U.S. Wheat and Barley Scab Initiative
FY01 Final Performance Report (approx. May 01 – April 02)
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Cover Page

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Grant Number:	**59-0790-9-045**
Grant Title:	**Fusarium Head Blight Research**
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Project

Program Area	Project Title	Requested Amount
Epid/Dis. Mgt.	Scab forecasting and environmental effects on inoculum in eastern South Dakota	$ 73,718
Germplasm	Maintain a germplasm center of scab resistant spring wheat	$ 86,121
	Total Amount Requested	**$ 159,839**

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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?

Environmental effects on inoculum dynamics and pathogen biology were addressed in this project. The overall goals of the project were 1) to better understand environmental factors affecting Fusarium head blight (or scab) inoculum development and survival, specifically soil surface wetness, and 2) to obtain information pertinent to the development of disease forecasting and management strategies. Multiple planting dates (PD) were used in experimental plots to generate variability in flowering time concurrent with different levels of inoculum and favorable environment. Environmental parameters were monitored continuously using a data logger, and included rainfall, relative humidity, temperature, wind speed/direction, leaf wetness duration, and soil temperature. Sensors were constructed to detect moisture/wetness at the soil surface. Sensors were also distributed to collaborators and integrated into their weather data logger system. Daily airborne inoculum levels were assessed by enumerating spores trapped using a Burkhard cyclone sampler. Inoculum on wheat spikes was estimated by washing spikes and plating onto media. Scab incidence and severity were assessed at early to late dough stages.

2. What were the most significant accomplishments?

Weather was dry and cool during the flowering period for PD 1 and a gradual increase in moisture and temperature for PD 2 and PD 3. The air-borne and spike-borne inoculum levels increased with time from the beginning flowering for PD 1 to end of flowering for PD 3. Distinct differences in disease incidence and severity over three planting dates were observed, with final scab indices (incidence*severity) 2.7%, 17.2%, and 62.0% for PD 1, PD 2, and PD 3, respectively. The increase of scab over planting dates was likely due to increased levels of inoculum and favorable conditions for infection. Inoculum levels were significantly correlated with nighttime temperature, vapor pressure, leaf wetness duration, and precipitation during anthesis. Disease incidence was positively correlated to temperature, vapor pressure, and leaf wetness duration. These results have been submitted to the collaborative forecasting group. The data will help to identify variables that are highly predictive of the various components in a local and regional forecasting or disease development model.

Soil wetness sensors were deployed again in 2001 to further test their effectiveness in monitoring soil wetness. Calibration was conducted for wet/dry differentiation compared to tactile estimates using three soil types. In the field trials, variations among sensors were observed, yet sensors were very consistent for indicating wetting events (rainfalls and heavy dew) and duration. Collaborators at Purdue Univ., Pennsylvania State Univ., Ohio State Univ., and North Dakota State Univ. participated in testing by deploying sensors along with their normal weather monitoring equipment. The sensors appear to be effective in detecting surface wetness across all locations.

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 Fusarium head blight (FHB, or scab) 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.

2. What were the most significant accomplishments?

A system of evaluating germplasm through multiple nurseries (fully implemented in the previous year) was used. 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 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 users.

In the 2001 season, a total of 1,262 accessions of spring wheat originated from Europe and South America and 150 accessions of spelta wheat were evaluated in the PSN. One hundred forty-one lines were selected for further testing in the greenhouse and in 2002 EGN. Selections from the 2000's PSN (131 lines) were evaluated with point-inoculation and spray-inoculation in the fall and spring greenhouse seasons and were tested in the 2001's EGN. After two consecutive years of evaluations in EGN, fifty-lines continued to exhibit low disease severity, low seed infection, or low DON. Five elite selections (PI104131, PI185380, PI349478, PI350768, and PI382140) were entered into the 2001's URSN for spring wheat. Evaluation data of entries from 2001 PSN have been posted in the GRIN database (USDA-ARS, National Genetic Resources Program, Germplasm Resources Information Network).

