USDA-ARS / USWBSI
FY03 Final Performance Report (approx. May 03 – April 04)
July 15, 2004

Cover Page

PI:	**Anne McKendry**
Institution:	**University of Missouri**
Address:	**Department of Agronomy** **106 Curtis Hall** **Columbia, MO 65211**
E-mail:	**mckendrya@missouri.edu**
Phone:	**573-882-7708**
Fax:	**573-884-7850**
Year:	**FY2003 (approx. May 03 – April 04)**
FY03 ARS Agreement ID:	**59-0790-9-052**
FY03 ARS Agreement Title:	**Fusarium Head Blight Research in Winter Wheat.**
FY03 ARS Award Amount:	**$ 174,593**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
GIE	Winter Wheat Germplasm Introduction and Evaluation.	$ 94,593
VDUN	Accelerating the Development of Scab Resistant Soft Red Winter Wheat.	$ 80,000
	Total Amount Recommended	**$ 174,593**

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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: ***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 917 accessions from Russia (268), Switzerland (325), Austria (111) and China (213); screen approximately 56 hexaploid winter wheat accessions from the Sando collection (derived from related species); verify through progeny testing, putative sources of resistance identified in approximately 561 Eastern European accessions screened first in 2002; quarantine, 37 spring and 33 winter wheat lines introduced from CIMMYT including lines from CIMMYT, Uruguay, China, South Africa, Brazil and Eastern Europe; screen spring wheat lines from Brazil, Argentina, Japan and CIMMYT introduced in 2002.

2. What were the most significant accomplishments?
A total of 156 lines (of 917 screened) were preliminarily identified with putative resistance including lines from Austria (8), China (37), Russia (27), Switzerland (75) and the Sando Collection (9). Of these, 39 lines had a spread of 1 spikelet or less when point-inoculated. Resistance in these lines will be verified in 2004. Verification of lines from Bulgaria, Hungary and Romania resulted in 30 lines with spread less than 2.0 spikelets and a FHBI (spread/total spikelets) less than 15% compared to 72% for the susceptible check variety. Spread in the resistant check Sumai 3 was approximately 1 spikelet and the FHBI was 5%. Lines from Bulgaria (7), Hungary (6), and Romania (3) had resistance statistically comparable to Sumai 3. All lines were cultivated, cultivars or breeding lines in winter wheat backgrounds and thus should be useful to breeders. Seven lines including those from Bulgaria (3) and Hungary (4) were adapted in Missouri and had verified field resistance with a field scab index less than 15%. Retained lines from the screening of 2000 lines from the Balkans were verified for a second time in the greenhouse and field. Following 3 cycles of screening, 12 landraces were identified with excellent levels of combined type II and type I (greenhouse and field resistance with FHBI less than 10%). As part of the CIMMYT collaboration, 70 lines were quarantined. In addition, 172 lines introduced and quarantined in 2002 from the CIMMYT collaboration including lines from Japan (15), Brazil (19), Argentina (107), and CIMMYT (32), were screened and verified. Verifications resulted in confirmation of resistance with FHBI less than 10% in 52 lines including those from Argentina (27), Brazil (7), Japan (5), and CIMMYT (13). These and all lines noted in this report are available for distribution.

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. Objectives for research in 2003 included: to identify useful sources of scab resistance through continued greenhouse and field screening of all advanced breeding lines in the Missouri wheat breeding program; to identify and/or confirm further useful sources of scab resistance through field and greenhouse evaluation of the Northern and Southern Winter Wheat Scab Nurseries; to continue to incorporate and pyramid new sources of resistance, as they are verified, into elite Missouri soft red winter wheat breeding lines; to characterize the genetics of resistance to scab in the Missouri scab resistant cultivar, Truman.

