USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
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Cover Page

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Fiscal Year:	2008
USDA-ARS Agreement ID:	59-0790-4-111
USDA-ARS Agreement Title:	Development of Scab Resistant Soft Red Winter Wheat Varieties.
FY08 USDA-ARS Award Amount:	$ 118,676

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
VDHR-NWW	Development of Scab Resistant Soft Red Winter Wheat Varieties and Scab Resistance QTL Mapping.	$94,941
VDHR-NWW	Mapping FHB QTL in an IL97-1828 x Clark Derived RIL Population.	$ 18,891
VDHR-NWW	Fungicide x Variety Interaction Experiment.	$ 4,844
	Total Award Amount	**$ 118,676**

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
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: *Development of Scab Resistant Soft Red Winter Wheat Varieties and Scab Resistance QTL Mapping.*

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

The major issue is that producers need varieties with high levels of scab resistance. We are working on the development of high-yielding, well-adapted, scab resistant lines. As more lines with good scab resistance are identified we are using these parents in crosses, so that in many crosses both parents, or two parents out of three in a three-way cross, are scab resistant. We also believe that it is important to combine several types of resistance rather than rely solely on Type II resistance. We are addressing this by using the ISK index to select breeding lines with high levels of scab resistance. Development of varieties with low deoxynivalenol (DON) levels is also crucial; therefore, all breeding lines are evaluated each year for DON level.

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: Fifty-eight varieties from the Illinois State Variety Trial were evaluated for FHB resistance in a FHB evaluation nursery, and data were made available to producers.

Impact: In order to use FHB resistance as a criterion in variety selection producers must have as much information as possible on FHB resistance. The FHB resistance data provide very useful information to Illinois seedsmen and producers and allows them to use FHB resistance as a criterion in variety selection. Producers and seedsmen have a three year summary of data of FHB resistance and DON level that can be used in decisions about what varieties to produce. The information on FHB resistance is available online at <http://vt.cropsci.illinois.edu/wheat.html >.

Accomplishment: About 286 breeding lines in cooperative nurseries including the Uniform Northern Winter Wheat Scab Nursery, the Uniform Preliminary Northern Winter Wheat Scab Nursery, the Uniform Southern Scab Nursery, the Uniform Eastern Soft Winter Wheat Nursery, and the Adv. and Prelim. Five-State Nurseries were evaluated for FHB resistance in a misted, inoculated FHB field nursery. Lines from the Univ. of Illinois program were submitted for all of the cooperative nurseries except the Uniform Southern Scab Nursery, thus, breeding lines with FHB resistance were made available to other breeding programs for use as germplasm. Three University of Illinois breeding lines were among the most FHB resistant lines in the 2008 NUWWN and four University of Illinois breeding lines were among the most FHB resistant lines in the 2008 PNUWWN.

Impact: The data provided were useful to many different breeding programs in making decisions about which breeding lines merit further evaluation as varieties and which breeding lines will be useful as germplasm. Exchange of FHB resistant breeding lines among programs is essential and will contribute to the development of FHB resistant varieties. Obtaining FHB resistance data for entries in the cooperative nurseries from many environments allow wheat breeders to make better selection decisions about what lines to advance for further evaluation. Breeding lines from the University of Illinois breeding program were made available to other breeding programs for use as parents if the breeders wish to use them.

Accomplishment: In 2008, about 470 breeding lines from the University of Illinois wheat breeding program were evaluated in the misted, inoculated scab evaluation field nursery. Scab resistant lines were evaluated for many additional traits including grain yield, milling and baking quality, standability, and resistance to other diseases.

Impact: Sustained annual selection for FHB resistance in the inoculated, misted field nursery has significant long-term impact by assuring that new varieties will be FHB resistant. Constant selection for FHB resistance in the breeding program is essential in order to identify breeding lines with FHB resistance and also to discard FHB susceptible lines early so that resources are not wasted evaluating FHB susceptible lines. The constant selection pressure applied using evaluation in misted, inoculated nurseries is essential in reducing DON.

Accomplishment: In 2008, 1178 wheat samples were sent to the lab at the University of Minnesota for deoxynivalenol (DON) analysis.

Impact: DON evaluation is an essential component of FHB resistance evaluation because new varieties must have not just lower FHB field symptoms but also reduced DON content. This is information that is primarily useful to the wheat breeder, but information on low DON producing varieties can also be used by the producer in variety selection.

Accomplishment: In 2008-09, 268 single crosses and 154 three-way and four-way crosses were made involving FHB resistance sources. For 16 of these populations MAS was used for F_2 enrichment for the 3BS FHB resistance locus.

Impact: The crosses of scab resistant parents by adapted high yielding parents will provide populations that can be used for development of scab resistant varieties. These crosses are the source of variability that will be used for future development of scab resistant soft red winter wheat varieties.

Accomplishment: Four soft red winter wheat breeding lines combining FHB resistance equal to or better than Ernie with high yield potential are in increase for release for licensing and potential commercial production.

