USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY05 Final Performance Report (approx. May 05 – April 06)
July 14, 2006

Cover Page

PI:	**Jeffrey M. Stein**
Institution:	**South Dakota State University**
Address:	**Plant Science Department** **Box 2108** **Brookings, SD 57007**
E-mail:	**Jeff.Stein@sdstate.edu**
Phone:	**605-688-5540**
Fax:	**605-688-4024**
Fiscal Year:	**2005**
FY05 ARS Agreement ID:	**59-0790-4-107**
Agreement Title:	**FHB Epidemiology on Spring Wheat in South Dakota.**
FY05 ARS Award Amount:	**$ 78,049**

USWBSI Individual Project(s)

USWBSI Research Area*	**Project Title**	**ARS Adjusted Award Amount**
EDM	FHB Forecasting and Model Validation for Spring Grains in South Dakota.	$ 58,537
EDM	Environmental Factors Influencing Scab of Barley in the Northern Great Plains.	$ 19,512
	Total Award Amount	**$ 78,049**

_____7/12/06_____
Principal Investigator Date

* BIO – Biotechnology
CBC – Chemical & Biological Control
EDM – Epidemiology & Disease Management
FSTU – Food Safety, Toxicology, & Utilization
GIE – Germplasm Introduction & Enhancement
VDUN – Variety Development & Uniform Nurseries

Project 1: *FHB Forecasting and Model Validation for Spring Grains in 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. The specific objectives addressed were to: 1) examine the effects of inoculum abundance, host resistance, fungicide, and weather on Fusarium head blight of wheat in order to provide a knowledge base for the development of accurate disease forecasting systems and comprehensive disease management strategies; 2) continue with the validation and ground-truthing of previously developed spring wheat FHB risk assessment/forecast models; and 3) continue exploring variables and variable components which may be useful in modeling FHB of spring grains. Objective 1 was studied in collaboration with researchers at Pennsylvania State University, North Dakota State University, Ohio State University, and Purdue University. Coordinated field plots with varying amounts of corn stubble residue were established to monitor disease development over time, in conjunction with environmental (weather) and inoculum monitoring. Objective 2 was also performed in collaboration (ala Objective 1) and continued the development of a spring wheat scab data set for model development and validation through the repeated assessment of numerous spring wheat crops. Objective 3 was performed by statistically examining data sets from a number of prior location-years.

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:
The temporal inoculum dynamics of airborne FHB inoculum within eastern South Dakota were assessed and examined with respect to environment. As part of our disease monitoring throughout parts of South Dakota, long-term air sampling was conducted in order to determine inoculum concentration and changes in airborne levels of ascospores and conidia during the critical parts of the growing season.

Impact:
This work provides an understanding of inoculum production and dissemination – in a way that is different from reports and studies conducted in other regions of the world. In South Dakota, and likely in North Dakota and Minnesota where climate patterns are somewhat similar, inoculum was shown to be ubiquitous in the air above wheat canopies across diverse environments. This would allow risk modeling and disease management strategies to focus on environment at flowering, environment post-flowering, and plant stage rather than on traditional inoculum development models which have had only modest success in our region.

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?:
We are continuing to refine and improve the system of prediction available to producers in order to help determine optimum spray timing. Grain marketing will be impacted by the

ability to predict when areas of production have had heavy levels of infection – and may allow for a greater lead time in planning for harvest and final marketing decisions.

Researchers in this region of the US can focus on a smaller set of factors (infection parameters, post-heading weather, growth stage) when developing predictive models. A scientific article for publication in a scholarly journal is in progress and models for use in risk assessment systems will be created and disseminated to researchers and producers.

Accomplishment:
Examination of FHB of wheat in response to corn residue treatments.

Impact:
It is widely accepted that FHB is more problematic over corn residues than over some other crop residues or clean tilled soils. This stems from frequent association of severe scab with corn-wheat or corn-barley rotations, and from the understanding that corn stover and grain serve as excellent hosts for the sexual stage of the FHB causal agent. Copious ascospores are produced from residues which are durable for one or more years in the field. It is important to understand just how much impact corn residues have on FHB when all other factors are controlled. In three years of field trials in which were represented 6 independent environments, residue had no discernable effects on disease amount in field plots as tested. Thus, it was concluded that inoculum coming into the plot area was far more important than inoculum produced directly beneath the canopy.

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?:
Researchers and producers in the region should gain an understanding that crop rotation as a means of preventing FHB has limited efficacy largely because of the importance of airborne inoculum entering an area and contacting susceptible heads. This again points to the importance of environment as the controlling factor for FHB in the Northern Great Plains. A scholarly journal article is in preparation.

