PROGRESS REPORT

PROJECT NO: BJKW66

TITLE: Pest status and IPM adoption surveys

PERSONNEL: Edward John Bechinski, Extension IPM Coordinator

ADDRESS: Department of Plant, Soil and Entomological Sciences, University of Idaho, PO Box 442339, Moscow, ID 83844-2339, 208.885-5972, edb@uidaho.edu

DURATION: 1-year

ACCOMPLISHMENTS:
Survey operations currently are in progress under my direction rather than through the UI Social Science Research Unit as originally planned. I will report results received to-date at the 16 February 2011 meeting of the Idaho Wheat Barley Commission in Boise and will forward the Final Report during May 2011.

PROJECTIONS:
Surveys will contribute to planning a coordinated program of pest management research, training and grower decision-support that responds to specific regional needs of Idaho grain producers. IPM adoption among grain growers will be enhanced.

PUBLICATIONS:
None to date; I plan to report grower perceptions of pest status and use of pest management methods as follows:
(1) formal written report to Idaho Wheat Commission, Idaho Barley Commission, and University of Idaho Cereal Team;
(2) informal (popular) articles in grower trade magazine and newspapers that describes the extent to which Idaho grain producers use IPM and how IPM directly benefits the consumer, the farmer and the environment; oral reports to wheat and barley producers at UI Extension Winter Crop Schools;
(3) on-line summary report posted to the University of Idaho Pest Management Center;
(4) oral and poster presentations for peer-colleagues at two professional meetings;

PROJECT NO: BJKW67, BJKW68

PERSONNEL: J. Chen, J. Marshall, J. Wheeler, W. Zhao

TITLE: Marker-assisted breeding of fusarium head blight resistance in wheat

ADDRESS: J. Chen, University of Idaho Aberdeen Research & Extension Center, Aberdeen, ID 83210; 208-397-4162, ext. 229; jchen@uidaoho.edu

JUSTIFICATION: FHB is one of the most destructive diseases of wheat and causes significant reductions in grain yield and quality in the world. The development and deployment of resistant germplasm is an environmentally sustainable method for the control of FHB. Scab epidemics occurred in sprinkler-irrigated wheat and barley fields in south central and eastern Idaho in 1982 and 1984, resulting in estimated yield losses as high as 50% (Michuta-Grimm and Foster, 1989). Scab epidemics in spring wheat occurred in sprinkler-irrigated wheat and barley fields in Montana in 2006 and 07 and resulted in estimated yield losses over 50% (Luther Talbert, personal communication). Scab infection was high (10 to 50%) in some adapted cultivars such as winter wheat Brundage and Coda in wheat fields in Aberdeen in 2009. *F. culmorum* was the predominant *Fusarium* species causing FHB and crown and foot rot of wheat and barley in Southern Idaho and Europe (Michuta-Grimm and Foster, 1989). Both *F. culmorum* and *F. graminearum* produce trichothecene mycotoxins like deoxynivalenol (DON) that pose a significant public health hazard (Pestka and Smolinski, 2005). Traditionally, Idaho has good environmental conditions to produce high quality, toxin free wheat grain that meets the needs of many end-products. With the increase in corn production (for dairy and biofuel), no-till or conservation tillage, and the substantial barley production in the area, it would be beneficial to have an active FHB resistance program to insure that future cultivars carry some resistance if corn production, especially under no-till, continues to increase in acreage in the south central and south eastern part of the state. Changing production practices and increasing temperatures in the PNW, as predicted by climate models (http://www.metoffice.gov.uk/research/hadleycentre/), may increase the risk of FHB. Incorporation of resistance into existing germplasm may prevent or reduce future losses.

HYPOTHESIS & OBJECTIVES: FHB resistance of wheat genotypes can be identified in a disease epidemic condition, warm and humid (85%) conditions for three to five consecutive days. FHB resistance can also be improved by selecting genetic recombination of desired genes. Both processes can be accelerated by using molecular marker-assisted selection. The ultimate objective of this proposal is to develop desirable wheat cultivars with value-added FHB resistance. The specific objectives for 2012 include: 1) Optimize greenhouse and field screening methods to evaluate and characterize type II resistance (resistance to disease spread), field resistance (type I and II), and DON resistance (resistance to mycotoxin accumulation) in ID and PNW cultivars, and 2) Evaluate and characterize type II and DON resistance in segregating populations and breeding lines via molecular markers.