Impact: The lines that enter commercial production will provide seedsmen and producers with additional FHB resistant varieties. The availability of improved varieties with FHB resistance provides additional choices for seedsmen and producers and contributes to an overall reduction in DON and decreased susceptibility to FHB. For the seed industry in this part of the Midwest, release of breeding lines for licensing results in breeding lines being grown on larger acreages than release as a named variety. Thus, licensing results in greater impact than release as a public variety because there is no marketing for a public variety.

Project 2: *Mapping FHB QTL in an IL97-1828 x Clark Derived RIL Population.*

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

   Many breeding lines in our program (and other soft winter wheat programs) exhibit FHB resistance that cannot be traced to a Chinese source or other known FHB resistance source. We are using this resistance ("native resistance") extensively in our breeding program and in many cases we are combining the native resistance with other resistance sources. The purpose of this experiment is to determine if the QTL controlling the resistance in IL97-1828 are the same as known FHB resistance QTL and to identify molecular markers associated with new QTL.

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: Seed of each RIL in the population was increased, DNA extraction from each line is in progress, and the population was phenotyped at Urbana, IL during the 2009 season.

   Impact: The association of markers with QTL for FHB resistance in this native resistance source will enhance our capability to select for FHB resistance in breeding materials involving this source. Although the information generated by this research will not be of direct use to wheat producers or consumers, information from this project combined with knowledge gained from other research should enhance the selection efficiency for FHB resistance which will benefit producers and consumers in the long-term through the development of improved FHB resistant varieties.

Project 3: *Fungicide x Variety Interaction Experiment.*

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

   Suppression of FHB under heavy disease pressure frequently requires more than a single method of control. In this experiment we studied the control of FHB under heavy disease pressure using resistant and susceptible varieties in combination with and without fungicide application. Our hypothesis was that the best suppression of FHB will occur by growing a FHB resistant variety and applying a fungicide at flowering.

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: Six FHB susceptible and six FHB resistant breeding lines and varieties were grown and three treatments (no fungicide, Folicur® and Prosaro®) were applied to each variety. A split plot design with three replications and fungicide treatment as the main plots was used. The plots were grown in a mist-irrigated, inoculated nursery to enhance disease pressure. Data were collected on FHB incidence, severity, % Fusarium damaged kernels, deoxynivalenol content (ppm), grain yield and test weight. The experiment was conducted in the 2008 season and is being repeated in the 2009 season. Useful data were obtained from the 2008 trial and the 2009 trial data are still being collected. The following results are based on the 2008 trial.

   - Both fungicide and cultivar had a significant effect on all variables.
   - Averaged over all cultivars both Folicur® and Prosaro® significantly increased yield and test weight, and significantly reduced incidence, severity, FHB index, FDK, ISK index, and DON.
   - Folicur® increased yield by an average of 9.5 bu/A and decreased FDK by 36% and DON by 44%, while Prosaro® increased yield by 13.8 bu/A and decreased FDK by 55% and DON by 67%. Prosaro® treated plots significantly outperformed Folicur® treated plots in yield, test weight, incidence, FHB index, FDK, and ISK index.
   - The FHB-resistant cultivars significantly ($P < 0.001$) outperformed the FHB-susceptible cultivars, regardless of the treatment, for all parameters. Averaged over cultivars yield increased 20%, FDK decreased 78%, and DON decreased 68%, when FHB-resistant cultivars were grown.
   - Averaged over cultivars, Prosaro® plus host resistance increased yield by 34%, test weight by 12%, and decreased disease symptoms (FHB index) by 88%, FDK by 91%, and DON by 93% compared to the average of six susceptible cultivars.

   Impact: Based on the 2008 results we clearly demonstrated that best management practices for suppression of FHB under heavy disease pressure include combining a resistant variety with fungicide application. The results from the 2008 trial were presented in a poster at the

2008 Scab Forum, and the results of this experiment have been used extensively locally in Illinois in a number of presentations at field-days and grower meetings and published in Extension newsletter articles to provide producers with important information on best management practices to use.

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.

Referred publication:

Bonin, C.M. and **F. L. Kolb.** 2009. Resistance to Fusarium Head Blight and Kernel Damage in a Winter Wheat Recombinant Inbred Line Population. Crop Sci. 49: 1304-1312.

Conference Proceedings:

Brown-Guedira, G., C. Griffey, **F.L. Kolb,** A. McKendry, J.P. Murphy, and D. Van Sanford. 2008 Breeding FHB-resistant soft winter wheat: progress and prospects. Cereal Research Communiations36, Supplement B (Proceedings of the 3rd Intl. Symposium of Fusarium Head Blight, Mesterhazy and Toth, eds.) 31-35.

Abstracts:

Perugini, L.D., C. Sneller, **F.L. Kolb**, D. Van Sanford, C. Griffey, H. Ohm, and G. Brown-Guedira. 2008. Haplotype diversity at six Fusarium head blight resistance QTL intervals in soft winter wheat germplasm. Plant & Animal Genomes XVI Conference, Jan. 12-16, 2008, San Diego, CA. (Abstract in the proceedings of the conference).