Project 2: *Environmental Factors Influencing Scab of Barley in the Northern Great Plains.*

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

Fusarium head blight (FHB) of barley continues to be a serious problem for producers in the Northern Great Plains. Barley production in the Dakotas and Minnesota has declined steadily since the mid 1980's and this can be attributed to, at least in part, the re-emergence of *Fusarium* head blight. Of particular importance to barley production is the accumulation of deoxynivalenol (DON) in the grain. Significant progress has been made in recent years in the development of disease forecast models for wheat; however, the effectiveness of these models in predicting disease, and more importantly DON accumulation, for barley is questionable. We are addressing this issue by attempting to develop models, and eventually a forecasting system, that can predict disease and DON accumulation for barley. Such a system would offer producers the information required to make effective management decisions.

The objectives of the proposed research were to 1) establish a database of information on weather, field disease, and mycotoxin levels for spring barley in the region and 2) begin identifying variables that are predictive of disease and DON accumulation in barley in order to develop models and risk advisory systems. Objective 1 was conducted in collaboration with researchers at North Dakota State University and the University of Minnesota, Crookston. Plots were planted at 15 locations throughout the region. The environment was monitored at each location during the growing season, field ratings of disease were taken, and DON concentration in the grain was quantified. Objective 2 was performed in collaboration with researchers at the Pennsylvania State University. Over 100 variables, both simple and complex, were generated using environmental parameters that are known to impact the biology of this pathosystem (temperature, relative humidity, vapor point depression, etc). Correlation analysis was conducted to determine which, if any, of these factors were strongly associated with field disease or DON content in the grain.

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:
Establish a database of information on weather, field disease, and mycotoxin levels for spring barley in the region.

Impact:
This is the first coordinated study in the region that examined the impact of environment on field disease and DON accumulation in the grain for barley. Results from this study will be used to develop models and risk advisory systems.

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?:
Currently, we lack the number of location-years required for the development of accurate and precise models. However, as the number of these increases, a database of sufficient size

will be available for intensive variable exploration and model development. This will lead to the development of models that are more robust and effective at prediction. The preliminary results of this portion were presented at the National U.S. Wheat and Barley Scab Initiative meeting.

Accomplishment:
Begin identifying variables that are predictive of disease and DON accumulation in barley in order to develop models and risk advisory systems.

Impact:
It is widely acknowledge that the amount of FHB disease in barley is highly influenced by weather prior to, and during, heading. This is the first attempt at identifying those environmental variables that impact both disease and DON accumulation in grain for malting barley. By better understanding these relationships, one can develop disease and DON forecasting models that would be used to make effective crop management decisions.

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?:
Through the preliminary exploration of environmental variables that are associated with FHB of barley and DON accumulation in the grain, we are one-step closer to the development of a system of prediction to help determine optimum fungicide application timing. We now have a better understanding of the influence of environment on the infection and disease development processes and have begun to investigate those factors that affect DON production by the fungus and accumulation in the grain.

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.

Osborne, L.E. and J.M. Stein. 200x. Relationship of spike-borne Fusarium Head Blight inoculum to DON accumulation in grain for spring wheat. *In Preparation*.

Osborne, L.E., Y. Jin, and J.M. Stein. 200x. Airborne Inoculum Dynamics of Fusarium Head Blight for Seven Location-Years in Relation to Environment. *In Preparation*.

Osborne, L.E. Y. Jin, and J.M. Stein. 200x. Inoculum, Variety, and Environment Interactions affecting Fusarium Head Blight. *In Preparation*.

Stein, J.M., and M.A. Draper. 2005. The Fusarium Head Blight Epidemics of the Winter and Spring Wheat Crops in South Dakota for 2005. Poster: Proceedings of the National Fusarium Head Blight Forum; 2005 Dec 11-13; Milwaukee, WI, USA. Canty, S.M., Boring, T., Wardwell, J., Siler, L. and Ward, R.W (Eds.), Michigan State University, East Lansing, MI. pp. 152.

Stein, J.M., C.M. Kirby, and L.E. Osborne. 2005. Environmental Factors Influencing Scab of Barley in the Northern Great Plains. Poster: Proceedings of the National FHB Forum as before. pp. 151.

Osborne, L.E., and J.M. Stein. 2005. Airborne Inoculum Dynamics for Seven Location-Years in Relation to Environmental Parameters. Poster: Proceedings of the National FHB Forum as before. pp. 129-133.

Osborne, L.E., and J.M. Stein. 2005. Effects of Maize Residues and Variety on Fusarium Head Blight in South Dakota. Poster: Proceedings of the National FHB Forum as before. pp. 134-137.

Kirby, C.M., L.J. Peterson, L.E. Osborne, J.M. Stein, and K.D. Glover. 2005. A Comparison of Type I and Type II Resistance within a Collection of Elite Spring Wheat Genotypes. Poster: Proceedings of the National FHB Forum as before. pp. 51.

Nita, M., E. De Wolf, L. Madden, P. Paul, G. Shaner, T. Adhikari, S. Ali, J. Stein, and L. Osborne 2005. Effect of Corn Residue Level on the Incidence of Fusarium Head Blight. Poster: Proceedings of the National FHB Forum as before. pp. 124.