

**U.S. Wheat and Barley Scab Initiative
Annual Progress Report
September 18, 2000**

Cover Page

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Year:	FY2000
Grant Number:	59-0790-9-052
Grant Title:	Fusarium Head Blight Research
Amount Granted:	\$172,750.00

Project

Program Area	Objective	Requested Amount
Germplasm	Maintain a germplasm center.	\$57,750.00
Variety Development & Uniform Nurseries	To enhance variety development of scab resistant varieties.	\$75,000.00
Biotechnology	To enhance variety development of scab resistant varieties.	\$29,127.00
	Requested Total	\$161,877.00¹

Principal Investigator

Date

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

Project 1: Maintain a germplasm center.

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

This project is aimed at finding, through a world-wide search, additional or new sources of resistance to Fusarium head blight (scab) in winter wheat. After discovery, this project is charged with verifying resistance and disseminating information to wheat breeders nationally. A third objective is 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 is underway. Accessions (4200) from targeted geographical regions where scab is a problem have been identified to be screened first. Approximately 1000 accessions per year are being screened. In FY1999, 1006 accessions from Yugoslavia were screened in the greenhouse and field. Resistance in approximately 250 of these lines (primarily landraces) will be verified during the fall of 2000. In FY2000, 947 further accessions from Yugoslavia will be screened for Type I, Type II and Type III resistance in the field and greenhouse. Finally, a visit to China in May facilitated the introduction of additional unique sources of resistance from programs working on scab resistance. These lines will be introduced into the United States in December 2000 along with approximately 100 elite scab resistant CIMMYT lines.

2. Please provide a comparison of the actual accomplishments with the objectives established.

Because this project involves winter wheat, the timing of the grant (May 2000) precluded new germplasm work during the summer of 2000, and as such, work for this grant will commence during the fall greenhouse after accessions have been vernalized and will continue with field screening in May 2001. In FY99, 1006 accessions were screened and accessions were identified as having good to excellent levels of Type II resistance and kernel quality compared to Sumai 3 and Ernie soft red winter wheat (the resistant checks). Of these, 209 were land races. During FY2000, Type II resistance in these plants will be verified through progeny tests conducted in the greenhouse. Data will be presented at the Scab Forum in December, 2000. Also in FY2000, 947 additional accessions from Yugoslavia will be screened for Type II resistance and kernel quality in the greenhouse during the fall of 2000 and winter of 2001. These lines will be planted in the field in October 2000 and evaluated for Type I resistance in May of 2001.

3. What were the reasons established objectives were not met? If applicable.

Distribution of funds in the spring of 2000, precluded work during the summer of 2000 because this center works on winter wheat which must be vernalized for fall greenhouse planting or planted in the fall for field screening in the spring. As such work will commence in the fall of 2000 as outlined above.

4. What were the most significant accomplishments this past year?

In FY 2000 resistant germplasm identified in FY98 and verified through 2 generations of progeny testing will be distributed to wheat breeders nationally. Resistance in landraces from Yugoslavia will be

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verified and the first new germplasm will be introduced from China and CIMMYT through the initiative's collaborative agreement with CIMMYT.

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?

Wheat scab has caused serious losses in both yield and quality in Missouri soft red winter wheat with combined losses in 1990 and 1991 exceeding \$250 million, however, few released cultivars have functional levels of resistance. Systematic screening of advanced lines has identified a number of pedigrees with incidental functional resistance. The cultivar 'Ernie' released by Missouri in 1995 is one such genotype. The goals of this project are to: (1) systematically evaluate all advanced breeding lines for scab resistance, (2) incorporate genes for resistance primarily from China, Japan, Italy, Eastern Europe and CIMMYT into elite breeding lines, (3) grow and evaluate the 2000 Winter Wheat Scab Nursery, and (4) study the inheritance of resistance in Ernie.

