center.**

## 2a) Screening of six-rowed spring barley accessions of the National Small Grains Collection (NSGC) for FHB resistance

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

In general, six-rowed barleys are more susceptible to FHB than two-rowed barleys. Unfortunately, six-rowed barley cultivars are the preferred type for malting in the Upper Midwest. Currently, the only six-rowed source of FHB resistance available is Chevron, a Swiss landrace with poor agronomic and malting traits. Additional six-rowed sources of resistance are needed to increase the genetic diversity for this trait in malting barley. Thus, the objective of this study was to evaluate the FHB reaction of the entire six-rowed spring barley collection of the USDA National Small Grains Collection (NSGC).

2. Please provide a comparison of the actual accomplishments with the objectives established.

Twenty-six barley accessions exhibiting a resistance level similar to Chevron (<20% FHB severity) were identified in FHB nurseries planted in North Dakota in 2000. These accessions were originally collected from Ethiopia (13 accessions), Romania (1), Switzerland (4), Germany (1), France (1), Finland (1), Canada (1), Peru (1) and China (3).

3. What were the reasons established objectives were not met? If applicable.

Not applicable.

4. What were the most significant accomplishments this past year?

Twenty-six accessions from diverse regions of the world were identified as possessing a useful level of resistance to FHB. The 15 most resistant accessions will be re-evaluated for their FHB reaction under greenhouse conditions. Additionally, all 26 selected accessions, plus 215 other accessions showing slightly higher disease levels will be re-evaluated for FHB resistance under field conditions in China and North Dakota in 2001.

## 2b) Re-evaluation of the six-rowed spring barley accessions exhibiting FHB resistance in the 1999 screening NSCG nurseries

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

The barley-FHB interaction can be extremely variable in the field. To obtain reliable results on the reaction of accessions to FHB, several disease evaluations should be made across different locations and years. The objective of this study was to conduct additional field and greenhouse

evaluations of accessions identified as resistant or moderately resistant in the 1999 NSCG screening nurseries.

2. Please provide a comparison of the actual accomplishments with the objectives established.

The FHB resistance of CIho 2236, CIho 4095, CIho 4530, CIho 6610, CIho 6613, CIho 9114, and CIho 11526 was confirmed in two greenhouse inoculation tests and at three locations (Fargo and Langdon, North Dakota and Hangzhou, China) in the field. These accessions originate from the USA, Georgia, China, and Yugoslavia. The resistance level in five other accessions (CIho 4339 CIho 5809, CIho 6611, CIho 7163, and CIho 15258) was found to be inadequate for use in the breeding programs based on the additional FHB evaluations.

3. What were the reasons established objectives were not met? If applicable.

Not applicable

4. What were the most significant accomplishments this past year?

The FHB resistance of seven previously selected six-rowed accessions from the 1999 NSGC screening was confirmed in additional greenhouse and field inoculation tests. These accessions will markedly increase the level of genetic diversity for FHB resistance in six-rowed barley breeding programs.

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.

**List of publications**

Scholz, U., Steffenson, B., Urrea, C. and Horsley, R. 1999. Evaluation of six-rowed spring barley accessions for resistance to Fusarium Head Blight. Pages 137-139, in: Proceedings, National Fusarium Head Blight Forum. December 5-7, 1999, Sioux Falls, SD, USA.

Scholz, U. and Steffenson, B. 2000. Screening for Fusarium Head Blight resistance in barley. Pages: 90-91, in Proceedings, 6th European Fusarium Seminar. September 11-17, 2000, Berlin, Germany.