USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY05 Final Performance Report (approx. May 05 – April 06)
July 14, 2006

Cover Page

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Fiscal Year:	**2005**
FY05 ARS Agreement ID:	**59-0790-4-092**
Agreement Title:	**Developing Winter Wheat with Improved Fusarium Head Blight Tolerance by Conventional and Transgenic Approaches.**
FY05 ARS Award Amount:	**$ 112,313**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
BIO	Enhanced Scab Resistance in Winter Wheat Germplasm by Plant Transformation.	$ 65,853
VDUN	To Enhance Variety Development of Scab Resistant Hard Winger Wheat Varieties.	$ 46,460
	Total Award Amount	**$ 112,313**

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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: *Enhanced Scab Resistance in Winter Wheat Germplasm by Plant Transformation.*

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

Problems encountered during 2005 were the low levels of correlation and consistency found between repetitions of the transgenic events during both field and green house trials. Low levels of correlation were seen during head inoculations and treatments that induced environmental stresses such as low and high temperatures, salinity, high levels of reactive oxygen species etc. Though low levels of correlation were noted, a lack of resistance was also found in the transgenic lines. All transgenic lines, except those in the YangMai background, demonstrated wild type levels of resistance, which were comparable to resistance levels inherent in the parent lines or controls. The parental line YangMai showed increased resistance irrespective of the presence of transgenes due to rapid maturity and compactness of the wheat heads.

To increase the level of correlation between field and green house assays, higher numbers of repetitions were used in the assays in conjunction with larger samples sizes taken from treated plants. This was carried out for all assays irrespective of the location or type of treatment. Also, new transgenic lines were not produced in the YangMai background because of its inherent native levels of resistance. The origin of YangMai was discussed with breeders from China at the International Wheat Workers Workshop in Argentina who said YangMai was derived from an Egyptian line that was originally developed by CIMMYT. Since the transgenes worked with thus far did not confer increased resistance to the parent lines, two more transgenes were introduced, Sf-IAP and Bcl2-161, as alternative genes for conferring resistance.

As a follow-up, a number of transgenic lines wee sent to Dr. Mohamed Mergoum for field testing in 2005 (damaged by take-all due to the isolation requirements putting the plots on previously grassy fields) and in 2006 (trial results pending). Lead transgenes were crossed into winter backgrounds so they could be tested in Nebraska in adapted backgrounds. Recently the Op-IAP transgene was determined to be from a potential disease, thus must undergo much more rigorous approvals, so this year will end field experimentation with this transgene.

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:

Identification of an inherently resistant parental line, YangMai. Identification of this line has demonstrated a lack of increased resistance conferred by the various transgenes previously implemented.

Impact:

The Identification of the inherently resistant parental line, has forced the expression and implementation of new transgenes into non-resistant parental lines in order to detect increased resistance conferred from the transgenes.

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?: The clientele will have a highly transformable FHB tolerant line in which to test putative FHB tolerant gene constructs to determine if they increase tolerance above the native levels.

FY05 (approx. May 05 – April 06) FY05 Final Performance Report
PI: Baenziger, Stephen
ARS Agreement #: 59-0790-4-092
Project 2: *To Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties.*

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

The major problem that this project addressed is the development and deployment of Fusarium head blight (FHB) resistant cultivars. To resolve this problem we are using a two-prong approach. First we are breeding for resistance in adapted genotypes for the upper Great Plains. Fusarium head blight is most common in the hard winter wheat areas of South Dakota, eastern Nebraska, and eastern Kansas. In addition to detached leaf assays, FHB resistance screens were conducted in the greenhouse and in the field under dry-land and misted conditions in Nebraska in 2005. Since many Nebraskan varieties are ultimately grown both here and in neighboring states, we collaborated in a tri-state nursery screen with South Dakota and Kansas, to ensure that our most promising FHB resistant cultivars perform well under these conditions. Second we are screening the Regional Germplasm Observation Nursery to identify the level of FHB resistance within the existing elite winter germplasm of the Great Plains. Both efforts are part of National Scab Initiatives efforts on VDUN and possibly GIE). A major change in 2005 was the addition of the genotyping center capabilities. Because Nebraska is suffering from droughts and high winds for the past number of years, we have decided it is imperative to augment our field screens with molecular markers. In 2005, we haplotyped 65 parental lines that were given to us or identified in our program as being scab tolerant, 98 experimental lines derived from our program. Most of our early crosses were with lines that had "native" resistance and for which there are no known QTLs. An example of improved tolerance using native resistance is the development of NE01643 (see below) which our tests has reduced FHB infection. Recently we have completely changed our crossing strategy to emphasize those lines with known, marked QTLs for resistance so we can track their resistance using markers, as well as our phenotypic screens. As such we have used Glenn and lines form Virginia extensively in our crossing blocks. While it is easy to remove spring growth habit from our segregating populations, soft winter wheat genotypes readily survive in Nebraska. To remove the unwanted soft genotypes, we initiated kernel-sorting experiments with Dr. Floyd Dowell of USDA-ARS. These experiments are in progress with the first harvest in summer, 2006. Our goals will be to couple of the power of designed crosses, molecular markers and kernel sorting capabilities so that we can first enrich our populations with FHB resistance QTLs and then sort for higher protein, hard kernel types in later generations.

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: There are three major accomplishments. First, NE01643 is being increased for release in 2006. In the Northern Regional Performance Nursery, it had the highest grain yield of the lines tested in both 2004 (5054 kg/ha) and 2005 (4342 kg/ha) and topped the Nebraska State Variety Trial in 2005 (10% higher than the popular line Millennium). Other important accomplishments were identifying advanced NE lines with the 3BS QTL for FHB tolerance and hiring Mr. Neway Mengistu (Ph.D. student) to help coordinate integrating molecular markers with the phenotypic screens.

Impact: It is too early to know the impact of NE01643, but it should become a popular variety that will reduce the risk of FHB in the northern Great Plains.

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?:

Our producers will have an outstanding variety that with enhanced FHB tolerance. Even without the threat of FHB, NE01643 should be grown on the basis of its performance.

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.

Schimelfenig, J., P.S. Baenziger, J. E. Watkins, S. Wegulo, J. Counsell. 2005. The Development of Fusarium Head Blight Tolerant Varieties of Wheat in Nebraska from 2001 to 2005. 2005 National Fusarium Head Blight Forum Proceedings. Pp 83.