USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY06 Final Performance Report (approx. May 06 – April 07)
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Cover Page

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Fiscal Year:	2006
USDA-ARS Agreement ID:	59-0790-4-123
USDA-ARS Agreement Title:	Fusarium Head Blight of Wheat: Epidemiology and Management by Genetic and Chemical Means.
FY06 ARS Award Amount:	$ 41,595

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Award Amount
CBCC	Uniform Fungicide Trials for Control of Fusarium Head Blight.	$ 15,300
EEDF	Effect of Inoculum, Host Resistance, Fungicide, and Weather on FHB.	$ 26,296
	Total Award Amount	**$ 41,595**

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Principal Investigator Date

* CBCC – Chemical, Biological & Cultural Control
EEDF – Etiology, Epidemiology & Disease Forecasting
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GET – Genetic Engineering & Transformation
HGR – Host Genetics Resources
HGG – Host Genetics & Genomics
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

Project 1: *Uniform Fungicide Trials for Control of Fusarium Head Blight.*

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

The shift to conservation tillage methods of crop production was a major contributor to destructive epidemics of *Fusarium* head blight (FHB) of wheat and barley in the U.S. in the 1990s. Production of susceptible cultivars and favorable weather also contributed to these epidemics. Control of FHB will require several disease management strategies, coupled with greater understanding of its epidemiology. Reduction of crop residue through tillage has not been widely used because efficacy has not been clearly demonstrated or because of negative impacts on soil conservation. Genetic resistance may provide only partial control. Cultivars with some degree of resistance are only now becoming available. Other disease management practices may be needed to augment partial resistance, especially under conditions very favorable for FHB.

Fungicides would provide growers with a management option when susceptible cultivars are grown, and may help protect grain yield and quality of cultivars with partial resistance under conditions particularly favorable for disease. A few fungicides have shown some efficacy against FHB, but do not provide complete control or the desired consistency. Some fungicides reduce DON contamination of grain, but others may cause an increased amount of DON.

The purpose of this cooperative study is to compare a core set of fungicide treatments at several locations throughout the Corn Belt and upper Midwest for their efficacy against FHB of wheat and barley and for their ability to preserve grain quality and prevent accumulation of DON.

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: At one location, where head blight was moderately severe, several fungicides reduced blight index, but only three reduced the frequency of visible damage on kernels, and only one, Prosaro, reduced DON content in grain. At a second location, where blight pressure was not as intense, several treatments reduced blight index, frequency of visibly damaged kernels, and DON concentration in grain.

Impact: Results from these and similar experiments conducted in other states provide data to support registration of new fungicides for control of head blight in wheat. These data have also been important for securing Section 18 exemptions for use of Folicur against head blight in many states. The data are used to advise growers as to the relative efficacy of various fungicides for control of head blight, as well as rates and timing of application for best control.

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?
Indiana has had a Section 18 exemption for use of Folicur to suppress head blight of wheat in each of the past 3 years. Data from the uniform fungicide trials were essential for securing this exemption.

Project 2: *Effect of Inoculum, Host Resistance, Fungicide, and Weather on FHB.*

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

Weather has a strong influence on development of head blight. Moisture and temperature control production of spores by *Gibberella zeae* and infection of wheat and barley. Abundance of the fungus presumably determines how many spores may be produced under any given weather conditions. Conservation tillage leaves much more corn residue on the soil surface than conventional tillage, and is thought to be a major contributor to destructive epidemics of *Fusarium* head blight (FHB) of wheat and barley in the U.S. in the 1990s. For whatever amount of inoculum that is in the air when wheat or barley is vulnerable to infection, the degree of cultivar susceptibility will influence the severity of head blight. Farmers now have the option of using a foliar fungicide to suppress head blight. Because of the influence of weather, abundance of the pathogen in crop residue, and degree of cultivar susceptibility on head blight intensity, it would be desirable to use a fungicide only when these factors all combine to result in a high enough risk for disease to justify the additional cost. This epidemiological study, part of a multi-state program, is generating data that can be used to develop and refine weather-based models of the risk of infection. Weather data are collected at 30-min. intervals in order to relate how weather affects disease development in plantings of susceptible or moderately resistant wheat cultivars, treated or not treated with a fungicide, and susceptible barley, all with or without corn residue on the soil surface. Disease variables monitored are inoculum production, head blight severity, frequency of scabby kernels, and DON content.

