

**U.S. Wheat and Barley Scab Initiative
 FY02 Final Performance Report (approx. May 02 – April 03)
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Cover Page

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Grant Title:	Fusarium Head Blight Research
FY02 ARS Award Amount:	\$ 94,024

Project

Program Area	Project Title	USWBSI Recommended Amount
BIO	Identification, Characterization, and Confirmation of Major QTLs for Scab Resistance in Common Wheat.	\$28,000
VDUN	Selective breeding for Scab Resistance in soft Winter Wheat.	\$68,375
	Total Amount Recommended	\$96,375

Principal Investigator

Date

Project 1: Identification, Characterization, and Confirmation of Major QTLs for Scab Resistance in Common Wheat.

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

Few QTLs (quantitative trait loci) other than the one located on chromosome 3BS governing resistance to scab have been verified in common wheat, yet identification of such unique QTLs is critical as the level of scab resistance conferred by genes on 3BS is not sufficient. Such QTLs were previously identified in our mapping studies of an F₂ population Pioneer 2684 x W14. Because this population may possess unique QTLs, it is important to verify and characterize these QTL regions in addition to evaluating the contribution of genes on 3BS to scab resistance in a unique background. The current study was conducted using two doubled haploid populations and an additional 120 SSRs. The major objectives of this project were: 1) to verify the presence and association of Sumai 3 derived markers on chromosome 3BS in our mapping populations and identify additional and unique markers providing further saturation of this region; 2) to validate unique QTL-marker associations identified in our mapping populations and saturate these chromosomal regions with selectable markers; 3) to use doubled haploid lines to verify QTL-marker associations identified in F₂ mapping populations and identify additional markers in associated regions.

2. What were the most significant accomplishments?

Two doubled haploid (DH) populations (PW= Pioneer 2684 x W14 and MW= Madison x W14) were used to verify and saturate QTLs identified in our previous study. These lines also were used to identify new QTLs controlling FHB resistance in Chinese wheat line W14 using SSR analysis. Five QTLs were detected on chromosome regions 1BL, 2BS, 3BS, 5AL, and 7AL. Eighteen markers in these regions were significantly ($P < 0.05$) associated with FHB resistance. These markers explained 42% and 62% of the total phenotypic variation in PW and MW, respectively. The QTL on 3BS was identified in both DH populations and confirmed as being a major QTL, which explained 29% and 42% of phenotypic variation in PW and MW, respectively. These markers are being used to identify and develop near isogenic lines. W14 was backcrossed four times to adapted scab tolerant variety Roane. A BC₄F₂ population was screened with major markers flanking the five QTL regions mentioned above. Most selected lines possess the 3BS QTL, and among these lines some also possess different combinations of the other four QTLs. These QTLs and NILs will be useful in gene pyramiding, fine mapping and studying interactions among resistance genes.

Project 2: Selective breeding for Scab Resistance in soft Winter Wheat.

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

The transfer of scab resistance (type II in particular) into soft red winter (SRW) wheat backgrounds is of great importance as production practices and environmental conditions in the Mid-Atlantic region are favorable for scab epidemics, which were severe in 2003 and 1998. Current type II resistance sources are not adapted to this region and are often susceptible to diseases such as leaf rust, glume blotch, and powdery mildew. The main goal of our project is to transfer type II resistance from unadapted sources into SRW backgrounds to develop scab-resistant germplasm and varieties with high yield potential and resistance to other wheat diseases. The strategies to achieve this goal include: 1) evaluation of newly developed scab-resistant and/or scab-tolerant wheat lines for effectiveness of resistance and other important agronomic traits; 2) evaluation of backcross progeny for scab resistance and resemblance to their respective recurrent parent to accelerate development of scab-resistant lines; and 3) identification and selection of scab-resistant wheat lines derived via doubled haploid techniques or from crosses among adapted and non-adapted lines possessing diverse types of resistance.

2. What were the most significant accomplishments?

Thirty-six scab-resistant sources have been used as parents in the breeding program and over 500 populations have been developed. In 2002, eighty out of 229 (35%) populations were advanced on the basis of scab incidence and severity. In headrow tests, approximately 7300 lines of varying generations derived from populations previously screened for scab resistance were evaluated for agronomic traits and resistance to diseases other than scab at Warsaw, VA. From these headrows, 32 backcross-derived lines and 26 topcross-derived lines were selected for further testing in our scab nursery at Blacksburg, VA and in Observation Yield Tests at two locations. One DH line, 4 F₈ lines, and 7 F₆ lines were advanced for testing in Preliminary Wheat Trials. Four lines were selected for further testing in the Advanced Yield Trial, two lines were selected as entries in Virginia's Official Variety Trial, and twelve lines were tested in the Uniform Winter Wheat FHB Nurseries. Growers will be able to purchase certified seed of moderately scab-resistant Tribute in fall 2003 and McCormick in fall 2004. Type II resistance derived from five different sources (Futai8944, Futai8945, Shaan85, VR95B717, and W14) has been backcrossed into seven SRW wheat backgrounds. Currently, 178 BC₄F₂ and 2 BC₅F₂ scab-resistant individuals are being evaluated for resistance, similarity to the recurrent parent, and agronomic traits at both Warsaw and Blacksburg, VA. Progress in transferring type II resistance into SRW wheat genotypes has been accelerated via use of the wheat by maize doubled haploid system. To date, 165 doubled haploid lines have been derived from 3-way crosses comprised of diverse scab-resistant parents. Of these DH lines, 135 previously selected in greenhouse and field tests are currently being evaluated at Warsaw, VA and in our scab nursery at Blacksburg, VA. One previously developed DH line, VA01W-476, developed from the cross 'Roane'/W14, has performed well in inoculated greenhouse and field tests and has major genes for scab resistance based on DNA analysis. Nine DNA markers associated with scab resistance genes on three chromosome regions have been used in selection of backcross progeny and genotyping advanced lines.

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.

Chen, J., C. A. Griffey, R. M. Biyashev, and M. A. Saghai Maroof. 2003. QTL Mapping and Marker Assisted Selection of *Fusarium* Head Blight Resistance in Wheat. In: Proceedings of the 1st Central Asian Wheat Conference. June 9-13, 2003. Alma-Ata, Kazakhstan.

Chen, J., C. A. Griffey, and M. A. Saghai Maroof. 2002. QTL Mapping and SSR Genotyping of *Fusarium* Head Blight Resistance in Virginia Tech Wheat Breeding Program. P. 26. In: Proceedings of 2002 National *Fusarium* Head Blight Forum. Dec. 7-9, 2002. Erlanger, KY, USA; also reported on P. 172. In: Proceedings of the International Conference on the Status of Plant & Animal Genome Research. Jan. 11-15, 2003. San Diego, CA, USA.

Chen, J., C. A. Griffey, M. A. Saghai Maroof, J. Wilson, and R. M. Biyashev. 2003. QTL Mapping and Marker Assisted Selection for *Fusarium* Head Blight Resistance of Chinese Wheat Line W14. Submitted: Tenth International Wheat Genetics Symposium. Sept. 1-6, 2003. Paestum, Italy.

Griffey, C. A., J. Wilson, D. Nabati, J. Chen, and T. Pridgen. 2002. Progress in Breeding *Fusarium* Head Blight Resistance in Soft Red Winter Wheat. P. 246. In: Proceedings of 2002 National *Fusarium* Head Blight Forum. Dec. 7-9, 2002. Erlanger, KY, USA.