USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY07 Final Performance Report (approx. May 07 – April 08)
July 15, 2008

Cover Page

PI:	Clay Sneller
Institution:	Ohio State University
Address:	Department of Horticulture and Crop Science OARDC 1680 Madison Ave Wooster, OH 44691
E-mail:	sneller.5@osu.edu
Phone:	330-263-3843
Fax:	330-263-3841
Fiscal Year:	2007
USDA-ARS Agreement ID:	59-0790-4-101
USDA-ARS Agreement Title:	Uniform Nursery for SRWW and Development Scab Resistance Varieties for Ohio.
FY07 ARS Award Amount:	$ 88,608

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
HGG	Sources of Variation for DON Concentration in Moderately Resistant SRWW.	$21,229
VDUN	Uniform Nursery for SRWW and Development Scab Resistance Varieties for Ohio.	$ 67,379
	Total Award Amount	**$ 88,608**

_____

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
IIR – Integrated/Interdisciplinary Research
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

Project 1: *Sources of Variation for DON Concentration in Moderately Resistant SRWW.*

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

Many lines with moderate resistance to FHB infection and/or spread still have high levels of DON. For some time researchers have speculated that there may be separate mechanisms of FHB resistance involving resistance to DON accumulation from either host degradation of DON or host inhibition of DON production. Thus a line with low FHB symptoms may still have high DON if is lacks these mechanisms.

This has been a very difficult question to research as DON levels are often confounded with other FHB symptoms. No one has conducted a controlled study where FHB infection levels were controlled across many genotypes, degree of infection was assayed, and don data collected. We are conducting such a study to see if the amount of DON accumulate with increasing infection varies among SRWW genotypes.

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:

We assayed heads from 80 SRWW cultivars. From each genotype we collected 15 heads with 0,1,2, or 3 infected spikelets (i.e. four sample per genotype, each with varying levels of infection based on visual symptoms). Each sample (80 x 4 =320 total) was assayed separately for DON and for degree of infection by using RT-PCR for *Fusarium graminearum* (Fg) and wheat specific primers. For the 4 samples from each genotype we regressed DON on Fg to assess the rate at which they accumulated DON with increasing infection.

While we did not have replications in 2007, we did note large differences among the slopes of individual genotypes. Some genotype essentially did not increase DON despite increase FHB infection, while others showed dramatic increases in DON. Some genotypes had high DON despite relatively low infection levels.

Impact:

While unreplicated at this time, the data shows that genotypes do vary in the rate of DON accumulation with increasing infection. This provides preliminary evidence that there is genetic variation for 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?:

If repeated and verified, the results will be the first conclusive evidence for resistance to DON accumulation and provided sources for this type of resistance. If this is verified, then research will be needed to understand the mechanisms of this resistance (ie, host degradation of DON, or host inhibition of DON production), identify other sources, and improved methods to screen for this trait.

Project 2: *Uniform Nursery for SRWW and Development Scab Resistance Varieties for Ohio.*

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

Planting varieties that are susceptible to FHB greatly increases the risk of yield loss and producing grain with excessive levels of DON. Host resistance is a primary mechanism for mitigating this risk. But increasing FHN resistance by itself is not enough as growers will not plant a variety that has other notable weaknesses such as moderate yield. FHB resistance must be combined with high yield, acceptable quality, and other traits. Our program aims to combine FHB resistance with other traits to produce SRWW varieties that are acceptable to Ohio growers. We use traditional breeding techniques supplemented with marker-assisted selection to accomplish the goal.

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:

1. We screened 700 breeding lines from the OSU program, 160 lines from other programs, and 250 lines related to genetic studies. Of the OSU breeding lines, 57% had an FHB index < than the index of Freedom and 20% had an index < than that of Truman.
2. We screened 175 families from a cross of an FHB resistant line from CIMMYT crossed to a moderately susceptible SRWW. Significant segregation was noted with several lines having Truman-like resistance. We developed a mapping population from the families for further phenotyping in 2008.
3. We used MAS to continuing BCing multiple QTL into 27 different genetic backgrounds. Of these 21 were advanced to the BC1F1 by the end of the grant, 3 to t he BC3F1 and 3 to the BC3F2 generation. We also used MAS for F1 enrichment of F1 from three-way crosses where the new BC derivatives were used as parents.
4. We coordinated the PNUWWSN and NUWWSN. For the 2007 nurseries this involved gathering and analyzing data from 13 cooperators on evaluation of 104 SRWW lines and checks. The seed of 120 lines for the 2008 test were distributed to 16 cooperators in three countries.

Impact:

1. Through the screening we identified many SRWW with at least moderate resistance to FHB. We released three of these based on their FHB resistance and overall performance. One of these, Malaabr (OH02-7217) has Truman-like resistance, while Bromfield (OH02-12678) and OH02-13567 (branded) have Freedom-like resistance.
2. The segregation and the resistance of the progeny of the CIMMYT/SRWW cross indicates that the CIMMYT line is contributing genes for resistance and we postulate these are novel to SRWW.
3. The sizable BCing effort will develop a broad base of SRWW with known genes for FHB resistance. All the RP have been selected to have acceptable; agronomic value

based on current tests as well as moderate FHB resistance. By adding new FHB QTL to these genetic backgrounds we hope to attain strong FHB resistance in argonomically useful backgrounds.

4. The successful execution of the uniform FHB nurseries ensures reliable FHB ratings of germplasm from 13 public and private breeding programs.

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 release of Malabar, Bromfield, and OH02-13567 provide Ohio growers high yield varieties with good FHB resistance. This expands their options tremendously, especially access to a variety with Malabar with Truman-like resistance and excellent yield potential for Ohio.

Attaining acceptable FHB resistance requires pyramiding several novel FHB resistance alleles. The CIMMYT line may have some novel QTL, especially from the D genome and this would provide breeders the ability to make and test more gene combinations than in the past.

Few agronomically competitive SRWW lines have major FHB QTL and this makes breeding difficult as we do not know what genes our resistant parents have and often must use agronomically unfit parents as sources of these QTL. The collection of breeding lines with FHB QTL that we are generating will significantly improve the agronomic value and diversity of lines with FHB QTL as well as potentially lead directly to release of an improved cultivar.

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.

Sneller, C, P. Paul, L. Herald, B. Sugerman, and A. Johnston. 2007. Report on the 2006-07 Northern Uniform Winter Wheat Nurseries. in Proceeding of the 2007 National Fusarium Head Blight (NFHB) Forum, Kansas City, MO, 12/2-4/2007, pages 237-242.

Sneller, C.H, P. Paul, and M. Guttieri. 2008. Prevalence of resistance to Fusarium Head Blight in Eastern US sort red winter wheat. Submitted to Crop Sci.