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

Cover Page

PI:	**Carl A. Griffey**
Institution:	**Virginia Tech**
Address:	**Crop & Soil Environmental Sciences** **Blacksburg, VA 24061-0404**
Email:	**cgriffey@vt.edu**
Phone:	**540-231-9789**
Fax:	**540-231-3431**
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Grant Number:	**59-0790-9-038**
Grant Title:	**Fusarium Head Blight Research**
2000 ARS Award Amount:	**$75,122**

Project

Program Area	Project Title	Requested Amount
Variety Development & Uniform Nurseries	Assessment and Selection for Scab Resistance in Soft Red Winter Wheat.	$40,000.00
Biotechnology	Heredity, Molecular Markers and Selective Breeding for Wheat Scab Resistance.	$35,000.00
	Requested Total	$75,000.00[1]

Carl A. Griffey July 24, 2001

Principal Investigator Date

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

Project 1: Assessment and Selection for Scab Resistance in Soft Red Winter Wheat.

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

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 to develop scab resistant germplasm and varieties with high yield potential and resistance to other prevalent diseases including powdery mildew, leaf rust and glume blotch. The major strategies being used in our program to accelerate development of scab resistant wheat genotypes include: 1) Incorporation and pyramiding of type II and other types of resistance into adapted SRW wheat backgrounds via selection of progeny from top-cross, backcross and doubled haploid populations; 2) Screening and selection for type II and other types of resistance in inoculated greenhouse and field nurseries and; 3) Simultaneous evaluation of progeny for disease resistance and other agronomic traits.

2. What were the most significant accomplishments?

Thirty-six scab resistant sources (21 Chinese, 2 French, 1 Japanese, 2 Canadian and 10 SRW wheat lines) have been used as parents in the breeding program and over five hundred populations from F_1 to F_5 have been evaluated in scab nurseries at Warsaw and Blacksburg, Virginia. Fifty advanced wheat lines were evaluated simultaneously for scab resistance in a scab nursery at Blacksburg and for other agronomic traits in observation yield tests at Warsaw and Blacksburg in spring 2001. Three of these lines were evaluated in preliminary variety yield trials and seven lines were tested in the uniform winter wheat scab nurseries. Scab resistance in 532 doubled haploid lines and 300 F_6 lines, selected from 2460 F_5 lines evaluated at Warsaw last year, were evaluated for scab resistance in an inoculated nursery at Blacksburg and for other agronomic traits in trials at Warsaw this spring. In addition, 2960 F_5 lines, derived from 53 F_4 populations screened for scab resistance, were evaluated for agronomic performance in a head-row nursery at Warsaw. Advanced lines developed in our program possess scab resistance derived from one or more type II resistance sources or type II resistance combined with other types of resistance. Some of these scab resistant lines (VA00W562, VA00W566, VA01W447, VA01W462, VA01W464, VA01W465, and VA01W483) have high yield potential and resistance to other diseases, such as powdery mildew and leaf rust. Progress in transferring type II resistance into SRW wheat genotypes has been accelerated via use of the wheat by maize double haploid system. To date, 109 doubled haploid plants and 101 haploid plants have been derived from 3-way crosses consisting of diverse scab resistant parents. Type II resistance derived from seven different sources is being back-crossed into eight different SRW wheat backgrounds, of which two are adapted sources with other types of resistance. Approximately 385 backcrosses were made between resistant progeny derived from three BC_3F_1 and 16 BC_2F_1 populations and their recurrent parents. This will result in the development of near-isogenic lines with type II resistance incorporated into adapted SRW wheat backgrounds and facilitate pyramiding of different types of resistance.

Project 2: Heredity, Molecular Markers and Selective Breeding for Wheat Scab Resistance.

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

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 likely involves complex gene interactions. The major objective of this project is to determine the amount of existing genetic diversity and genetic control of resistance in three identified resistance sources. Inheritance of scab resistance was studied using conventional and molecular techniques. Four F_2 populations (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 toxin content. In addition, two $F_{2:3}$ populations Madison x W14 and Pioneer 2684 x W14 were characterized for scab severity. The F_2 population Pioneer 2684 x W14 is being used to map resistance to scab using SSR markers. SSR markers associated with resistance in this population are also being used to genotype six identified resistance sources.

2. What were the most significant accomplishments?

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 F_2 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 cultivar Ernie. Using 180 pairs of SSR primers, three major quantitative trait loci (QTL) were identified on wheat chromosomes 3BS, 5AL and 7BL, and explained 15, 10 and 10% of the total variation in disease severity among 82 F_2 individuals and 26, 12 and 11% of total variation in disease severity among 82 $F_{2:3}$ lines. In addition to theses major QTL, two minor QTL were identified on chromosomes 2B and 6A, and explained 6 and 4% of the total variation in disease severity among 82 F_2 individuals, and 4 and 2% of total variation in disease severity among 82 $F_{2:3}$ lines. Seven DNA markers from the five chromosome regions mentioned above were used to genotype six diverse resistance sources. Differences observed in these markers among several of the six lines indicate that some lines may possess different resistance genes that could be used to pyramid resistance from these sources and, thereby improve the level of scab resistance. Two doubled haploid populations were developed and will be evaluated for disease reaction in greenhouse tests this winter. These lines will be used to verify genetic and marker data in the coming year.

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.

Chappell, M., C. Griffey, J. Chen, T. Pridgen, D. Nabati, W. Zhao, and M. Vaughn. 2001. Assessment and reaction of *Triticum aestivum* genotypes to *Fusarium graminearum* and its effects on traits related to grain yield and quality. pp.7-8. *In***:** Proceedings of Southern Small Grain Workers Conference. April 22-24. University of Georgia. Griffin, GA.

Chen, J., C. Griffey, M. Chappell, T. Pridgen, D. Nabati, W. Zhao. 2001. Efficacy of haploid production using wheat by maize hybridization method. pp. 2. *In*: Proceedings of Southern Small Grain Workers Conference. April 22-24. University of Georgia. Griffin, GA.

Chen, J., C.A. Griffey, W. Zhao and M. Chappell. 2001. Resistance to *Fusarium* head bight and associated molecular markers. Abstract submitted for 2001 ASA meetings. Charlotte, NC.

Griffey, C.A., J. Chen, T. Pridgen, and M. Chappell. 2001. Breeding for scab resistance in soft red winter wheat. Wheat Newsletter 47: (in press).

Chappell M., C. Griffey, J. Chen, T. Pridgen, D. Nabati, W. Zhao, and M. Vaughn. 2000. Assessment and reaction of *Triticum aestivum* genotypes to *Fusarium graminearum* and its effects on traits related to grain yield and quality. pp. 246-250. *In*: Proceedings of 2000 National Fusarium Head Blight Forum. December 10-12. Erlanger, KY.

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

Chen J., C.A. Griffey, M.A. Saghai Maroof , W. Zhao, W. Xie, T. Pridgen and R.M. Biyashev. 2000. Genetic analysis of resistance to *Fusarium* head blight in common wheat. p.19-24. *In*: Proceedings of 2000 National Fusarium Head Blight Forum. December 10-12. Erlanger, KY.

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.

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