USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
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Cover Page

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Fiscal Year:	2008
USDA-ARS Agreement ID:	59-0790-4-121
USDA-ARS Agreement Title:	Spring Wheat Breeding for Scab Resistance in South Dakota.
FY08 USDA-ARS Award Amount:	$ 80,409

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
MGMT	Effects of Spring Wheat Flowering Phenology on Fusarium Head Blight Resistance.	$7,750
VDHR-SPR	Spring Wheat Breeding Scab Resistance in South Dakota.	$ 72,659
	Total Award Amount	**$ 80,409**

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Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
BAR-CP – Barley Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Effects of Spring Wheat Flowering Phenology on Fusarium Head Blight Resistance.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   The research conducted was to be used to support and improve existing environmental models for FHB risk assessment. Current models employed in risk prediction rely on producers to estimate crop growth stage which has proven difficult and inaccurate at best. This research would have provided data to create a weather-based phenology model to aid producers and crop managers in targeting fungicide control measures to a particular crop stage. The project was not renewed for a second year.

2. **List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):**

   Accomplishment:

   Excellent crop phenology data was collected at two locations in 2008 from three hard red spring wheat cultivars with distinct maturity ratings. The flowering phenology data preliminarily appears to be sound and useful in developing a temperature-based flowering phenology model which would be useful in augmenting current decision-support tools available to growers. A second year of data (at least) is necessary to provide a robust data set from which to generate weather-based models, however the project was not renewed by the Initiative.

   Impact:

   The current research will have very little impact because of the limited data set afforded by the single year of collection. Additional environments will need to be employed to generate robust data from which to create models for this work to have impact.

Project 2: *Spring Wheat Breeding Scab Resistance in South Dakota.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   Fusarium head blight (FHB) is a serious wheat disease that continues to pose a threat to production within South Dakota as well as the North Central region of the USA. In an attempt to alleviate this threat, development of resistant cultivars has became a high priority within the spring wheat breeding program at South Dakota State University. An aggressive program was initiated to accelerate the development of spring wheat cultivars with improved FHB resistance and desirable agronomic traits. Established off-season nurseries and mist-irrigated greenhouse and field screening nurseries are utilized to accelerate breeding efforts in improving resistance along with desirable agronomic characteristics. Three early generations of breeding materials are evaluated for resistance each year: two generations in the greenhouse and one in the field. Approximately 8,000 individual hills are evaluated in the greenhouse nurseries and 3,000 rows are screened in the field nurseries. Both the field and greenhouse nurseries are inoculated with infested corn and conidial suspensions. A mist-irrigation system is used to provide a favorable environment for infection and disease development. Each year we make a large number of crosses to introduce new resistance genes and create new resistance gene combinations. Sources of resistance used in the crosses include materials from the Uniform Regional Scab Nursery (URSN) for spring wheat parents, (a cooperative regional effort to identify and utilize sources of scab resistance) newly identified germplasm provided through introduction and evaluation efforts, other introduced sources, as well as both cultivars and advanced breeding lines with various levels of resistance. The off-season nursery aids in the simultaneous selection for resistance and desirable agronomic characteristics.

2. **List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):**

   <u>Accomplishment:</u>

   Our program has provided elevated levels of resistance to FHB in the form of Hard Red Spring Wheat (HRSW) cultivars and germplasm made available to regional growers and other breeders that wish to utilize the germplasm. Within the past several years, four cultivars have been released to growers by our program. Over three years of simultaneous testing, the FHB disease index ratings recorded for ‘Briggs’, ‘Granger’, ‘Traverse’, and ‘Brick’ were 39.4, 34.7, 31.6, and 20.8, respectively, compared to ‘Sumai 3’, (15.4) the resistant check.

   <u>Impact:</u>

   Elevated resistance levels in released cultivars are immediately utilized by the most apparent beneficiaries of our work; HRSW producers. Through utilizing the elevated resistance levels,

growers are more able to protect themselves from suffering complete devastation of fields in the presence of a severe FHB epidemic. Elevated resistance levels in germplasm is also quite often utilized by a less immediately apparent group; HRSW breeders. Through utilizing both germplasm and released cultivars, other breeding programs strive to further increase FHB resistance among germplasm pools that will eventually result in the release of continually improved cultivars.

