

**U.S. Wheat and barley Scab Initiative
Annual Progress Report**

PI:	Carl A. Griffey
Institution:	Virginia Tech
Address:	Crop & Soil Environmental Sciences Blacksburg, VA 24060-0404
Email:	cgriffey@vt.edu
Phone:	540-961-7189
Fax:	540-231-3431
Year:	FY2000
Grant Number:	59-0790-9-038
Grant Title:	Fusarium Head Blight Research
Amount Granted:	\$77,000.00

Project

Program Area	Objective	Requested Amount
Variety Development & Uniform Nurseries	Accelerate development of resistant varieties.	\$40,000.00
Biotechnology	Facilitate marker-assisted selection of scab resistance and gene pyramiding by identifying molecular markers linked to scab resistance genes.	\$35,000.00
	Requested Total	\$75,000.00¹

Dr. Carl A. Griffey

09/06/00

Principal Investigator

Date

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

Project: Assessment and Selection for Scab Resistance in Soft Red Winter Wheat

Major problem or issue being resolved and methodology:

Highly effective type II scab resistance has not been identified in soft red winter (SRW) wheat. Most of the type II resistance sources currently being used are progeny of Sumai #3, and are spring habit, low yielding and susceptible to glume blotch, powdery mildew and leaf rust in Virginia and the mid-Atlantic region. A major objective is to transfer type II resistance from these sources into SRW wheat backgrounds. Assessment and selection methods have been developed to accomplish this objective, and parents, progeny and advanced lines were evaluated and selected for scab resistance this year. We also have identified and confirmed the presence of moderate levels of scab resistance in SRW wheat cultivars and elite lines, such as Roane and Ernie. Type II resistance is being transferred into scab susceptible and tolerant SRW wheat backgrounds via top-cross and back-cross procedures. Scab resistant progeny and advanced lines were selected based on greenhouse and field assessments made in mist-irrigated tests inoculated with *Fusarium*.

Comparison of the actual accomplishments with the objectives established:

Thirty scab resistant sources (21 Chinese, 2 French, 1 Japanese and 6 SRW wheat lines) have been used as parents in the breeding program and over five hundred populations from F₁ to F₅ have been evaluated in scab nurseries at Warsaw and Blacksburg, Virginia. Twenty-seven advanced wheat lines possessing scab resistance combined with higher yield potential and resistance to other diseases were evaluated simultaneously for scab resistance in a scab nursery at Blacksburg and for agronomic traits in observation yield tests at Warsaw and Blacksburg. Three of these lines will be evaluated in Preliminary Variety Yield Trials and seven lines will be tested in the Uniform Winter Wheat Scab Nurseries this coming year. Three hundred wheat lines were selected from 2470 F₅ head-rows, and 50 of these lines will be evaluated in observation yield tests at two locations in the coming year. In addition, 2800 head rows derived from diverse resistant sources were selected from 41 F₃ and 11 F₄ populations, and 238 F₁, 100 F₂ and 50 BC₂ F₁ populations were advanced. About 240 double haploid lines derived from 12 crosses were assessed for scab resistance and agronomic traits, and 13 of these lines will be evaluated in yield tests this year.

Progress in meeting established objectives and other initiatives:

As far as expected progress on a temporal basis, all objectives were fully met. In addition, resistance to toxin accumulation, type III resistance, was assessed in 300 wheat accessions and 2500 F₂ individuals. The relationship between different types of resistance was studied in conjunction with other genetics research conducted in our mapping project.

Most significant accomplishments this past year:

Soft red winter wheat lines with improved scab resistance derived from type II sources were identified this past year. Some of these lines have good yield potential combined with resistance to powdery mildew, leaf rust, or both. Progress in transferring type II resistance into SRW wheat genotypes has been facilitated by use of the wheat by maize double haploid system. This past year 450 haploid plants from 9 three-way crosses comprised of scab resistant parents were produced and doubled.

Project: Heredity, Molecular Markers, and Selective Breeding for Wheat Scab Resistance

Major problem or issue being resolved and methodology:

Knowledge concerning the amount of available genetic diversity and genetic mechanisms governing scab resistance is ambiguous and insufficient, and the mode of inheritance of resistance is not clear and may involve complex gene interactions. The major objective of this project is to determine the amount of existing genetic diversity and genetic control of resistance in currently used sources. Inheritance of scab resistance was studied using conventional and molecular techniques. Four F₂ populations derived from the crosses Madison x W14, Pioneer 2684 x W14, Pioneer 2684 x Shaan 85, and Pioneer 2684 x Ernie were characterized for number of infected spikelets, severity, percentage of scabby seeds and DON content. Two F₂ populations Madison x W14, Pioneer 2684 x W14 are being characterized using SSR markers.

Comparison of the actual accomplishments with the objectives established:

Two complementary genes with major effects were found to confer scab resistance in wheat lines W14 and Shaan 85 based on similar segregation patterns of F₂ progeny from three populations characterized for the number of infected spikelets, severity, percentage of scabby seeds and DON content. One to two genes were found to confer resistance in the SRW wheat Ernie. Segregation patterns observed in four F₂ populations suggest that gene interaction is likely and may explain the transgressive segregation observed in this study and in those reported by other researchers. Among 58 pairs of SSR primers used, GMS 533, an SSR marker on chromosome 3B reported by other researchers to be associated with scab resistance, was associated with scab resistance in wheat line W14. Two additional markers with putative linkage to resistance loci have been identified and currently are being verified. Comparison of disease data with corresponding marker data indicates that epistasis may be involved in the expression of scab resistance. This will be confirmed in further studies.

Progress in meeting established objectives and other initiatives:

As far as expected progress on a temporal basis, all objectives were fully met. In addition, resistance to toxin accumulation, type III resistance, was assessed in 300 wheat accessions and 2500 F₂ individuals. The relationship between different types of resistance was studied. Similar segregation patterns were observed in three F₂ populations classified for scab severity, percentage scabby seeds, and DON toxin accumulation.

Most significant accomplishments this past year:

Genetic analysis of type II resistance in four F₂ populations and preliminary mapping data of two populations, indicates that scab resistance in wheat line W14 is governed by two or more genes having complementary and/or epistatic interactions. An allele of one of these genes may suppress the expression of resistance by the other gene. The susceptible parents used in this study may possess genes conferring minor positive or negative effects on scab resistance. These results contribute to a better understanding of the genetic control of scab resistance.

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.

Griffey, C.A., J. Chen, T. Pridgen, M. Chappell, J. Shaw and W. Xie. 2000. Research progress on *Fusarium* head blight in the Virginia wheat breeding program. 2000. Wheat Newsletter 46:258-259.

Chen, J., C.A. Griffey, T. Pridgen, M. Chappell. 2000. Assessment and rational utilization of scab resistance sources in the Virginia Wheat Breeding Program. p. 10-17. In: Proceeding of International Wheat Scab Symposium. May 2000. Suzhou & Nanjing, P.R. China.

Chen J., C.A. Griffey, T. Pridgen, M. Chappell, J. Shaw. 2000. Characterization of scab (*Fusarium*) resistance in wheat. p. 91. In: Proceedings of the 3rd International Crop Science Congress. August 17-22. CCH Congress Centrum, Hamburg, Germany.