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:

In a field experiment, presence or absence of corn residue on the soil surface had no effect on the intensity of Fusarium head blight symptoms on wheat, nor on frequency of visibly damaged kernels (VDK), on frequency of infection of visibly sound kernels by *Gibberella zeae*, or on level of DON in the flour. Inoculum in the Corn Belt may be sufficiently abundant and widespread to negate local field effects of corn residue. A foliar fungicide had no effect, except to reduce the frequency of visibly scabby kernels (VDK). Assessment of airborne spores of *Gibberella zeae* revealed considerable day-to-day variation in spore numbers. Spores were detected throughout the sampling period, which began approximately one week before onset of flowering of wheat, and continued for 3 weeks. Cultivar Patterson developed substantially more head blight than cultivars Hopewell and Truman, which began flowering 3 to 4 days later than Patterson. Airborne spores of *G. zeae* were abundant on the second day of flowering of Patterson, before the other two cultivars had begun to flower, which may account for the greater disease intensity on Patterson. There were weak but significant correlations between head blight intensity in the field and frequency of VDK or infection of apparently sound kernels. At very low intensities of head blight (<1%), VDK ranged from 0 to 4% and infection of apparently sound kernels ranged from 28 to 68%. There was no correlation between level of DON and intensity of head blight, frequency of VDK, or frequency of infection of apparently sound kernels.

Eleven wheat lines were evaluated for head blight development in cultivar trials at 5 locations throughout Indiana. There was little or no head blight at 4 locations, but moderate disease at the west-central location. Lines differed in incidence of head blight at 3 locations, frequency of VDK at 3 locations, and DON content at 3 locations. Except for 1 line at 1 location, DON levels were less than 2 ppm. The correlation between head blight intensity and DON level was significant at only 2 locations, but even there the association was weak. The same level of DON was found over a range of head blight intensities. At the location with the greatest intensity of head blight, 9 of the 11 lines headed on 10 or 11 May, and among these, incidence of head blight ranged from 5.4 to 11%, suggesting that differences reflected genetic resistance rather than simply escape from infection.

Impact:

The disease data from this experiment are being used to further refine the model.
This research contributes data for the development of a weather-based risk model for Fusarium head blight of wheat. This model is deployed on the Web, for all states where head blight is a threat. Our studies also demonstrate that head blight intensity is not a reliable predictor of concentration of DON toxin in grain. This means that plant breeders should select for resistance to toxin accumulation directly, in addition to resistance to head blight, that fungicides should be evaluated for suppression of DON as well as suppression of blight symptoms, and that weather-based risk models should aim to predict DON content in grain as well as blight symptom intensity in the field.

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?

The web-based risk model, developed from data from this and identical studies in several states, has proven to be generally reliable for our area. Growers, grain buyers, and grain end users have a means for assessing the risk of head blight. Growers can use the model to determine the need for fungicide applications. Grain buyers can use the model to identify areas that might have a head blight problem, and take measures to check grain for scab and DON. Millers can use the model to identify areas where head blight may have reduced grain quality, and take steps to identify sources of sound 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.

Day KM, Lorton WP, Christmas EP, Mansfield CW, Buechley GC, Shaner GE. 2006. Performance of Public and Private Small Grains in Indiana, 2005. Bulletin No. B 17994 <Available at: http://www.agry.purdue.edu/pcpp/smgrains.html>.

Nita M, DeWolf E, Madden L, Paul P, Shaner G, Adhikari T, Ali S, Stein J, Osborne L. 2005. Effect of corn residue level on the incidence of Fusarium head blight. Proc 2005 National Fusarium Head Blight Forum. Available at <http://www.scabusa. org>.

Shaner G, Buechley G. 2007. Control of leaf blotch and Fusarium head blight of wheat in north central Indiana with foliar fungicides, 2006. PDMR, Report No. 1:CF004. Available at <http://www.plantmanagementnetwork.org/pub/trial/pdmr/volume1/abstracts/cf004.asp>.

Shaner G, Buechley G. 2007. Control of leaf blotch and Fusarium head blight of wheat in southeastern Indiana with foliar fungicides, 2006. PDMR, Report No. 1:CF005. Available at <http://www.plantmanagementnetwork.org/pub/trial/pdmr/volume1/abstracts/cf005.asp>.