2. Please provide a comparison of the actual accomplishments with the objectives established.

The scab screening nursery was doubled in size for the summer of 2000 to evaluate 55 F2 populations segregating for scab resistance, approximately 3,000 F5 head rows selected from populations developed from parents with good to excellent levels of scab resistance, and approximately 150 plots of lines in advanced stages of testing. The 2000 scab nursery was screened for Type I resistance in the field and for Type II resistance and kernel quality in the greenhouse during the spring of 2000. The 2001 nursery (49 advanced breeding lines from the eastern region) will be screened in the greenhouse and field in 2001. Highly susceptible lines continue to be eliminated from the breeding stream. New pedigrees (approximately 20 of 102 screened) were identified that carry excellent incidental Type II resistance and kernel quality combined with good Type I resistance. A further 320 advanced will be planted in October for evaluation in 2001. Growth room crosses were made during the summer to continue development of genetic populations for conventional genetic analyses of resistance in Ernie. New germplasm will begin to be introduced into Missouri genetic backgrounds in January, 2001. This germplasm will provide access to new genes from China and those from elite CIMMYT germplasm including resistance from *Thinopyrum* and *Aegilops tauschii*.

3. What were the reasons established objectives were not met? If applicable.

Although breeding work is ongoing, distribution of funds in the spring of 2000 delayed work on FY2000 objectives until the fall because the Missouri wheat breeding program focuses on soft red winter wheat. Verification and nursery expansion funded with FY 1999 funds were completed as outlined above.

4. What were the most significant accomplishments this past year?

Incidental Types I, II and III resistances were verified in 20 pedigrees in the Missouri wheat program. We continued to develop genetic populations to evaluate the inheritance in Ernie. New and otherwise inaccessible germplasm will be introduced into the program through collaborations with CIMMYT. Three new lines were entered into the scab nursery for regional evaluation.

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Increase of MO 980525 a new scab resistant line was initiated. It is anticipated that this line may be released in the summer of 2001.

Project 3: Identify molecular markers associated with scab resistance in a highly resistant winter wheat cultivar,

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

'Ernie', released by the Missouri Agricultural Experiment Station, has been identified by many programs as a valuable source of broadly based scab resistance, having excellent Type II resistance and kernel quality and good Type I resistance under both natural and artificial disease pressure. Combining the resistance genes in Ernie with other sources of resistance should enhance the resistance in resulting cultivars. The identification of molecular markers associated with the resistance genes in this cultivar will both facilitate pyramiding these genes and reduce the labor associated with scab resistance breeding. MO 94-317 is a widely adapted, inbred (F_{12}) line developed at Missouri that is highly susceptible to scab with a Type II rating of $> 90\%$. It was crossed with Ernie in 1995 to initiate development of a recombinant inbred line (RIL) set for molecular analyses of the scab resistance in Ernie. Two hundred and fifty F_3 -derived F_9 recombinant inbred lines (RILs) will be used to map, using RFLP, AFLP and/or SSR markers, all resistance genes in Ernie.

2. Please provide a comparison of the actual accomplishments with the objectives established.

Because this project involves winter wheat, the timing of the grant (May 2000) precluded work during the summer of 2000, and as such, work for this grant will commence during the fall greenhouse after lines have been vernalized. Reviewers asked that RILs be advanced from the F_7 to the F_9 prior to commencing mapping work. Lines were advanced to the F_8 during the spring 2000 greenhouse cycle and are currently being advanced in the fall greenhouse to the F_9 . Mapping is expected to begin by January 2001.

3. What were the reasons established objectives were not met? If applicable.

We expected mapping to begin this fall, however, reviewers felt the population should be advanced through to the F_9 prior to beginning so generation advance from the F_7 to the F_9 has delayed the project. F_3 -derived F_9 RILs are now growing in the greenhouse and mapping is expected to begin in January 2001.

4. What were the most significant accomplishments this past year?

This is a new project involving winter wheat. The timing of the grant (May 2000) has precluded many accomplishments. RILs have been advanced and mapping should begin in January 2001.

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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:

Rudd, J.C., R. D. Horsley, A. L. McKendry, and E. H. Elias. 2000. Host Plant Resistance Genes for Fusarium head blight: Sources, Mechanisms, and Utility in Conventional Breeding Systems. *Crop Science*. (accepted).

Non Peer Reviewed:

Truong, L. 2000. Research into scab resistance will allow producers to have their cake and eat it too. *The Source*. College of Agriculture, food and Natural Resources, University of Missouri, Columbia.

Extension Talks:

McKendry, A. L., and K. S. Bestgen. 2000. Progress towards finding new sources of resistance to scab. *Missouri Area Agronomist's Field Day*. June 28th, 2000.