USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
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Cover Page

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Fiscal Year:	2008
USDA-ARS Agreement ID:	59-0790-4-130
USDA-ARS Agreement Title:	Winter Wheat Breeding for Scab Resistance in South Dakota.
FY08 USDA-ARS Award Amount:	$ 51,718

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
HWW-CP	Winter Wheat Breeding for Scab Resistance in South Dakota.	$51,718
	Total Award Amount	**$ 51,718**

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Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
BAR-CP – Barley Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Winter Wheat Breeding for Scab Resistance in South Dakota.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   In 2005 there was a FHB epidemic in South Dakota, and winter wheat losses for that year are estimated to be approximately $20 million. To eliminate or reduce such losses, we are attempting to resolve this problem and limit the risk of scab by developing FHB resistant hard red and white winter wheat varieties for South Dakota and the surrounding region. This is being accomplished by inter-mating winter wheat parents expressing unidentified native and known sources of resistance and selecting for low levels of FHB damage in inoculated and naturally infected breeding nurseries. When appropriate and feasible, phenotypic selection is augmented and genotypic selection is aided by the use of molecular markers closely linked to host plant resistance genes. Additional and more basic research goals related to breeding for FHB resistant varieties included 1) examining the relationship between winter and spring habit and the association of growth habit with FHB resistance, 2) determining the relative contribution of specific and general combining ability to the FHB resistance expressed by three adapted wheat parents, and 3) identifying trait loci for two new sources of FHB resistance.

2. **List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):**

   Accomplishment:

   An important accomplishment was the release of Lyman hard red winter wheat. Prior to its release in August 2008, it tested as one of most scab resistant winter wheat releases available in the entire region. For example, it was rated 4th lowest for FHB Disease Index in the 2004 NRPN and 2nd lowest for FHB Disease Index in the 2006 Tri-state FHB Nursery (KS, NE, SD). The line which became Lyman also tested as the line with the lowest index in the 2009 Kansas FHB Nursery.

   Impact:

   In the next several years, we expect Lyman to be grown on a significant number of acres in SD and throughout the region. Therefore, as perhaps the most resistant winter wheat to FHB, it is expected to have a significant impact on reducing losses due to FHB and on reducing mycotoxins in the harvested grain. Not only does Lyman exhibit excellent resistance to FHB, but it exhibits superior resistance to leaf diseases compared with other regional winter wheat varieties. It is expected to be listed on ScabSmart as one of the regional varieties with a higher level of resistance to FHB. Hence, when combined with recommended management practices, it should be utilized to minimize the grower's risk of experiencing significant losses in winter wheat due to FHB.

Accomplishment:

Three wheat populations were successfully developed by hybridizing winter with spring types -ND2710(S) x 2137 (W); ND2710(S) x Bacup(S); Nekota(W) x ND2710(S) - to determine the level of association between growth habit and FHB resistance. A chromosome 3BS QTL was detected in a lower frequency in spring growth habit backgrounds; whereas, a chromosome 5A QTL was detected in a lower frequency in winter growth habit backgrounds.

Impact:

Results may be utilized by breeders to determine the most beneficial molecular marker to use in selecting for resistance to FHB in winter or spring growth habit wheats.

Accomplishment:

A diallel crossing procedure was used to determine the impact of specific and general combining ability on the expression of resistance to FHB. To produce the diallel, FHB susceptible parents Nekota, 2139, and Harding were successfully hybridized to resistant parents Ning7840, ND2710, and BacUp. Moderate narrow-sense heritability and moderate combining ability ratios confirmed the importance of additive gene effects for resistance to FHB, and transgressive segregants were identified from crosses involving ND2710 and BacUp.

Impact:

Identification of the importance of additive gene effects in the expression of FHB resistance demonstrates that significant progress can be made in selecting for resistance utilizing traditional breeding methods; whereas, the existance of transgressive segregants suggests lines with higher levels of resistance can be identified among progeny resulting from crosses between parents expressing lower levels of resistance to FHB. Breeders are expected to use this information to improve their breeding and selection for more resistant varieties.

Accomplishment:

Two populations were successfully produced by hybridizing Jagalene with SD97060 and Tokai 66. Breeding line SD97060 expresses a native source of resistance to FHB, and Tokai66 expresses a source of resistance originating from Japanese germplasm. FHB resistance genes for reduced severity were identified on chromosomes 3Bs and 5B of Tokai 66, and a FHB resistance gene on chromosome 2BL was identified as the native source in SD97060.

Impact:

The native source of resistance to FHB expressed by SD97060 is expected to be combined with other sources to enhance varietal resistance in the South Dakota Winter Wheat Breeding Program. A better understanding of the nature of the resistance genes expressed by Tokai 66 is expected to help breeders determine how best to utilize this source to augment or complement other sources of resistance in regionally adapted hard winter wheat varieties.

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.

Malla, S., A.M.H. Ibrahim, and W. Berzonsky. 2008. Mapping QTLs for Fusarium Head Blight from novel source - Tokai-66. *In* Proc. National FHB Forum, Indianapolis.

Malla, S., A.M.H. Ibrahim, and W. Berzonsky. 2008. Mapping QTLs for Fusarium Head Blight from South Dakota's indigenous genotype - SD97060. *In* Proc. National FHB Forum, Indianapolis.

Malla, S., A.M.H. Ibrahim, and W. Berzonsky. 2008. Inheritance of FHB Resistance in spring versus winter wheat growth habit backgrounds. *In* Proc. National FHB Forum, Indianapolis.

If your FY08 USDA-ARS Grant contained a VDHR-related project, include below a list all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance. If this is not applicable (i.e. no VDHR-related project) to your FY08 grant, please insert 'Not Applicable' below.

The South Dakota Agricultural Experiment Station announces the release of a new hard red winter wheat (*Triticum aestivum* L.) cultivar to certified growers. Tested as SD00111 in the 2004 Northern Regional Performance Nursery, the cultivar will be named 'Lyman'. Lyman was developed from an initial cross made in 1998, and it has the pedigree KS93U134/Arapahoe. In 2000, a line designated as SD00111 was one of twenty lines advanced to an early yield trial nursery, and in 2004, SD00111-9 was a reselection from among 12 lines which were entered into an early yield trial nursery. In 2005, the line designated SD00111-9 was tested in a preliminary yield trial and it was subsequently tested in a 2006 advanced yield trial as well as a commercial performance trial at locations around the state of South Dakota in 2007 and 2008. Lyman has excellent disease resistance, including leaf rust, and is postulated to have *Lr24* and *Lr16* host resistance genes, a combination that provides good resistance to prevalent leaf rust races in the Great Plains. Lyman has been identified as having the 1AL.1RS chromosome translocation, which likely contributes to its generally excellent resistance to stem rust. In regional performance trials, Lyman exhibited superior resistance to Fusarium head blight; however, it has a tendency to lodge under high moisture conditions, similar to Arapahoe. Lyman has excellent milling and acceptable baking quality attributes. It is targeted as a replacement for both Arapahoe and Harding, and it is complementary to Millennium and Overland in its genetic performance. Lyman is similar to Arapahoe in maturity (medium), height (medium) and in winter hardiness. Lyman will have a 30-cents-per-bushel royalty assessed on all Certified Seed sold. It will also have three classes of seed; Foundation, Registered and Certified, and an application will be made for Plant Variety Protection.