PROCEDURES: FHB is a new wheat disease in Idaho. Evaluation of FHB resistance can be difficult using phenotypic evaluation as the disease nursery cannot be set up in field in Aberdeen. Therefore, we initiated a project and evaluated 276 Idaho and PNW historical lines via marker-

assisted selection in 2008 in collaboration with Western USDA genotyping center. Based on the preliminary evaluation, we found that quite a few lines have known FHB resistance QTL, such as FHB1. In order to know if those lines with FHB1 have functional gene against FHB infection and colonization, we initiated multi-state collaborations and conducted phenotypic evaluation for spring wheat genotypes in the disease nurseries at University of Minnesota in 2008 and in Bozeman at Montana State University in 2009, and for winter wheat at Virginia Tech in 2009 and 2010. Field resistance of those lines inoculated by *F. graminearum* aligned well with their QTL/marker haplotypes in most cases. In 2010, with the support from IWC, we modified our greenhouse; installed two misting benches; and conducted one screening of 50 spring wheat cultivars and advanced lines. We also developed a field screening method and evaluated all elite lines (200) in both spring and winter wheat. In the current proposal, we are going to optimize the GH screening and newly-developed field screening methods; to conduct the second GH screening of the 50 spring wheat lines; to deploy MAS for pyramiding FHB resistance with high protein content, H25/H3, and HTAP resistance in 1768 F3 lines.

DURATION: 2010 – 2012

Expected Objectives for 2011:

- Conduct the second GH screening for the 50 spring wheat lines
- Validate the newly-developed field inoculation method in Aberdeen
- Pyramid FHB resistance with H3 and H25, high protein content, and Yr36 via MAS

COOPERATION: Robert Zemetra, Katherine O'Brien, N. Bosque-Perez, University of Idaho
D. See, Wheat Genotyping Center, WSU

ANTICIPATED BENEFIT/EXPECTED OUTCOMES/INFORMATION TRANSFER

This project firstly identified FHB resistance QTL in adapted varieties and cultivars grown in PNW wheat production areas. These varieties and cultivars will be the primary resources to help growers to fight FHB when it occurs. Establishing a greenhouse screening nursery and use of MAS are critical and will identify and develop more adapted lines with resistance to FHB.

LITERATURE REVIEW

Three components of FHB resistance have generally been accepted and included type I, type II and type III (Somers et al., 2003). Type II resistance is the major type of resistance and has been studied most extensively. Type II resistance is usually assessed as FHB severity or Area Under the Disease Progress Curve (AUDPC) using single-floret inoculation methods conducted in greenhouse and/or in field experiments. Type I resistance is usually assessed as FHB incidence using spray-inoculation methods generally conducted in field experiments and occasionally in greenhouse studies. Type III resistance is usually assessed as DON content of grains from naturally infected field trials or single-floret and spray-inoculated experiments conducted in both the greenhouse and field. Highly significant correlations were reported between FHB incidence, severity, and DON content using the same inoculation method and under same environment (Chen et al., 2000; Miedaner et al., 2004; Mesterhazy et al., 2005). Phenotypic selection on the basis of reduced FHB symptoms should result in a correlated selection response for low fungal biomass and low DON content in the grain (Miedaner et al., 2004). However, poor correlations

often have been observed between FHB severity evaluated in greenhouse versus field experiments (Chen et al., 2005), and between FHB incidence, severity, and DON using different inoculation methods and/or experiments conducted in different years (Somers et al., 2003).
Chinese spring wheat cultivar Sumai 3 and its derivatives are important sources of FHB resistance that have already been widely deployed in breeding programs worldwide. Great progress has been made with the release of a number of adapted lines containing the Sumai 3 resistance (WWW.scabusa.org). Upon mapping of Sumai 3 and its derived lines, QTL on chromosomes 2D, 3A, 3B, 5A, and 6B have been confirmed in two or more mapping populations and used in MAS of FHB resistance (Chen et al., 2008). However, due to the historically low incidence of FHB in the PNW region, a comprehensive assessment of resistance in PNW wheat has not yet been done.

Chen, J., C.A. Griffey, Sh. Chao, and G. Brown-Guedira. 2008. Validation of Six QTL Associated with Fusarium Head Blight Resistance in Adapted Soft Red Winter Wheat. 2008 International Plant and Animal Genome XVI Conference, Town & Country Convention Center, San Diego, California, Jan. 12-16, 2008.

Chen, J., C.A. Griffey, T.H. Pridgen, and M. Chappell. 2000. Assessment and rational utilization of scab resistance sources in the Virginia Wheat Breeding Program. *P.*10-17. *In*: Proceedings of the International Symposium on Wheat Improvement for Scab Resistance, Suzhou and NanJing, China, 5-11 May 2000. Edited by J. Raupp, Z. Ma, P. Chen, D. Liu. Kansas State Printing, Manhattan, Kansas.

