

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY06 Final Performance Report (approx. May 06 – April 07)
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Cover Page

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USDA-ARS Agreement Title:	Development of Scab Resistant Wheat Cultivars for Kansas.
FY06 ARS Award Amount:	\$ 25,818

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Award Amount
VDUN	Development of Scab Resistant Wheat Cultivars for Kansas.	\$ 25,818
	Total Award Amount	\$ 25,818

Principal Investigator

Date

* CBCC – Chemical, Biological & Cultural Control
EEDF – Etiology, Epidemiology & Disease Forecasting
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GET – Genetic Engineering & Transformation
HGR – Host Genetics Resources
HGG – Host Genetics & Genomics
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

(Form – FPR06)

Project 1: *Development of Scab Resistant Wheat Cultivars for Kansas.*

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

Serious scab (*Fusarium* head blight) epidemics occurred in Kansas in 1982, 1990, 1993, and 1995 and annual losses average \$2.1 million. Approximately one million acres of wheat in the eastern part of Kansas are annually at risk from scab where rainfall is higher during heading and corn residue is more prevalent. Since 1980, wheat acreage in the eastern one quarter of Kansas has declined by two thirds and a major cause of the decline has been farmer aversion to the risk of scab epidemics. Therefore, the availability of cultivars with resistance to scab is highly desirable for eastern Kansas. Additionally, there are three main reasons that scab has the potential to become much more prevalent in central Kansas where wheat is the traditional dominant crop (about 5 million additional wheat acres). First, there is a trend for increasing cultivation of corn in that part of the state, the main reservoir of inoculum of the scab pathogen. Second, there is a strong trend for decreasing tillage, which allows spore production and release from the residue. Third, the prevalent varieties in central Kansas are susceptible to scab. Resistant wheat cultivars adapted to this area of Kansas would also be highly desirable. Genetic resistance offers the best hope for economic management of this disease. The long-term goal of this research is to develop hard red and hard white winter wheat cultivars adapted for Kansas with improved resistance to scab. Short term objectives are to: 1) test existing local cultivars for resistance, 2) test advanced breeding lines for resistance, 3) test exotic germplasm lines for resistance, 4) test the Northern Uniform Winter Wheat Scab Nursery and the Tri-state (Kansas, Nebraska, South Dakota) Scab Nurseries for reaction to scab, and 5) incorporate new sources of scab resistance into the Kansas wheat breeding program. Testing will be done in misted field nurseries using soil-applied infested corn grain inoculum and in the greenhouse using single-floret inoculations. Visual disease evaluation methods will be used to rate the percentage spikelets infected by the pathogen. Data will be disseminated to wheat producers and used by wheat breeders as they make selections for future Kansas cultivars.

2. List the most important accomplishment and its impact (how is it being used?).

Complete all three sections (repeat sections for each major accomplishment):

Accomplishment:

Until involvement in the USDA Scab Initiative, there was virtually no effort to identify sources of scab resistance in Kansas breeding programs. The Initiative has resulted in the development of accurate and efficient greenhouse and field testing nurseries that are providing useful ratings for current cultivars in Kansas, advanced breeding lines, and allow participation in the Regional Scab Nursery. Respectively, these nurseries allow dissemination of information to growers on the reaction of current commercial cultivars, selection by breeders for scab resistance in their breeding lines, and identification of additional sources of resistance from other breeding efforts in the region that can be incorporated into Kansas breeding lines. Kansas has also taken the lead in organizing a Tri-state Scab Screening Nursery for the hard red winter wheat breeding programs of Kansas, Nebraska, and South Dakota. This latter nursery provides valuable data on the reaction of hard red winter wheat cultivars to scab in their area of adaptation. The long-term goal of the research is to develop, deploy, and advertise winter wheat cultivars adapted for Kansas with improved levels of resistance to scab.

