U.S. Wheat and Barley Scab Initiative
FY02 Final Performance Report (approx. May 02 – April 03)
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Cover Page

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Year:	**FY2002 (approx. May 02 – April 03)**
Grant Number:	**59-0790-9-045**
Grant Title:	**Fusarium Head Blight Research**
FY02 ARS Award Amount:	**$ 153,452**

Project

Program Area	Project Title	USWBSI Recommended Amount
EDM	Scab forecasting and environmental effects on inoculum in eastern South Dakota.	$71,000
GIE	Maintain a germplasm center of scab resistant spring wheat.	$86,288
	Total Amount Recommended	**$157,288**

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Principal Investigator Date

Project 1: Scab forecasting and environmental effects on inoculum in eastern South Dakota.

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

We are addressing the issues related to the epidemiology of scab on spring wheat in South Dakota. Specific objectives addressed were: 1) investigation of inoculum and environmental factors influencing scab infection and development; 2) further development and testing of scab risk advisory models for South Dakota spring wheat production areas; 3) evaluation of the spatial dynamics of ascospore and conidial inoculum in the canopy; and 4) investigation of perithecial development in relation to soil wetness. Objective 1 was studied in collaboration with university researchers from North Dakota, Ohio, Purdue, Pennsylvania, and Manitoba (Canada). Coordinated field plots were established to monitor disease development over time, in conjunction with environmental (weather), and inoculum monitoring. Five additional locations across South Dakota were established for inoculum and environmental monitoring to provide model validation data. Objective 2 was addressed using multi-year data analysis to develop regression models for validation testing. Objective 3 was addressed through a multi-location plant sampling and spore enumeration protocol. Objective 4 was addressed in the field and in the greenhouse on soil beds, with soil wetness sensors and misting systems for controlling wetness.

2. What were the most significant accomplishments?

Environmental parameters, airborne inoculum, and disease levels were assessed over a range of planting dates, and geographical locations in producers' fields in eastern SD. Spore traps were deployed at five locations across the northeast part of South Dakota. Hourly levels of airborne ascospores and Fusarium-type conidia in wheat fields were monitored over the course of the heading and seed development stages. Weather data from nearby weather stations were also collected. These data will greatly advance the forecasting effort for South Dakota's spring wheat growing areas. Intensive sampling from each location will be highly valuable for validating predictive models and for developing new models. On-campus research was conducted to monitor disease development over time in relation to environment. Data from these plots indicated a small window of time when conditions were favorable for scab infection to occur (co-incident with flowering), followed by weather considered poor for scab development in the 2002 field season. Disease data reflects the weather-based prediction with high incidence (20-30%) and very low severity (1-3%). A web-based scab risk advisory was developed and delivered to producers in eastern SD. This advisory system assisted some producers in their decision-making process for determining the application of a fungicide. Studies on spore distribution within a wheat canopy uncovered a large number of ascospores and conidia on different leaf positions. This suggests that the fungus may undergo epiphytic growth and reproduction, resulting in increased inoculum load within the canopy of a wheat crop. Studies on perithecial development of the fungus showed a distinct response in the formation of perithecia to a soil-surface wetness gradient. Colonized grains in contact with wet soil for approximately 16 or more hours per day promoted rapid development of perithecia after 6 to 8 days under greenhouse conditions, while colonized grains exposed to between 8-12 hours of wetness, produced far fewer perithecia and required a longer time.

Project 2: Maintain a germplasm center of scab resistant spring wheat.

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

The use of resistant cultivars will be one of the major components in managing scab (or Fusarium head blight) in small grain cereals. The development of scab resistant cultivars will depend upon the availability of germplasm possessing effective levels of resistance. Identifying and utilizing additional sources of resistance will be critical for enhancing the level of scab resistance and diversifying the current resistance gene pool. This project confronts the issue of finding additional or new sources of scab resistance in spring wheat, maintaining and characterizing the resistance, and facilitating the utilization. We also focused on the development of techniques and process for germplasm evaluation and of systems for facilitating the distribution and utilization of resistant germplasm. A system of evaluating germplasm through multiple screening nurseries was used. Artificial inoculations and mist-irrigation were used to generate high disease pressure in the nurseries. Spring wheat germplasm from targeted regions of the world are planted in non-replicated row plots and evaluated for scab reaction in the Preliminary Screening Nursery (PSN) in the field. Selections from the PSN are re-evaluated in the greenhouse to make further selections. Field and greenhouse selections are used as test entries in a replicated field Elite Germplasm Nursery (EGN) for further evaluation for at least three consecutive years. Elite selections are integrated into the Uniform Regional Scab Nursery (URSN) system for testing at multiple locations and for direct access and utilization by breeders and other researchers.

