

**U.S. Wheat and Barley Scab Initiative
 FY00 Final Performance Report (approx. May 00 – April 01)
 July 30, 2001**

Cover Page

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Year:	FY2000 (approx. May 00 – April 01)
Grant Number:	59-0790-9-025
Grant Title:	Fusarium Head Blight Research
2000 ARS Award Amount:	\$102,439

Project

Program Area	Project Title	Requested Amount
Biotechnology	Development of DNA Markers for Fusarium Head Blight Resistance in Wheat.	\$30,000.00
Variety Development & Uniform Nurseries	To enhance variety development of scab resistant varieties.	\$70,000.00
	Requested Total	\$100,000.00¹

Principal Investigator

Date

¹ Note: The Requested Total and the Award Amount are not equal.

Project 1: Development of DNA Markers for Fusarium Head Blight Resistance in Wheat.

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

DNA markers for FHB resistance may be useful in speeding the process of breeding for resistance. We are using SSR markers to saturate genomic regions known to contain FHB resistance genes. The two objectives of this project are to i) increase marker density near FHB QTLs (resistance genes) and determine the utility of these DNA markers on additional populations segregating for FHB resistance; and ii) develop breeder-friendly markers for the Sumai 3 scab resistance gene on chromosome 3BS.

During this reporting period, additional SSR markers bracketing the previously reported 3BS QTL region (*Qfhs.ndsu-3BS*) were mapped in each of two populations (Sumai 3/Stoa and ND2603/Butte 86). These markers are being used in a high-throughput screening system using a Li-Cor DNA sequence analyzer. Additional SSR markers were mapped near another suspected FHB QTL locations on chromosome 6BS.

We have physically located the 3BS QTL using the available deletions lines of Chinese Spring. We have been using resistance gene analog (RGAP) and AFLP primers in combination with the deletion lines to rapidly locate additional markers near the 3BS QTLs. Four fragments mapping to the deletion bin containing the QTL have been cloned and sequenced and database homology searches have been conducted. These and additional cloned fragments will be mapped on our mapping populations.

Six additional RIL populations have been evaluated for FHB resistance in the field and greenhouse to choose populations for additional gene mapping. In total, 605 and 854 genotypes were evaluated in 3025 and 2562 plots of these materials in greenhouse and field FHB evaluations, respectively. On the basis of the results obtained, DNA marker analyses of known QTL regions are in progress for the Fujian 5114/Norm and Wuhan 3/Norm populations.

2. What were the most significant accomplishments?

- Mapping of SSRs bracketing a major QTL on chromosome 3BS
- Identification of the deletion bin containing the 3BS QTL and DNA fragments from RGAP-AFLP analysis that map to this bin
- Implementation of marker-assisted selection for the chromosome 3BS QTL

Project 2: To enhance variety development of scab resistant varieties.

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

Scab resistant varieties are necessary to reduce the impacts of this disease. We are developing scab resistance hard red spring wheat lines adapted to the Northern Great Plains, especially wheat-growing areas in Minnesota. The objectives of this grant were to i) develop Fusarium head blight resistant wheat varieties adapted for commercial production in Minnesota; and ii) investigate breeding strategies to more efficiently develop regionally adapted, FHB resistant wheat germplasm. Techniques include conventional breeding procedures of crossing, selection, and multilocation testing of germplasm. Scab resistance is assessed by greenhouse screenings and three field nurseries each year, and also marker-assisted selection.

A total of 5,476 plots containing breeding material and FHB resistance sources (excludes mapping populations) were screened in inoculated, misted field FHB nurseries in Crookston, Morris, and St. Paul. These evaluations included 176 lines in advanced yield trials and 297 lines in preliminary yield trials. Five experimental lines were entered into the 2001 Uniform Regional Scab Nursery. These lines were identified in 1999 and 2000 as having improved levels of FHB resistance. Nine hundred ninety three breeding lines were screened during 2000/2001 in the greenhouse for reaction to FHB inoculation. Marker-assisted selection using the markers for the QTL on chromosome 3BS was used to screen approximately 800 F4 lines during the summer of 2000.

Based on FHB field screening data of 14 spring wheat cultivars evaluated in 10 Minnesota nurseries, protocols for resource allocation for the purposes of early generation and advanced-generation materials were derived. The data showed that for initial evaluations, susceptible material could be reliably identified and discarded based on data from 2 replicates in three environments, and advanced generation material requires 5 to 7 environments of replicated testing to accurately assess FHB reaction.

2. What were the most significant accomplishments?

- Screening of FHB reaction of 473 breeding lines currently in yield trials
- Identification of high levels of FHB resistance in material entered into the 2001 Uniform Regional Scab Nursery
- Determination of the ideal resource allocation for FHB evaluation of early and advanced generation materials in field screening nurseries

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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.

Peer-reviewed Article s:

Anderson, J.A., R.W. Stack, S. Liu, B.L. Waldron, A.D. Fjeld, C. Coyne, B. Moreno-Sevilla, J. Mitchell Fetch, Q.J. Song, P.B. Cregan, and R.C. Frohberg. 2001. DNA markers for Fusarium head blight resistance QTLs in two wheat populations. *Theor. Appl. Genet.* 102:1164-1168.

Mickelson, H.R., R.H. Busch, R. Dill-Macky, C.K. Evans, J.V. Wiersma, and J.A. Anderson. 200X. Assessment of Fusarium Head Blight Reaction in Spring Wheat: Breeding-Nursery Requirements. *Crop Sci.* submitted.

Abstracts:

Anderson, J.A. 2000. Marker-assisted breeding of wheat. p. 114 *In Agronomy abstracts.* ASA, Minneapolis, MN.

Liu, S., J.A. Anderson, R.W. Stack, and R.C. Frohberg. 2000. Microsatellite markers for a major Fusarium head blight resistance QLT in two wheat populations. p. 186 *In Agronomy abstracts.* ASA, Minneapolis, MN.

Liu, S., J.A. Anderson, R.W. Stack, and R.C. Frohberg. 2001. Validation of a major QTL for Fusarium head blight resistance in wheat. Page 167 in *Plant & Animal Genome IX Abstracts*, San Diego, CA.

Proceedings:

Anderson, J.A., S. Liu, M.O. Pumphrey, J.L. Gonzalez-Hernandez, and E.J. Wennerlind. 2000. A protocol for marker-assisted selection of a Fusarium head blight resistance gene derived from Sumai 3. pp. 239-243 in *Proceedings of The 2000 National Fusarium Head Blight Forum*, edited by R.W. Ward et al., Kinko's, Okemos, MI.

Reports:

Anderson, J., J. Wiersma, D. McVey, and R. Dill-Macky. 2000. Wheat. *In Preliminary Report 24; 2000 Wheat, Barley and Oat Variety Performance in Minnesota*, Preliminary Report, Edited by Jochum Wiersma.

J. Anderson, R. Busch, G. Linkert, L. Matthiesen, E. Wennerlind, A. Procopiuk, H. Mickelson, S. Liu, K. McGowan, J. Gonzalez, D. Bowen, M. Pumphrey. 2001. Wheat production, breeding, and scab screening. *Ann. Wheat Newsletter* vol. 47.

Anderson, J.A., R.H. Busch, G. Linkert, and L. Matthiesen. 2000. Wheat. *In Minnesota Varietal Trials Results*, University of Minnesota Extension Service.