2. What were the most significant accomplishments?
A milestone in our breeding research, funded in part by the USWBSI, was reached in August 2003 with the release of the scab resistant cultivar 'Truman' (tested as MO 980525). It was the top line in the 2001 Winter Wheat Scab Nursery, having low ratings in all seven categories of resistance evaluated. In addition to being an excellent source of scab resistance, Truman placed second overall in the 2001 Eastern Winter Wheat Nursery and was in the top yield group in 3 years of combined data (21 location-years) in the 2003 Missouri Winter Wheat Performance Tests. Beyond Missouri, Truman is particularly adapted to Northern Corn Belt. Truman will be widely available to MO growers in the fall of 2004 and beyond MO in 2005. Development of doubled haploid lines and populations for genetic analysis of resistance in Truman continued in 2003. Two additional resistant lines, MO 981020 and MO 980829, are on track for release in 2004 and 2005, respectively. Within our breeding nurseries, 124 F3 and F4 segregating plots and 79 new F2 plots were evaluated for scab resistance. These plots involve scab crosses from Asian sources, the best newly identified sources of resistance identified in the MO breeding program, those of other collaborating scientists identified in the Northern and Southern Winter Wheat Scab Nurseries, and/or sources introduced from international sites. Screening of materials being advanced from our Preliminary Yield Nurseries (PYN) identified a number of new sources of resistance. These genotypes all have acceptable or superior agronomic performance in MO. In 2002, 73 lines had resistance levels better than Ernie (20%). In 2003, 17 lines from 15 different pedigrees (5 of which were Ernie-derived) were verified to have resistance levels better than Ernie. Also in 2003, 250 new PYNs were preliminarily screened for resistance. Of these, 72 had resistance better than Ernie (FHBI = 20%), while 13 had resistance levels comparable to Truman and Sumai 3 (FHBI=10%). These lines will be verified in 2004. Finally, work was completed in 2003 on the molecular and conventional genetic analysis of resistance in Ernie, which was part of the 2001 proposal. Four major additive genes condition resistance and 4 QTL have been identified that are associated with resistance. Resistance in Ernie appears to differ from that in Sumai 3. Publications resulting from this work are currently under review.

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.

Peer-reviewed manuscripts:

McKendry, A.L., D.N. Tague, R.L. Wright, J.A. Tremain, and S.P. Conley. 2004. Registration of 'Truman' wheat. Crop Sci. (in press).

Liu, S., Z. Abate, and A.L. McKendry. 2004. Inheritance of Fusarium head blight resistance in the soft red winter wheat 'Ernie'. Theor. Appl. Genet. (under review)

Liu, S., Z. Abate, G.L. Davis, and A.L. McKendry. 2004. QTL associated with Fusarium head blight resistance in the soft red winter wheat 'Ernie'. Theor. Appl. Genet. (under review)

2003 National Fusarium Head Blight Forum Proceedings:

McKendry, A.L., T. Musket, D. Davis, Z. Abate, and G. Davis. 2003. Molecular genetic diversity of geographically diverse scab resistant wheat lines. 2003 National Fusarium Head Blight Forum, Bloomington MN. p. 224 (Abstract)

Liu, S., H. Lu, G. Davis, and A.L. McKendry. 2003. Genetic studies of scab resistance in the soft red winter wheat 'Ernie'. 2003 National Fusarium Head Blight Forum, Bloomington MN. p. 21-23 (paper)

Abstracts:

Musket, T., D. Davis, Z. Abate, A. McKendry, and G. Davis. 2003. Molecular genetic diversity of geographically diverse scab resistant wheat lines. Plant and Animal Genome XI Meeting, San Diego, CA. Jan. 2003.

S. Liu, H. Lu, G. Davis, A. McKendry, 2003. QTL associated with scab resistance in the soft red winter wheat 'Ernie'. Plant and Animal Genome XI Meeting, San Diego, CA. Jan. 2003. p.173.

Liu, S., H. Lu, G. Davis, and A. McKendry. 2003. Molecular and conventional genetic studies on Fusarium head blight resistance in the wheat cultivar 'Ernie'. American Society of Agronomy Annual Meeting, Denver, CO.

Presentations:

McKendry, A.L. Update on the Missouri Winter Wheat Breeding Program: The Release of 'Truman' Wheat. Presented at the Missouri Seed Improvement Annual Meeting, Holiday Inn Select, Columbia, MO.