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.

Peer-reviewed articles

Kadariya, M., K. D. Glover, M. Mergoum, and L. E. Osborne. 2008. Biplot Analysis of Agronomic and *Fusarium* Head Blight Resistance Traits in Spring Wheat. J. Crop Improvement. 22:147-170.

Stein, J.M., L.E. Osborne, K.D. Bondalapati, K.D. Glover, and C.A. Nelson. 2009. Fusarium Head Blight Severity and Deoxynivalenol Concentration in Wheat in Response to Gibberella zeae Inoculum Concentration. Phytopathology. 99:759-764.

Rosyara, U.R., J.L. Gonzalez, K.D, Glover, K. Gedye, and J.M. Stein. 2009. Family-based mapping of quantitative trait loci in plant breeding populations with resistance to Fusarium head blight in wheat as an illustration. Theor. Appl. Genet. 118:617-1631.

Malla, S., A.M.H. Ibrahim, and K.D. Glover. 2009. Diallel analysis of Fusarium head blight resistance in wheat. J. Crop Improvement. 23:213–234.

Poster/abstract presentations

Glover, K.D., J.A. Anderson, and M. Mergoum. Development of FHB resistant spring wheat in the northern Great Plains. In: Canty, S.M., Clark, A., and Van Sanford, D. (Eds.), Proceedings of the 2008 National Fusarium Head Blight Furum; 2008, 2-4 December; Indianapolis, IN., USA. Michigan State University, East Lansing, MI. p. 160.

Glover, K.D., J.L. Gonzalez-Hernandez, U.R. Rosyara, D. Karki, K. Gedye, and J. M. Stein. Validation of a family-based quantitative trait locus mapping approach for selection of Fusarium head blight resistant spring wheat breeding lines. In: Canty, S.M., Clark, A., and Van Sanford, D. (Eds.), Proceedings of the 2008 National Fusarium Head Blight Furum; 2008, 2-4 December; Indianapolis, IN., USA. Michigan State University, East Lansing, MI. p. 161.

Rosyara, U.R., J.L. Gonzalez-Hernandez, K.D., Glover, K. Gedye, and J.M. Stein. Power of Family-based QTL Mapping: Optimizing Family Type, Size and Marker Density for QTLs of Different Magnitudes. In: Canty, S.M., Clark, A., and Van Sanford, D. (Eds.), Proceedings of the

2008 National Fusarium Head Blight Furum; 2008, 2-4 December; Indianapolis, IN., USA. Michigan State University, East Lansing, MI. p. 197.

Rosyara, U.R., J.L. Gonzalez-Hernandez, J.M. Stein, K. Gedye, and K.D. Glover. Selective Genotyping in Family-based Mapping of FHB Resistance QTLs in Hexaploid Wheat. In: Canty, S.M., Clark, A., and Van Sanford, D. (Eds.), Proceedings of the 2008 National Fusarium Head Blight Furum; 2008, 2-4 December; Indianapolis, IN., USA. Michigan State University, East Lansing, MI. p. 198.

K.R. Ruden, L.E. Osborne, B.E. Ruden, K.D. Glover, and J.L. Kleinjan. 2008 Uniform Fungicide Performance Trials for the Suppression of Fusarium Head Blight in South Dakota. In: Canty, S.M., Clark, A., and Van Sanford, D. (Eds.), Proceedings of the 2008 National Fusarium Head Blight Furum; 2008, 2-4 December; Indianapolis, IN., USA. Michigan State University, East Lansing, MI. p. 57.

Invited presentations

Glover, K.D. Development of FHB Resistant Spring Wheat in the Northern Great Plains. USWBSI. National Fusarium Head Blight Forum. 4 December 2008. Indianapolis, IN.

If your FY08 USDA-ARS Grant contained a VDHR-related project, include below a list all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance. If this is not applicable (i.e. no VDHR-related project) to your FY08 grant, please insert 'Not Applicable' below.

Brick (SD3851) – A hard red spring wheat cultivar was released in spring 2009. Release notice for publication is in preparation.