USDA-ARS / USWBSI
FY04 Final Performance Report
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Cover Page

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Year:	**FY2004** (approx. May 04 – April 05)
FY04 ARS Agreement ID:	**59-0790-4-102**
FY04 ARS Agreement Title:	**Validation, Fine Mapping, Marker Assisted Selection, and Accelerated Breeding for Scab Resistance in Soft Red Winter Wheat.**
FY04 ARS Award Amount:	**$ 118,383**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
BIO	Validation and Fine Mapping of Three QTLs For Resistance to Scab in Common Wheat.	$ 45,273
VDUN	Accelerated Breeding for Scab Resistance in Soft Red Winter Wheat.	$ 73,110
	Total ARS Award Amount	**$ 118,383**

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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: ***Validation and Fine Mapping of Three QTLs For Resistance to Scab in Common Wheat.***

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

Chinese wheat line W14 is a unique source like Sumai 3 in that it possesses highly effective resistance to FHB; however, it also possesses a lot of undesirable traits, such as spring habit, low yield potential, and susceptibility to other foliar diseases. The project goals were to validate three FHB QTL on 2BS, 3BS, and 5AS previously identified in W14, to develop near-isogenic lines of soft red winter (SRW) wheat carrying favorable alleles derived from W14 at the three QTL regions from W14 and a related source Futai 8944, and to discern the contribution and interaction of theses QTL in two SRW wheat backgrounds, Ernie and Roane. These goals were achieved using molecular marker assisted backcrossing.

2. What were the most important accomplishments and their impact?

Accomplishment: W14 and Futai8944 were backcrossed four times to the recurrent parents Ernie and Roane, respectively. Eighteen SSR and three STS markers in the three target QTL regions were used for marker assisted backcrossing starting from BC_4F_1. To date, over 3000 individuals have been evaluated in four greenhouse experiments and two field tests. This assessment resulted in the development of 200 BC_4F_5 FHB resistant NILs comprising of 12 different 3BS and 5AS QTL haplotypes. The study also demonstrates that MAS for FHB resistance is effective using haplotype selection for a combination of seven markers for 3BS (FHB1B, STS3B-66, STS3B-142, CFD79B, Xgwm493, Xgwm533, BARC133), and five markers for 5AS (Barc117, Barc186, Barc56, Barc100 and Gwm186). The higher the number of resistant marker alleles used in haplotype selection, the higher the level of resistance selected.

Impact: Development of near-isogenic lines of SRW wheat carrying FHB resistance will accelerate development of FHB resistant wheat (*Triticum aestivum* L.) varieties and germplasm, providing wheat breeders and molecular biologists with unique genetic stocks and associated molecular markers facilitating marker assisted selection, pyramiding of FHB resistance genes, and the capability of cloning these unique scab resistance genes. Currently, over two hundreds of BC_4F_5 NILs are being developed and evaluated in our breeding nursery. In spring 2005, four NILs developed by our group for use as parental lines were provided to seven breeding programs.

Project 2: ***Accelerated Breeding for Scab Resistance in Soft Red Winter Wheat.***

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

The overall project goal is to accelerate development of adapted and commercially viable scab resistant wheat varieties by identifying, incorporating and pyramiding diverse types of resistance into elite genotypes. The specific objectives of this project are to: 1) Incorporate and combine scab resistance genes from the newly-developed scab resistant and/or scab tolerant SRW wheat lines into commercially viable SRW and specialty wheat varieties and; 2) Evaluate backcross derived wheat lines, originating from crosses between adapted SRW wheat lines with non-adapted resistance sources, for scab resistance and agronomic performance to accelerate development of scab resistant wheat lines and cultivars.