Critical evaluations of materials in PSN and EGN were achieved because of high and relatively consistent scab pressure during the field evaluation period. Additional criteria, i.e. % scabby seed, 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. Evaluation data of elite selections have been posted in the National Scab Initiative website. Resistance from several elite selections is being introgressed into adapted germplasm.

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. 2001. Spring wheat scab evaluation data from Brookings (SD) in 2001. USDA-ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN): (http://www.ars-grin.gov/cgi-bin/npgs/html/desc.pl?65066)

Jin, Y., X. Zhang, and L. Osborne. 2001. Survival of *Gibberella zeae* ascospores on the plant surface. Phytopathology 91:S44.

Jin, Y., X. Zhang, and J. Rudd. 2001. Germplasm screening approach and sources of Fusarium head blight resistance identified from the USDA spring wheat collection. Pages 53-57 In: Can. Workshop on Fusarium Head Blight, Nov. 3-5, 2001, Ottawa, Canada.

Osborne, L. 2001. Small grain disease forecasting in South Dakota. A presentation to producers and crop advisors. July 2, 2001, SDSU Agric. Exp. Sta. Northeast Farm, South Shore, SD.

Osborne, L. and Y. Jin. 2001. A novel sensor for detecting wetness at the air-soil interface. 2001 Agronomy Abstract.

Osborne, L. and Y. Jin. 2001. Fusarium head blight: epidemic vs. non-epidemic conditions in South Dakota for 2001. Pages 137-140. In: Proc. 2001 National Fusarium Head Blight Forum. Dec. 8-10, 2001, Erlanger, KY.

Osborne, L. and Y. Jin. 2001. Soil-surface wetness sensor: report of further testing. Pages 142-146. In: Proc. 2001 National Fusarium Head Blight Forum. Dec. 8-10, 2001, Erlanger, KY.

Osborne, L., Y. Jin, and R. Kohl. 2001. Furarium head blight: inoculum detection, disease progress, and environmental influences. Phytopathology 91:S68.

Osborne, L., J. Vreugndenhil, S. Osborne, W. Reidell, and Y. Jin. 2001. Hyperspectral reflectance of eight spring wheat varieties in a scab nursery. Page 141. In: Proc. 2001 National Fusarium Head Blight Forum. Dec. 8-10, 2001, Erlanger, KY.

Weng, Y., X. Zhang, Y. Yen, and Y. Jin. 2001. Characterization of Fusarium head blight resistance germplasm with SSR markers linked to FHB resistance in Sumai 3. Pages 212-215. In: Proc. 2001 National Fusarium Head Blight Forum. Dec. 8-10, 2001, Erlanger, KY.

Xing, D., Y. Yen, J. Rudd, and Y. Jin. 2001. ESTs probably related to virulence or avirulence genes of *Fusarium graminearum*. Page 39. In: Proc. 2001 National Fusarium Head Blight Forum. Dec. 8-10, 2001, Erlanger, KY.

Zhang, X., P. Anderson, and Y. Jin. 2001. A procedure of producing *Fusarium graminearum* conidia in large quantities. Pages 216-219. In: Proc. 2001 National Fusarium Head Blight Forum. Dec. 8-10, 2001, Erlanger, KY.

Zhang, X., Y. Jin, J. Rudd, and H. Bockelman. 2001. Evaluation of USDA spring wheat germplasm for Fusarium head blight resistance. Pages 220-224. In: Proc. 2001 National Fusarium Head Blight Forum. Dec. 8-10, 2001, Erlanger, KY.

Zhu, L., J. Rudd, and Y. Jin. 2001. Pre-anthesis drought and heat stress on Fusarium head blight development in spring wheat. Page 293. In: Proc. 2001 National Fusarium Head Blight Forum. Dec. 8-10, 2001, Erlanger, KY.