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

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Fiscal Year:	**2005**
FY05 ARS Agreement ID:	**59-0790-4-096**
Agreement Title:	**Crop Residue Management and Screening Techniques for Improved Management of FHB.**
FY05 ARS Award Amount:	**$ 66,429**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
EDM	Characterizing Barley Near-Isogenic Lines for a QTL-Conditioning DON Accumulation.	$ 32,283
VDUN	FHB Resistance QTLs in Hard Red Spring Wheat Near-Isogenic Lines.	$ 34,146
	Total Award Amount	**$ 66,429**

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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: *Characterizing Barley Near-Isogenic Lines for a QTL-Conditioning DON Accumulation.*

1. What major problem or issue is being resolved and how are you resolving it?
The accumulation of deoxynivalenol (DON) in barley grain is the principal concern of the barley industry related to Fusarium head blight (FHB) epidemics. We have observed higher DON accumulation, within 72 hours of inoculation, in barley genotypes which demonstrate resistance to point-inoculation with *Fusarium graminearum* in greenhouse experiments. This work led to the identification of a single quantitative trait loci (QTL) on chromosome 3 in a Frederickson/Stander mapping population that explained 18-35% of the variation in DON accumulation in barley spikes within 72 hours of inoculation. This QTL was validated in subsequent greenhouse experiments using near-isogenic lines (NILs). Given the importance of DON to the malting barley industry it is essential to develop a better understanding of the biology of toxin accumulation in Fusarium-infected barley. In this project we used these NILs to examine toxin accumulation in barley spikes between anthesis and harvest under both greenhouse and field conditions and to examine the stability of the QTL with experiments using a wider range of Fusarium isolates.

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 NILs for a QTL, on chromosome 3 in a Frederickson/Stander population, for DON accumulation within 72 hours of inoculation were examined in inoculated, mist-irrigated field experiments in St Paul in 2004 and 2005. The data indicated slight differences in DON accumulation with the NIL carrying the Frederickson QTL (for DON accumulation) having slightly higher DON in grain at harvest, however the differences between the two NILs was not significant in either year of the study.

Impact: These results indicate that the QTL identified on chromosome 3 likely impacts toxin accumulation only in the first few days following infection. Although the QTL has a measurable effect on DON accumulation in the period immediately following infection it's commercial vale in preventing DON accumulation in commercial situations appears to be limited.

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 now know that while this QTL has the potential to aid our understanding of DON accumulation in tissues it appears that it will not provide protection to DON accumulation in barley as is needed for commercial barley production. While this may seem to be a negative outcome the finding will enable us to redirect our efforts to examining alternative approaches to mitigating the accumulation of DON in barley.

Accomplishment: The experiments conducted in 2004 and 2005 to examine the DON accumulation in these QTLs were conducted with each of five *F. graminearum* isolates used individually as inoculum. The data indicated substantial differences in the development of FHB and thus DON accumulation among the isolates examined, although in 2005 disease levels were lower and DON accumulation was also low for all treatments.

Impact: These results indicate that the isolates of *F. graminearum* which infect barley will impact both FHB development and toxin accumulation in grain.

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?:
This work indicates that individual isolates of the fungus *Fusarium* which causes FHB may have a substantial impact on the subsequent development of FHB and associated accumulation of DON in harvested grain. The finding helps both researchers and producers understand one of the factors that contribute to variation in the observed level of DON in barley grain following infection with *Fusarium*.

Project 2: *FHB Resistance QTLs in Hard Red Spring Wheat Near-Isogenic Lines.*

1. What major problem or issue is being resolved and how are you resolving it?
In many instances presumptive unique Fusarium head blight (FHB) resistance quantitative trait loci (QTLs) have been mapped in a diverse range of common wheat (*Triticum aestivum*) genotypes and related species, but have not yet been introgressed into U.S. hard red spring wheat (HRSW). This limits the utility of such QTLs. We have initiated a program to use marker-assisted backcrossing to individually introgress a number of FHB resistance QTL from diverse germplasm sources into HRSW. Our goal is to develop wheat lines that are principally HRSW in genome composition, but are near-isogenic for the different novel QTLs (QTL NILs). These lines will be used to determine which of the new introgressed QTL confer resistance in HRS backgrounds, and what level of resistance each QTL confers.

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: We completed the introgression of three different FHB resistance QTLs into three different HRSW backgrounds, and completed the first year of disease evaluations both in the field and greenhouse. Our results suggest that we have been successful in introgressing a new FHB resistance QTL into HRSW from soft red winter wheat. We also advanced the introgression of two other novel QTL to near completion.

Impact: Introgression of novel FHB resistance QTLs from exotic germplasm or even related species is challenging because of the possible erosion of performance and quality that comes with such efforts, the time and labor required to accomplish this, and the uncertainty of success. By undertaking this research project, we are producing valuable new HRSW germplasm with novel FHB resistance QTLs that will allow breeders to sidestep the aforementioned problems and concerns.

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?:
HRSW NILs that harbor new validated FHB resistance QTLs will be released on request to HRSW breeding programs, as sources of new genes with which to increase FHB resistance. These NILs will be far more attractive as parents for crosses than the original sources of the QTLs because their genomes will be primarily HRS in derivation. Introducing more FHB resistance QTLs in HRSW provides an avenue for further increasing FHB resistance, in turn reducing the large economic losses associated with this disease.

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.

Dill-Macky, R., Steffenson, B.J.,. Hollingsworth, C., and Smith, K.P (2005). Management of barley diseases in the upper Midwest. In: *Proceedings of the 35th Barley Improvement Conference*, Charlestown, South Carolina, USA, January 11-13, 2005, p. 13-15.

Blechl A., Somleva, M., Okubara P., and Dill-Macky, R. (2005). New Approaches to overcome Fusarium Head Blight. In: *Proceedings of the IWQCIII*, Manhattan, Kansas, USA, May 22-26, 2005.

Garvin, D.F. and Dill-Macky, R. (2005). Evaluation of wheat lines near-isogenic for diverse Fusarium Head Blight resistance QTLs. In: *Proceedings of the 2005 National Fusarium Head Blight Forum*, Milwaukee, Wisconsin, USA, December 11-13, 2005, p. 29-30.