Impact:

Two commercial cultivars in Kansas (Hondo and Heyne) were identified in 2000 (and confirmed in later years) as having good levels of scab resistance (3 and 4 on the 1-9 scale where 1=immune and 9=highly susceptible). During the past few years, these cultivars have averaged only 12 and 15% scab, respectively compared with about 50% in susceptible cultivars. Similarly, the recently-released cultivar Lakin has shown moderate levels of resistance with 22-34% scab. Six other commercial cultivars have also displayed moderate levels of resistance equal to, or better than, Lakin. Therefore, we have identified a few genes for scab resistance already present in cultivars adapted to Kansas that can be used by producers and may be potential sources of resistance for the development of future cultivars. Finally, both KSU wheat breeders and the USDA wheat geneticist have been involved in the project by having their breeding lines evaluated for resistance to scab. Several breeding “populations” are tested each year from which the breeders make selections of promising lines showing resistance. Also, there are approximately 40 advanced breeding lines (The Kansas Intrastate Nursery) that are tested each year.

As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?

Because of the scab testing efforts, a new column for reaction to “Head Scab” was added to the popular KSU extension publication *Wheat Variety Disease and Insect Ratings* for the fall, 2000 issue and has been updated in subsequent years. For the first time, this has allowed producers in Kansas to use the reaction to scab to help select cultivars for planting. Similarly, data produced from nurseries funded by the Scab Initiative have recently been incorporated into another popular extension publication (*Kansas Performance Tests with Winter Wheat Varieties*). Both publications are available as “hard copy” or online. The involvement of breeders and the wheat geneticist has resulted in significant progress to improve the level of resistance to scab in future commercial wheat cultivars. Additionally, this research has resulted in a germplasm release in 2004 from Kansas State University with resistance to scab derived from *Triticum timopheevii* ssp. *armeniacum*.

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.

1. Bockus, W. W., Su, Z., Garrett, K., A., Gill, B. S., Stack, J. P., Fritz, A. K., Roozeboom, K. L., and Martin, T. J. 2007. Number of experiments needed to determine wheat disease phenotypes for four wheat diseases. *Plant Dis.* 91:103-108.
2. Bockus, W. W., Fritz, A. K., and Martin, T. J. 2006. Reaction of the 2005 Kansas Intrastate Nursery to Fusarium head blight, 2005. *Biol. Cult. Tests Control Plant Dis. Report* 21:FC002, DOI:10.1094/BC21, The American Phytopathological Society, St. Paul, MN.
3. Bockus, W. W., and Davis, M. A. 2006. Reaction of selected winter wheat accessions to Fusarium head blight, 2005. *Biol. Cult. Tests Control Plant Dis. Report* 21:FC003, DOI:10.1094/BC21, The American Phytopathological Society, St. Paul, MN.
4. Bockus, W. W. 2006. Effect of foliar fungicides on Fusarium head blight of winter wheat, 2005. *Fung. & Nema. Tests. Report* 61:CF012, DOI:10.1094/FN61, The American Phytopathological Society, St. Paul, MN.
5. Roozeboom, K., Fritz, A., Jardine, D., Knapp, M., Whitworth, J., Claassen, M., Gordon, W. B., Heer, W., Kimball, J., Maddux, L., Evans, P., Long, J., Martin, T. J., Schlegel, A., Parker, E., Lingenfelter, J., Bockus, B., and Shroyer, J. 2006. 2006 Performance Tests. Pages 5-26 in: 2006 Kansas Wheat Seed Book. Contribution No. 07-8-S from the Kansas Agricultural Experiment Station. 48 pp.
6. Bockus, W. W., Davis, M. A., Roozeboom, K. L., and Stack, J. P. 2005. Determining and reporting the reaction of Kansas commercial wheat cultivars to Fusarium head blight. *Proceedings of the 2005 National Fusarium Head Blight Forum*, p. 16.
7. Bockus, W. W. 2006. Kansas. Report for the Western Education/Extension Research Activities Coordinating Committee on cereal diseases (WERA-97). (<http://plantsciences.montana.edu/wera97/Default.htm>)
8. Bai, G., St. Amand, P., Ibrhim, A., Baenziger, S., Bockus, B., and Fritz, A. 2006. Transfer of a QTL for FHB resistance into hard winter wheat using marker-assisted backcross. *Proceedings of the 2006 National Fusarium Head Blight Forum*, p. 82.