

**U.S. Wheat and Barley Scab Initiative
 FY02 Final Performance Report (approx. May 02 – April 03)
 July 15, 2003**

Cover Page

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Grant Number:	59-0790-9-052
Grant Title:	Fusarium Head Blight Research
FY02 ARS Award Amount:	\$ 177,137

Project

Program Area	Project Title	USWBSI Recommended Amount
GIE	Winter Wheat Germplasm Introduction and Evaluation.	\$99,800
VDUN	Accelerating the Development of Scab Resistant Soft Red Winter Wheat.	\$81,765
	Total Amount Recommended	\$181,565

Principal Investigator

Date

Project 1: Winter Wheat Germplasm Introduction and Evaluation.

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

Fusarium graminearum Schwabe (teleomorph *Gibberella zeae* (Schwein.), also known as scab, is an increasingly important problem in the north-central region of the United States. Host resistance has long been considered the most practical and effective means of control but breeding has been hindered by a lack of effective resistance genes and by the complexity of the resistance in identified sources. The objective of this project was to identify, through a world-wide search, additional sources of resistance to *Fusarium* head blight (scab) in winter wheat. After discovery, this project was charged with verifying resistance and disseminating information to wheat breeders nationally. A third objective was to continue to facilitate the introduction of elite scab resistant germplasm from international breeding programs. A systematic search of winter wheat cultivars, breeding lines and land-races currently maintained in the National Small Grains Collection was undertaken. Specific objectives of this grant were to: screen under field and greenhouse protocols, the remaining 620 winter wheat accessions from targeted regions of Eastern Europe; verify through progeny testing, resistance identified in approximately 720 accessions from Yugoslavia, Romania, Hungary, and Bulgaria, and continue distribution to interested breeders of purified, and verified sources of resistance. With regards to introductions from international breeding programs, this grant specifically involved the introduction, quarantine, increase and distribution of resistant spring and winter wheat germplasm, identified and acquired from scab breeding programs globally through the collaborative agreement between the USWBSI and CIMMYT.

2. What were the most significant accomplishments?

During this grant cycle, we verified resistances identified in 360 Yugoslavian lines and found 24 highly resistant lines with disease spread of less than 1 spikelet, 4 of which showed no rachis involvement. An additional 25 lines had a spread of between 1 and 1.5 spikelets. The resistant checks had a spread of 1 spikelet (Sumai 3) and 2 spikelets (Ernie). Eighteen lines had a field score of less than 15% disease compared to the field checks Ernie (18%) and MO 94-317 (80%). In addition, resistances identified in 360 lines from Bulgaria, Romania and Hungary were verified. Nine lines had an average spread of less than one spikelet while 12 additional lines had an average spread of between 1 and 1.5 spikelets. These spreads reflected type II resistance of 10% severity in the head and were comparable to or better than the resistant checks Sumai 3 and Ernie. Finally, 620 accessions from several Eastern European countries were screened for the first time. Although data are not yet complete, to date, 27 lines have been identified with a spread of less than 1 spikelet and 89 lines had type II resistance with less than 10% severity, comparable to or better than the resistant checks. The range of severity for all nurseries was from 2.7% severity to 100% severity. The CIMMYT collaboration in 2002 led to the introduction and quarantine of 159 germplasm lines from Japan (15), Argentina (107), Brazil (19) and the CIMMYT program itself (32). These lines were increased and available for distribution. Preliminary resistance data found 31 of these lines to have a spread of less than 1 spikelet and 52 lines with type II resistance of less than 10% severity. Data will be posted on the USWBSI website to facilitate seed requests.

Project 2: Accelerating the Development of Scab Resistant Soft Red Winter Wheat.

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

Fusarium graminearum Schwabe (teleomorph *Gibberella zeae* (Schwein.)), is an increasingly important problem in the north-central region of the United States. Breeding has been hindered by a lack of sources of resistance. No source of complete resistance is known, and current sources provide only partial resistance. In addition, there has been a lack of routine screening of breeding material to eliminate the highly susceptible lines thereby lessening the economic losses in the farm community. The long term objectives of our scab research include: 1) the continued identification of useful adapted sources of resistance to scab through routine screening of all advanced breeding material using both field and greenhouse inoculation protocols; (2) to share newly identified Missouri sources with cooperating programs through the cooperative scab nursery system; (3) to incorporate new sources of resistance, and/or combine multiple sources of resistance into elite Missouri soft red winter wheat breeding lines; (4) to study the genetics of newly identified sources of resistance, differing from Sumai 3 or other known and well-used sources of resistance, using both conventional and molecular genetic approaches. Specifically, for objective 4, we are investigating the genetics of resistance in the Missouri developed line MO 980525 which breeders in the region have determined to have high levels of type I, and type II resistance, low DON and good kernel quality under inoculation. Of the lines in the Northern Scab Nursery, it and its sister line MO 981020 were the only two lines with resistance for all 7 parameters measured.

