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:	**59-0790-4-111**
Agreement Title:	**Development of Scab Resistant Soft Red Winter Wheat Varieties.**
FY05 ARS Award Amount:	**$ 111,918**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
BIO	Mapping QTL Resistance Associated with Kernel Retention Scab Resistance in Wheat.	$ 33,140
VDUN	Development of Scab Resistant Soft Red Winter Wheat Varieties.	$ 78,778
	Total Award Amount	**$ 111,918**

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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: *Mapping QTL Resistance Associated with Kernel Retention Scab Resistance in Wheat.*

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

Production of sound, plump kernels rather than shriveled or "tombstone" kernels when wheat is infected with scab is an important component of host plant scab resistance. Some lines produce sound, unshriveled kernels in spite of severe scab symptoms in the spike. In these lines the percentage of shriveled kernels produced is lower than would be expected on the basis of the level of symptoms observed in the heads. We refer to this as "kernel retention". Identification of QTL conferring kernel retention resistance (from a source other than Sumai 3 derived lines) would facilitate combining scab resistance genes from different sources to produce transgressive segregants with both Type II resistance and kernel retention. The plump kernels produced must also be evaluated for 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: The 269 $F_{6:8}$ RILs we developed from the cross IL94-1653 / Patton were evaluated for FHB symptoms (AUDPC) and percentage of FDK in the greenhouse. Thus, phenotypic data on kernel retention were collected in the greenhouse and are currently being collected from the 2006 misted, inoculated FHB evaluation nursery. This phenotypic data will now need to be combined with molecular marker data.

Impact: 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 scab resistance which will benefit producers and consumers in the long-term through the development of improved scab resistant varieties.

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 primary users of the information generated by this project will be other scientists working on scab resistance.

Accomplishment: In 2005-06, to better understand the kernel retention type of resistance, we are examining kernel retention in two groups of breeding lines; one group of lines that differ in kernel retention but have the same FHB index and a second group that have the same kernel retention percentages but differ in FHB index. These groups of lines include lines with diverse pedigrees and are currently being evaluated in the mist-irrigated, inoculated field scab evaluation nursery. DON levels will be determined.

Impact: This experiment examines the relationship among percentage of FDK, DON level and FHB field symptoms and will provide information that will aid in the development of wheat varieties with low DON levels.

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?:
Breeders will have information that will aid in the development of wheat varieties with low DON levels and low percent FDK.

Project 2: *Development of Scab Resistant Soft Red Winter Wheat Varieties.*

1. What major problem or issue is being resolved 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. We are continuing to select and evaluate as many breeding lines as possible. In addition, 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 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 (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):

Accomplishment: Four soft red winter wheat breeding lines combining FHB resistance equal to or better than Ernie with high yield potential were released in 2006 for brand labeling.

Impact: These lines will enter commercial production following seed increase and will provide seedsmen and producers with additional FHB resistant varieties.

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 availability of these varieties provides additional choices for seedsmen and producers and should contribute to an overall reduction in DON and decreased susceptibility to FHB.

Accomplishment: Forty-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 provides very useful information to Illinois seedsmen and producers and allows them to use FHB resistance as a criterion in variety selection.

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?:

Producers and seedsmen have a three year summary of data of FHB resistance that can be used in decisions about what varieties to produce.

Accomplishment: 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 Advanced and Preliminary Five-State Nurseries were evaluated for FHB resistance in a misted, inoculated FHB field evaluation nursery. Lines from the University of Illinois program were submitted for all of the cooperative nurseries listed above except the Uniform Southern Scab Nursery, thus, breeding lines with FHB resistance were made available to other breeding programs for use as germplasm.

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.

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?:

Many breeding programs evaluating entries in cooperative nurseries simultaneously provide a more data on each entry than would be possible for a program working alone. Obtaining FHB resistance data 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 2005, about 400 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.

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?:

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: About 650-700 seed samples were ground and sent to the Michigan State lab for 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.

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 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: About 200 single crosses and 150 three-way and four-way crosses were made in 2005-06 involving FHB resistance sources. In addition 16 BC_1 crosses were made crossing F_1s back to an adapted parent after that adapted parent had been crossed to a FHB resistant parent.

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.

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?:

These crosses are the source of variability that will be used for future development of scab resistant soft red winter wheat varieties.

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.

Refereed Publications:

Browne, R.A., Murphy, J.P., Cooke, B.M., Devaney, D., Walsh, E.J., Griffey, C.A., Hancock, J.A., Harrison, S.A., Hart, L.P., Kolb, F.L., McKendry, A.L., Milus, E.A., Sneller, C., and Van Sanford, D.A. 2005. Evaluation of Fusarium head blight resistance in U.S. soft red winter wheat germplasm using a detached leaf assay. Plant Dis. 89-404-411.

Zhou, W.C., F.L. Kolb, and D.E. Riechers. 2005. Identification of proteins induced or upregulated by Fusarium head blight infection in the spikes of hexaploid wheat (*Triticum aestivum*). Genome 48:770-780.

Non-refereed bulletins, reports and publications:

F.L. Kolb, 2005. Fusarium head scab evaluation of variety trial entries at Urbana, Illinois. Tables of data prepared for field days, variety trial report, and posted on Variety Trial website.

Abstracts:

Brown-Guedira, G., L. Perugini, C. Sneller, F. Kolb, D. VanSanford, C. Griffey, and H. Ohm. 2005. Phemotypic and genotypic analysis of scab resistance in soft red winter wheat germplasm. Proceedings of the 2005 National Fusarium Head Blight Forum, Milwaukee, WI, Dec. 11-13, 2005. p. 19.

Brucker, E.A, and F.L. Kolb. 2005. Comparison of deoxynivalenol (DON) analysis on wheat milled with different grinders. Proceedings of the Eastern Wheat Workers and Southern Small grains Workers Conference, May 9-12, 2005, Bowling Green, KY, p.89.

Brucker, E. A., F.L. Kolb, A.D. Wilson, and N.J. Smith, 2005. Comparison of two scab inoculation methods in wheat. Proceedings of the 2005 National Fusarium Head Blight Forum, Milwaukee, WI, Dec. 11-13, 2005. p. 20

Wilson, A.D., E.A. Brucker, and F.L. Kolb, 2005. Effect of glyphosate on *Gibberella zeae* Schwabe(Petch) (anamorph *Fusarium graminearum* (Schwabe) mycelial growth and macroconidia production. Proceedings of the Eastern Wheat Workers and Southern Small grains Workers Conference, May 9-12, 2005, Bowling Green, KY, p. 90.

Wilson, A.D. F.L. Kolb, E.A. Brucker, and D.G. Bullock. 2005. Effect of glyphosate on the *in vitro* growth of fungal organisms. Proceedings of the 2005 National Fusarium Head Blight Forum, Milwaukee, WI, Dec. 11-13, 2005. p. 236.

Yu, J., G. Bai, W. Zhou, F. Kolb, Y. Dong, and P. Hart. 2005. Mapping QTLs for different types of resistance to Fusarium head blight in Wangshuibai. Proceedings of the 2005 National Fusarium Head Blight Forum, Milwaukee, WI, Dec. 11-13, 2005. p. 96.