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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Fiscal Year:	2006
USDA-ARS Agreement ID:	59-0790-6-061
USDA-ARS Agreement Title:	Development of FHB Resistant Soft White Wheat Varieties for Michigan and Similar Environments.
FY06 ARS Award Amount:	$ 84,545

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Award Amount
VDUN	Development of FHB Resistant Soft White Wheat Varieties for Michigan and Similar Environments.	$ 84,545
	Total Award Amount	**$ 84,545**

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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

Project 1: *Development of FHB Resistant Soft White Wheat Varieties for Michigan and Similar Environments.*

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

Soft white winter wheat (SWWW) is a significant element of Michigan agriculture-both on the farm and in the food processing industry. Kellogg's and other major cereal companies use processed soft white wheat with high-bran content in many of their products. The high concentration of wheat in such cereal foods results in lower maximum tolerances for deoxynivalenol (DON) in soft white wheat. SWWW cultivars with adequate resistance to FHB are not currently available. In addition, SRWW is now being grown by a large proportion of MI farmers. MI has also formally begun working to ensure improved levels of FHB resistance in SRWW varieties that perform well in the state of MI. We employ conventional plant breeding approaches including field and greenhouse FHB screening nurseries to overcome this shortcoming.

2. **List the most important accomplishment and its impact (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):**

<u>Accomplishment (1):</u>
Evaluation and Selection in Early and Advanced and Elite Germplasm:
For the 05/06 season we screened over 1400 early generation and pre-yield test single plant progeny plots/rows between the F2 and F6 generations. Parents exhibiting high levels of FHB resistance have been regularly used in the generation of these breeding materials. Below is an abbreviated summary of the current progress:

Of the F2:3 families selected in the 04/05 FHB nursery, one hundred twenty nine F3:4 progeny exhibited excellent resistance in the 05/06 nursery, verifying the utility of screening in the F3 in the FHB nursery. Of these, one hundred twenty five F4:5 single plant progeny plots were planted in the 06/07 season in our standard breeding nursery. Fifty-six F4:5 plots (20 white and 36 red) were selected in 06/07 and are now being bulk harvested for advancement to preliminary yield trials in the 07/08 season (several of these will be bulked together for a total of 12 white and 21 red F4:6/F3:6 lines). This preliminary yield trial will be planted in the FHB nursery, providing another year of confirmation of FHB resistance, in addition to agronomic performance. Individual plants are also being selected out of 17 other F4:5 single plant progeny plots for further evaluation as F5:6 lines.

Nine hundred eight F2:3's were evaluated in the 05/06 FHB nursery, out of which 667 (477 white and 190 red) single plant and 15 (9 white and 4 red) bulk selections were made and planted as F3:4's or F2:4's in the 06/07 standard breeding nursery for agronomic performance. Out of these F4's, 282 single plants will be harvested and selected for grain soundness before being advanced for further evaluation as F5's in the 07/08 season.

In addition to our early generation materials, multiple advanced and regional trials were evaluated in the FHB nursery in 05/06 (Table 1):

Table 1: Advanced MSU and Regional Nurseries Evaluated in 05/06:

Trial Name	# Entries	# Replication Evaluated
Advanced Yield Trial	15	2
Preliminary Yield Trials (combined)	58	2
State Performance Trial	72	2
Northern Uniform Winter Wheat Scab Nursery	58	2
Northern Preliminary Winter Wheat Scab Nursery	39	2
Uniform Eastern Soft Red Winter Wheat Nursery	48	2
Uniform Eastern Soft White Winter Wheat Nursery	24	2

FHB levels were very good, showing a wide range of both incidence and severity levels. For example, incidences of <15% and >70%, and severity of 25% and >70% occurred in the Uniform Eastern Red and White Winter Wheat Nurseries combined. The 06/07 FHB Nursery contains the 06/07 entries for the nurseries listed in Table 1.

As reported in the MSU FY05 progress report, two sets of sisters exhibiting nearly zero incidence (and very low spread when a spikelet is symptomatic), winter hardiness, white grain, good plant height, and also visual agronomic characteristics were distributed to cooperators for confirmation in the fall plantings of '06. Currently we are waiting for the results of the performance of these advanced lines.

Impact (1):

In addition to our regular use of parents exhibiting high levels of FHB resistance in our crossing blocks, our continued use of early generation selection is leading to a larger proportion of germplasm with improved levels of FHB resistance within which to select for other traits, such as yield, quality and testweight. In addition, screening of MSU yield and regional trials containing both MSU and cooperator entries ensures that the most advanced materials are confirmed for resistance prior to release in Michigan or cooperator states.

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?

Increased proportion of FHB resistant germplasm with good agronomic traits. Development of superior FHB resistant parents for breeding. Continued availability of FHB data for advanced and elite materials which enable informed decisions for lines being considered for release.