2. What were the most significant accomplishments?

In the 2002 field season, a total of 1000 accessions of spring wheat mainly originated from Russia, Mid-east, Africa, and southwest Asia were evaluated in the PSN nursery. After field screening, 97 accessions were selected as putative resistant sources. These selections were inoculated in the greenhouse for confirmation and entered into the 2003 EGN for further evaluations. The 2002 EGN consisted of 342 lines selected from previous years, ninety of which have undergone field and greenhouse evaluations for three consecutive years. Data and seed of these lines are available to other researchers. In the 2002 field season critical evaluations of materials in PSN and EGN were achieved because of high and relatively consistent disease pressure during the field evaluation period. Additional criteria, i.e. % Fusarium damaged kernel, test weight, yield, and DON concentration were used in the evaluation of advanced EGN materials, resulting in more complete information on scab reaction of the selections. Data on plant types, maturity and responses to rust infections were also collected to facilitate the utilizations. Five lines, PI 168727, PI 345731, PI 163429, PI 264940, and PI 185843, were entered into the URSN for testing at multiple locations and for direct access by breeders. Repeated and vigorous evaluations of selections were conducted in greenhouse experiments. A number of selections were found to be susceptible to spread within a spike while they exhibited moderate level of resistance in the field nurseries. Mapping populations developed from two elite selections (Abura and Tokai 66) have been advanced into F5 derived lines, and phenotyping of scab responses have been initiated.

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.

Jin, Y. and X. Zhang. 2002. Spring wheat scab evaluation data from Brookings (SD) in 2002. USDA-ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN): (http://www.ars-grin.gov/cgi-bin/npgs/html/desc.pl?65066)

Osborne, L. 2002. Small grain disease forecasting in South Dakota. A presentation to producers and crop advisors. July 1, 2002, SDSU Agric. Exp. Sta. Northeast Farm, South Shore, SD.

Osborne, L. and Y. Jin. 2002. Epidemiological studies on Fusarium head blight of wheat in South Dakota for 2002. Pages 171-174. In: Proc. 2002 National Fusarium Head Blight Forum. Dec. 7-9, 2002, Erlanger, KY. (Symposium/Conference Proceedings)

Osborne, L. and Y. Jin. 2002. South Dakota Fusarium head blight risk advisory for 2002. (Abstr) Page 176. In: Proc. 2002 National Fusarium Head Blight Forum. Dec. 7-9, 2002, Erlanger, KY. (Symposium/Conference Proceedings)

Osborne, L. and Y. Jin. 2002. A resistance-based sensor for detecting wetness at the soil-air interface. 2002 ASA-CSSA-SSSA Annual Meeting Abstract.

Osborne, L. E., and Y. Jin. 2003. Development of a resistance-based sensor for detection of wetness at the air-soil interface. Agronomy Journal *In review* (A03-0031).

Osborne, L., Y. Jin, F. Rosolen, and M. Hannoun. 2002. Fusarium head blight inoculum distribution on wheat plants within the canopy. (Abstr) Page 175. In: Proc. 2002 National Fusarium Head Blight Forum. Dec. 7-9, 2002, Erlanger, KY. (Symposium/Conference Proceedings)

Xing, D., Y. Yen, and Y. Jin. 2002. A non-coding wheat RNA may play an important role in wheat resistance to Fusarium head blight. (Abstr) Page 49. In: Proc. 2002 National Fusarium Head Blight Forum. Dec. 7-9, 2002, Erlanger, KY. (Symposium/Conference Proceedings)

Xing, D., Y. Yen, and Y. Jin. 2002. A putative acyl-CoA-binding protein of Fusarium graminearum may play an important role in the FHB pathogenesis. (Abstr) Page 50. In: Proc. 2002 National Fusarium Head Blight Forum. Dec. 7-9, 2002, Erlanger, KY. (Symposium/Conference Proceedings)

Zhang, X. and Y. Jin. 2002. Putative sources of Fusarium head blight resistance in spring wheat identified from the USDA small grains collection. Pages 220-222. In: Proc. 2002 National Fusarium Head Blight Forum. Dec. 7-9, 2002, Erlanger, KY. (Symposium/Conference Proceedings.