2. What were the most significant accomplishments?

MO 980525 was evaluated in commercial trials throughout Missouri and ranked 3rd of 64 commercial entries tested, not different from the top yielding line. In 2001, it ranked 2 in the Eastern Soft Red Winter Wheat Nursery, having broad adaptation in Northern Corn Belt States. The release of MO 980525 will represent the first release from our program, funded in part by the USWBSI. Population development for genetic analyses (including a doubled haploid mapping population) is underway for this line. Two other lines, MO 981020, and MO 980829 with equal or better scab resistance are on track for release in 2004 and 2005 respectively. Routine screening of all breeding lines going into advanced stages of testing resulted in the screening of 120 new breeding lines in the greenhouse and the field. Of these, 22 lines had a spread of less than 2 spikelets and an index (spread/total spikelets) of less than 15%. Of these, 16 lines differed from Ernie and MO 980525 by descent. Resistances in these lines will be verified in 2003. Resistances identified in 2001 were also verified in 2002. Of 172 lines re-screened, 40 lines had type II resistance of less than 10% severity in inoculated heads. Most of the lines (34) differed from Ernie by descent. The range of severity in the nursery was from 3.1% to 100% with the resistant checks scoring 4.4% (Sumai 3) and 15% (Ernie). Twenty-three additional lines had a type II score lower than Ernie. These resistances, for the most part, have held up well under field inoculation protocols. Although data are not yet complete as inoculations were done in May 2003 for winter wheat, many of these lines have disease scores in the field of less than 20% infection. In addition, to the breeding nurseries, each year we have grown and screened both the Northern and Southern Scab Nurseries and have entered our best lines in the nursery each year since the inception of the nursery, thereby sharing our germplasm with other breeders within the initiative.

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.

Papers and Abstracts:

McKendry, A.L., K.S. Bestgen, and D.N. Tague. 2002. Types I, II, and field resistance to Fusarium head blight in winter and spring wheat germplasm. *In*: 2002 National Fusarium Head Blight Forum Proceedings. P 204-207.

Liu, S. T. Musket, A.L. McKendry, and G.L. Davis. 2002. Identification of QTL associated with scab resistance in Ernie. *In*: 2002 National Fusarium Head Blight Forum Proceedings. P 33.

Liu, S., H. Lu, T. Musket, A.L. McKendry, and G.L. Davis. 2002. QTL Associated with scab resistance in the soft red winter wheat 'Ernie'. American Society of Agronomy Annual Meetings, Indianapolis, Abstracts.

McKendry, A.L., K.S. Bestgen, D.N. Tague, and Z. Abate. 2002. Stability of type II resistance and DON levels across isolate and soft red winter wheat genotype. 2002 National Fusarium Head Blight Forum Proceedings. P 248

Posters and Oral Presentations:

Liu, S., H. Lu, T. Musket, A.L. McKendry, G.E. Davis. 2002. QTL associated with Type II scab resistance in the soft red winter wheat cultivar Ernie. Poster Presentation at the American Society of Agronomy Annual Meetings in Indianapolis.

Liu, S., H. Lu., T. Musket, A.L. McKendry, and G.L. Davis. 2002. Identification of QTL associated with scab resistance in Ernie. Presented at the 2002 National Fusarium Head Blight Forum in Erlanger, KY, December 7-9, 2002.

McKendry, A.L., K.S. Bestgen, D.N. Tague. 2002. Types I, II and field resistance to Fusarium head blight in winter and spring wheat germplasm. Presented at the 2002 National Fusarium Head Blight Forum in Erlanger, KY, December 7-9, 2002.

McKendry, A.L. 2002. Scab Research at the University of Missouri. Presented as part of the Missouri Seed Improvement Association Annual Meeting. February 7, 2002.