Brucker, E.A., C.J. Thompson and **F.L. Kolb**. 2008. Comparison of two Fusarium head blight inoculation methods in wheat. Proceedings of the 2008 National Fusarium Head Blight Forum. Indianapolis, IN, December 2-4, 2008, page 149.

Brucker, E.A., N.H. Karplus, C.A. Bradley and **F.L. Kolb**. 2008. Evaluation of host plant resistance and fungicide treatment for suppression of Fusarium head blight and deoxynivalenol. Proceedings of the 2008 National Fusarium Head Blight Forum. Indianapolis, IN, December 2-4, 2008, page 150.

Presentation:

Bradley, C.A. and **F.L. Kolb**. 2008. Management of Fusarium head blight of wheat. University of Illinois Crop Sciences Research and Education Center Agronomy Day. August 2008, Urbana, IL.

Additional publications and presentations by Carl Bradley related to Project #3:

Extension Publications:

Bradley, C.A. 2009. Management of Fusarium head blight (scab) of wheat. University of Illinois Pest Management and Crop Development Bulletin, Issue No. 5, April 24, 2009.

Presentations:

Bradley, C.A. 2008. Management of wheat diseases. University of Illinois Brownstown Agronomy Research Center Field Day, July 2008, Brownstown, IL.

Bradley, C.A. 2008. Management of wheat diseases. University of Illinois Dixon Springs Agricultural Center Field Day, August 2008, Dixon Springs, IL.

Bradley, C.A. 2009. Management of corn, soybean, and wheat diseases with fungicides. Southern Illinois Crop Management Conference, January 2009, Whittington, IL.

Bradley, C. A. 2009. Management of corn, soybean, and wheat diseases with fungicides. Northern Illinois Crop Management Conference, February 2009, Malta, IL.

Bradley, C.A. 2009. Management of wheat diseases with fungicides. Ag Issues Forum, February 2009, Grapevine, TX.

Bradley, C. A. 2009. Management of wheat diseases. University of Illinois Small Grains Field Tour, June 2009, DeKalb, IL.

If your FY08 USDA-ARS Grant contained a VDHR-related project, include below a list all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance. If this is not applicable (i.e. no VDHR-related project) to your FY08 grant, please insert 'Not Applicable' below.

The following breeding lines were released for licensing in 2008 (approved by the University of Illinois Plant Variety Review Committee in 2008).

2006-2008 Advanced Nursery - Illinois

Entry	Release	4 Locations		2 Locations		3 year Inoculated Nursery Average					
		Yield	Yield Rank	TW	Height	FHB Incid.	FHB Severity	FHB Index	Kernel Rating	ISK Index	DON
		(bu/A)		(lb/bu)	(in.)	(%)	(%)		(% FDK)	(0-100)	ppm
IL96-357	**2008**	67.7	39	56.9	39.7	62.8	27.7	18.3	17.0	34.0	5.7
IL99-15867	**2008**	73.5	17	57.8	37.8	65.0	42.2	29.2	31.7	44.8	6.5
IL00-8109	**2008**	72.5	21	57.8	37.5	46.1	41.6	19.0	21.7	35.0	4.2
IL00-8530	**2008**	74.1	14	59.0	37.8	55.6	38.3	19.8	18.0	35.3	3.9
IL01-11934	**2008**	75.9	8	57.9	38.0	61.1	38.0	24.1	16.0	36.2	4.7
IL01-16170	**2008**	69.6	30	57.8	36.8	43.9	24.0	9.5	25.7	30.6	4.2
IL02-19463	**2008**	72.9	20	59.0	38.2	52.2	47.4	26.2	20.7	38.1	8.0
Expt. Mean		72.5		58.1	38.4	59.6	42.9	25.1	26.6	41.5	5.9
LSD (0.05)						24.7	22.8	- -	15.0	13.3	- -
CV (%)						28.7	32.9	- -	35.0	20.3	- -
Checks:											
Kaskaskia		67.8	38	59.3	43.2	79.4	52.9	44.5	28.7	51.0	9.1
Pioneer 25R47		80.3	2	55.8	36.5	85.6	51.4	44.6	66.7	67.7	19.9
Resistant Checks:											
Bess		65.7	41	58.0	38.0	62.2	27.3	17.8	19.7	35.8	6.8
Ernie						61.4	34.4	21.6	27.7	39.7	4.0
IL96-6472						57.2	38.4	22.0	24.0	38.2	4.7
IL97-6755						30.5	46.0	14.0	9.3	26.7	2.1
IL97-1828						23.3	53.2	12.3	5.0	25.1	1.4
IL01-34159		66.4	40	58.1	38.5	32.8	20.2	6.0	4.7	17.7	0.9
IL02-18228		72.9	19	60.1	39.8	31.1	49.3	12.7	11.0	28.6	1.2