USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
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Cover Page

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Fiscal Year:	2009
USDA-ARS Agreement ID:	59-0790-8-070
USDA-ARS Agreement Title:	Developing Practical FHB Disease Management Strategies for Wheat and Barley Crops.
FY09- USDA-ARS Award Amount:	$ 47,503

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
MGMT	Differential DON Accumulation from Pre-head Foliar-applied Fungicide Application.	$ 24,390
MGMT	2009 Uniform Fungicide Trial on Spring Wheat in Minnesota.	$ 5,321
MGMT	Developing Practical and Economic Disease Management Strategies for FHB in MN.	$ 14,634
BAR-CP	Development and Validation of FHB and DON Prediction Models for Barley.	$ 3,158
	Total Award Amount	**$ 47,503**

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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
DUR-CP – Durum 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: *Differential DON Accumulation from Pre-head Foliar-applied Fungicide Application.*

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

The project evaluates of the potential to reduce FHB through combinations of host resistance and fungicides and will improve our understanding of the factors that influence the final DON levels in grain. The specific project objective are to determine the effect of applications of triazole and strobilurin fungicides in the Feekes growth stages 2, 9, 10.5 and 10.51 (anthesis) for managing FHB and DON in spring wheat. Strobilurin fungicides are implicated in increased deoxynivalenol accumulation in wheat grain and this research project aims to confirm the influence of this class of fungicides in disease development and mycotoxin accumulation.

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:

The inoculated mist-irrigated field experiment was completed as planned in 2009. The experiment was planted May 20 at the Northwest Research and Outreach Center (NWROC) in Crookston as a randomized complete block design with three replicates. A mist-irrigation system was installed before the experimental plots were inoculated. Plots were inoculated by spreading *F. graminearum*-colonized grain on June 25. The mist-irrigation began on July 2 and ran until disease assessment, except when rain events caused soil saturation. Fungicide application treatments were timed approximately a week apart. FHB symptoms (incidence and severity) were rated when visual symptoms were fully developed but prior to the natural senescence of the heads. Plots were harvested September 4. The harvested seed was cleaned and processed for yield, test weight and protein. Sub-samples of grain have been submitted for mycotoxin analysis.

Fusarium head blight symptoms were widespread although environmental conditions did not promote FHB development in commercial fields so it appears that use of an irrigation system was warranted. Treatments means for FHB incidence, FHB severity, FHB index, yield (bu/a), test weight (lb/bu) and thousand kernel weight (g) were significantly different. No differences in protein levels were detected. FHB symptoms were highest in Reeder and lower in Glenn and Knudson. The yield of Knudson was the highest, while Glenn had the lowest. Glenn treatments had the highest test weights and Reeder the lowest.

Impact:

The DON data contributed to our understanding of the interactions of the fungicides (esp. strobilurins), fungicide application timing and mycotoxin development by demonstrating that DON levels may indeed be increased by the use of strobilurin fungicides for the control of FHB in wheat.

Project 2: *2009 Uniform Fungicide Trial on Spring Wheat in Minnesota.*

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

   The project evaluating of the potential disease reductions through combinations of host resistance and fungicides and is focused on developing FHB management strategies focused on fungicide application, selection, and timing in epidemic FHB years.

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:

   The inoculated, mist-irrigated experiment was conducted as planned in 2009. The experiment was planted May 20 at the NWROC in Crookston. The experimental design was a randomized complete block with four replicates. The experiment was inoculated by spreading *F. graminearum*-colonized grain inoculum on 25 June. A mist-irrigation system was installed and activated on July 2, well before the wheat reached Feekes growth stage 10.51. Fungicide application treatments were applied per the established protocol for the collaborative study beginning on July 10. Leaf disease and FHB symptoms were rated when plants were at the appropriate growth stages. The experiment was harvested at maturity on September 4. Harvested grain was cleaned and tested for yield, test weight, thousand kernel weight and protein. Sub-samples of grain have been submitted for mycotoxin analysis.