2. What were the most important accomplishment and its impact?

Accomplishment: To accelerate development of high yielding, scab resistant SRW wheat lines, we have deployed a combination of top-cross, doubled haploid, backcross, and molecular-marker assisted breeding methods. Initially, we developed a doubled haploid line, VA01W-476, which expressed a high level of resistance in both greenhouse and field trials. This line has been used as a parent in many breeding programs in the Eastern United States. We also have made great progress in the development of FHB resistant lines using top-crossing and backcrossing methods. VA02W-713, a top-cross (Ning7840/Pioneer2691//Roane) derived elite FHB resistant SRW wheat line, ranked 1st in grain yield (77 Bu/Ac) among 54 entries in Virginia's Advance Wheat Test over three locations in 2004. Currently, 14 elite wheat lines are being evaluated in Advance, VA-State & Uniform Yield Tests, 64 advanced lines are being evaluated in Preliminary Tests, and 359 new lines are being evaluated in a Scab Observation nursery for yield performance at multiple locations. An additional 200 SRW wheat genotypes, including entries in the three Uniform Scab Nurseries, as well as entries from Virginia's 2005 Official State Wheat and Barley Variety Tests, are being evaluated for scab resistance in replicated disease assessment trails at Blacksburg, VA. Around 3,600 topcross and backcross derived lines are being evaluated in headrows for agronomic traits and resistance to other prevalent diseases at Warsaw, VA before being evaluated under epidemic conditions in a replicated disease assessment test the following year at Blacksburg, VA. A total of 100 populations (28 F_2, 47F_3, 9F_4, 9F_5, 5F_6, 1F_7 and 1 BC_3F_4) are being evaluated in 160 ft^2 blocks in an irrigated scab nursery at Warsaw, VA. In spring 2005, an additional 180 crosses were made, and nearly 1,500 BC_4F_4 and advanced lines were evaluated for type II resistance in greenhouse tests. Molecular markers for resistance genes located at chromosome 3BS and 5AS regions are being used to assist in the selection and improvement of scab resistance in the breeding program. Elite wheat lines are currently being characterized for the presence of scab resistance genes on chromosomes 3BS, 5AS or both.

Impact: VA01W-476, VA00W-566, VA00W-562 have been used as parental lines in several breeding program and will facilitate the release FHB resistant varieties or improved germpalsm. Roane, McCormick, Tribute, VA00W-38, VA01W-99, and VA02W-713 are FHB resistant varieties or elite lines currently grown by producer and potential releases.

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 you grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Griffey, C.A., J. Chen, J. A. Wilson, J. Shaw, D. Nabati, M.R. Chappell and T. Pridgen. 2004. *Fusarium* Head Blight Resistance Incorporated into Soft Red Winter Wheat. *P*. 70. *In*: Proceedings of 2nd International Symposium on Fusarium Head Blight Incorporating the 8th European Fusarium Seminar. Dec. 11-15, 2004. Wyndham Orlando Resort, Orlando, FL, USA.

Chen, J., C. A. Griffey, M.A. Saghai Maroof, E. Stromberg, R. M. Biyashev, W. Zhao, M. Chappell, and Y. Dong. Update on QTL Mapping of *Fusarium* Head Blight Resistance in Wheat. *P*. 32. *In*: Proceedings of 2nd International Symposium on Fusarium Head Blight Incorporating the 8th European Fusarium Seminar. Dec. 11-15, 2004. Wyndham Orlando Resort, Orlando, FL, USA.

Chen, J., C. A. Griffey, M.A. Saghai Maroof, J. Wilson, D. Nabati, and T. Pridgen. 2004. Haplotyping of Unique Near Isogenic Lines for Resistance to *Fusarium* Head Blight in Common Wheat. *P*. 31. *In*: Proceedings of 2nd International Symposium on Fusarium Head Blight Incorporating the 8th European Fusarium Seminar. Dec. 11-15, 2004. Wyndham Orlando Resort, Orlando, FL, USA.

Chen, J., C. A. Griffey, M.A. Saghai Maroof. 2005. Prospect for Introgression of Fusarium Head Blight Resistance QTLs into Soft Red Winter Wheat. *P*. 158. *In*: Proceedings of the International Conference on the Status of Plant & Animal Genome Research. Jan. 15-19, 2005. Town & Country Hotel, San Diego, CA, USA.

Chen, J., C. A. Griffey, M.A. Saghai Maroof, E. L. Stromberg, R. M. Biyashev, W. Zhao, M. R. Chappell, T. H. Pridgen, Y. Dong, and Z. Zeng. 2005. Mapping Quantitative Trait Loci for *Fusarium* Head Blight Resistance in Chinese Wheat Line W14. Submitted to Plant Breeding, March, 2005.