Accomplishment (2):

Toxin evaluation

From the 05/06 season FHB nursery, MSU harvested, threshed, sampled and sent two replication of each of three regionally relevant trials (Table 1) for toxin (DON) quantification to both Michigan State University and the University of Minnesota USWBSI funded laboratories. Although MSU participates in all three of these trials,

the majority of entries are from cooperators. The data from the two evaluations (MSU and U of M) were averaged, and the DON levels of treatments were analyzed by PROC GLM with replication used as a random factor. Mean DON levels for treatments showed a large range of toxin levels, with relatively small LSDs (least significant differences), as can be seen in Table 2 below. These results confirm 1) the isolates being used in the MSU FHB nursery are DON producers, 2) MSU capable of inducing a high level of toxin accumulation in our FHB nursery, and 3) MSU is able to differentiate between lines with higher and lower toxin accumulation.

Table 2: Toxin level ranges for 05/06 harvested MSU FHB nursery plots.

Trail Name	# Entries	Minimum Mean DON (ppm)	Maximum Mean DON (ppm)	Average DON (ppm)	LSD
Michigan State Wheat Performance Trial	68	0.4	8.05	2.73	1.587
Northern Uniform Winter Wheat Scab Nursery	58	0.2	7.3	1.53	1.47
Preliminary Northern Uniform Winter Wheat Scab Nursery	39	0.35	5.45	1.47	0.947

Impact (2):

MSU is capable of providing high levels of disease with the accompanying high levels of toxin in the FHB nursery. We also have sufficient precision from our samples to differentiate between entries with higher and lower DON accumulation.

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?

Regional cooperators in the U.S. have access to the performance of their entries in Michigan, not only with respect to FHB visual symptoms, but also toxin contamination.

Accomplishment (3):

New Wheat Breeder Hired at MSU

MSU's Wheat Breeding and Genetics program had been without a PI since the resignation of Dr. Richard Ward in the spring of 2006. In the spring of 2007, MSU confirmed the hiring of Dr. Janet Lewis for the MSU Wheat Breeding and Genetics position. Dr. Lewis has been working with FHB, both in research and in selections in the field, since 1999. Most recently she has been directing the FHB phenotypic work at CIMMYT in Mexico. Her employment will begin officially in October of 2007, but she is spending 7 weeks at MSU during the summer of 2007 during critical evaluation and field planning periods. Her employment as the MSU Wheat Breeder will ensure continued improvements in FHB resistance in MI wheat varieties.

Impact (3):

MSU is demonstrating its commitment to see continued improvements in FHB resistance in MI wheat varieties through hiring an experienced FHB researcher as MSU's new wheat breeder. MSU will continue to develop wheat lines with improved FHB resistance.

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?

FHB researchers around the world (and especially in the Soft Eastern Wheat region of N. America) have a new collaborator in Michigan, a critical Soft White Winter Wheat growing region. In addition, farmers and industry in Michigan will have a breeder who will work to address their needs, including reducing the prevalence and impact of FHB in Michigan.

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.

Publications (Peer Reviewed):

Jiang, G.-L., and R.W. Ward. 2006. Inheritance of resistance to Fusarium head blight in the wheat lines 'CJ 9306' and 'CJ 9403'. Plant Breeding, 125: 417-423.

Jiang, Guo-Liang, Yanhong Dong, Janet M. Lewis, Lee Siler, and Richard W. Ward. 2006. Characterization of Resistance to Fusarium graminearum in a recombinant inbred line population of wheat: Resistance to fungal spread, mycotoxin accumulation and grain yield loss, and trait relationships. Crop Science, 46: 2590-2597.

Proceedings:

Jiang, Guo-Liang, JianRong Shi, Lee Siler, and Richard Ward. 2006. Identification of QTLs for Type II resistance to FHB in the novel wheat germplasm CJ 9306. In: Canty, S.M. et al. (eds.), Proceedings of the 2006 National Fusarium Head Blight Forum, Research Triangle Park, NC: 104-108.

Reports:

Lee Siler, Jessica Hamel, Rick Ward, and Guo-Liang Jiang, 2006. Michigan State Wheat Variety Trial: 2006. Michigan State Univeresity, East Lansing, MI

Germplasm Registered:

Jiang, Guo-Liang, Dechong Huang, Qiuquan Shen, Zhanlin Yang, Weizhong Lu, Jianrong Shi, Han Zhu, Zhaoxia Chen, and Richard Ward. 2006. Registration of wheat germplasms CJ W14 and CJ 9306 highly resistant to Fusarium head blight. Crop Science, 46: 2326-2328.

Jiang, Guo-Liang, Zhaoxia Chen, Yong Xu, Zhanlin Yang, Qiuquan Shen, Weizhong Lu, and Richard Ward. 2006. Registration of FHB-resistant and high-yielding wheat germplasms CJ 9403 and CJ 9815. Crop Science, 46: 2724-2726.