   FHB was moderately severe throughout the trial. The results indicated significant treatment differences. Treatment differences are evident for FHB incidence, FHB severity, FHB index and test weight. Means for yield, thousand kernel weight, and protein did not show any significant treatment effects. In general, timely or later growth stage fungicide treatments (Feekes 10.51, Feekes 10.51+) resulted in higher test weight and fewer FHB symptoms than either/or the nontreated control or early fungicide applications (Feekes 10, Feekes 10.5). That there was not a significant loss of yield, given the level of disease present was unexpected.

   Fusarium head blight symptoms were widespread across the test in a year when natural environmental conditions did not promote disease development, suggesting that the use of an irrigation system was beneficial to the experimental design.

   Impact:

   Testing wheat responses following fungicide treatment(s) in an inoculated and mist-irrigated experiment provides data that can be delivered as best management practices for FHB/DON. As part of large collaborative effort this project is helping build a knowledge base for integrated management throughout the hard red spring wheat growing region.

Project 3: *Developing Practical and Economic Disease Management Strategies for FHB in MN.*

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

The project will allow us a better understanding of specific factors that influence infection and toxin accumulation. This research effort is focused on the development of FHB management strategies in hard red spring wheat that encompasses fungicide application, crop rotation, and cultivar selection.

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:

Two experiments were established in the Red River Valley in 2009. One at Fisher, planted on May 7 into sugar beet residue and the second east of Crookston on May 11 planted into wheat residue. Both experiments were a split plot design with four replicates. Fungicide treatment (2; untreated control, Prosaro) was the main-plot treatment and wheat cultivar (6 HRS wheat cultivars, varying in FHB resistance) was the sub-plot treament. The fungicide applications (at Feekes growth stage 10.51) commenced on July 6. Hail damage was sustained at both locations. Foliar disease and FHB symptoms were rated visually. Additional data collected included residue cover after planting, stand counts, grain yield and quality. The Fisher site was harvested August 26 and the East Crookston location on August 31. **FISHER**: The wheat at this site sustained ca. 11% injury from hail after heading. Yield means were unusually low at this site (36.0 bu/a to 52.5 bu/a) as a result of the hail damage. Symptoms of bacterial leaf streak (BLS) worsened following the storm and the plots became severely diseased. As this site the wheat was planted into sugar beet residue, so little to no endogenous *F. graminearum* inoculum was present. Cultivar differences were significant for stand counts and test weight. Cultivar and fungicide treatments were significant for yield, 1000-kernel weight and protein. Leaf disease and FHB ratings were low and no significant differences were detected. **E. CROOKSTON**: This test was planted into 2008 wheat residue but had a substantial amount of corn residue remaining from 2007. Leaf disease symptoms were severe at Feekes 2, but an early fungicide application stopped additional tan spot development, and FHB development was light. Cultivar effects were significant for stand counts. Both cultivar and fungicide treatments effects were significant for test weight and thousand kernel weight. No significant treatments effects were identified for yield. A cultivar*fungicide treatment interaction was significant for protein.

Impact:

Treatment effects have contributed to out knowledge of integrated research efforts and should contribute to providing economically sound disease management recommendations.

Project 4: *Development and Validation of FHB and DON Prediction Models for Barley.*

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

   This project aimed to provide data to help validate prediction models for FHB and DON for barley which when deployed will provide a valuable management tool for growers similar to that already available for wheat.

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:

   Data on weather, crop growth stage and disease observations were collected in naturally infected fields and provided to cooperators to validate current models and allow revision of the models. The final models are aimed to predict both the risk of a given FHB severity and also the content of DON in harvested grain.

   Impact:

   A multi-state scab forecasting model is under development at South Dakota State University. When deployed this model will help growers throughout the Upper Midwest predict the risk of Fusarium head blight during the growing season and thus aid them in the decision whether to apply, or not apply, a fungicide.

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.

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