Mesterhazy, A., T. Bartok, G. Kaszonyi, M. Varga, B. Toth, and J. Varga. 2005. Common resistance to different Fusarium spp. Causing Fusarium head blight in wheat. European Journal of Plant Pathology 112: 267-281.

Miedaner, T., N. Heinrich, B. Schneider, G. Oettler, S. Rohde, and F. Rabenstein. 2004. Estimation of deoxynivalenol (DON) content by symptom rating and exoantigen content for resistance selection in wheat and triticale. Euphytica 139: 123-132.

Mihuta-Grimm, L. and R. L. Forster. 1989. Scab of wheat and barley in Southern Idaho and evaluation of seed treatments for Eradication of *Fusarium* spp. Plant Disease 73: 769-771.

Pestka, J. and A. T. Smolinski. 2005. Deoxynivalenol: toxicology and potential effects on humans. Journal of Toxicology and Environmental Health-part B-Critical Review 8: 39-69.

Somers, D.J., G. Fedak, and M. Savard. 2003. Molecular mapping of novel genes controlling Fusarium head blight resistance and deoxynivalenol accumulation in spring wheat. Genome 46: 555-564.

COMMODITY COMMISSION BUDGET FORM
BJKW67, BJKW68

Allocated by	Idaho Wheat Commission	during FY 2010		$ -
Allocated by	Idaho Wheat Commission	during FY 2011		$ 16,066

REQUESTED FY 2012 SUPPORT:

	Salary	Temporary Help	Fringe	Travel	OE	CO	Grad Fees	TOTALS
Idaho Wheat Commission	$ -	$ 8,320	$ 2,746	$ -	$ 8,000	$ -	$ -	$ 19,066

OTHER RESOURCES (not considered cost sharing or match):

a) Industry	$ -
b) UI (salaries, operating)	$ -
c) Other (local, state)	$ -
d)	$ -
e)	$ -
TOTAL OTHER RESOURCES	$ -

TOTAL PROJECT ESTIMATE FOR FY 2012:	$ 19,066 *(Requested)*	$ - *(Other)*	$ 19,066 *(Total)*

BREAKDOWN FOR MULTIPLE SUB-BUDGETS:

	(Chen)	*(Marshall)*	*(PI name)*	*(PI name)*
Salary	$ -	$ -	$ -	$ -
Temporary Help	$ -	$ 8,320	$ -	$ -
Fringe Benefits	$ -	$ 2,746	$ -	$ -
Travel	$ -	$ -	$ -	$ -
Operating Expenses	$ 8,000	$ -	$ -	$ -
Capital Outlay	$ -	$ -	$ -	$ -
Graduate Student Fees	$ -	$ -	$ -	$ -
TOTALS	$ 8,000	$ 11,066	$ -	$ -

Total Sub-budgets $ 19,066

11.3.2010 - Version

* For a currently employed IH with B.S. degree and experience on FHB research

** For greenhouse fee $3536, $2/Sq feet for 1768 Sq feet; $4,464 for purchasing chemical for inoculum production and MAS.

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CURRENT AND PENDING SUPPORT Form:

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Name: Jianli Chen

NAME (List PI/PD #1 First)	SUPPORTING AGENCY AND AGENCY NUMBER	TOTAL $ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITT-ED	TITLE OF PROJECT
	Current/Active :				
J. Chen	IWC	$97,027	7/01/10 – 6/30/11	30	Developing wheat cultivars for Idaho and world markets
J. Chen and J. Windes	IWC	$37,131 ($26,066)	7/01/10 – 6/30/11	5	Genomics-Accelerated Breeding for Abiotic Stress Resistance in Wheat
J. Chen and J. Windes	IWC	$16,066 ($5,000)	7/01/10 – 6/30/11	2	Marker-assisted breeding of fusarium head blight resistance in wheat
J. Chen	BASF	$10,000	1/01/10 – 12/31/10	3	Development of Imazamox resistant wheat cultivars
J. Chen	Arcadia	$5,000	4/15/10 – 10/31/10	1	Field evaluation of nitrogen use efficiency in spring wheat
J. Chen	USDA-ARS	$75,000	9/01/10 – 6/30/15	5	Phenotyping of NSGC via SCA
R. Zemetra, J. Chen, & D. Hole	NNF, NIFA-AFRI	$258,000 ($80,000)	01/01/11 – 12/31/14	5	Developing the Next Generation of Neoclasical Plant Breeders
J. Chen	USDA-ARS	$246,625	02/01/11 – 12/31/15	10	Phenotyping of NSGC via SCA under T-CAP
Dubcovsky, Chen et al.	T-CAP	$25M ($510,495)	02/01/11 – 12/31/15	15	Improving barley and wheat germplasm for changing environments

	Pending:				
J. Chen and J. Marshall	IWC	$19,066	7/01/11 – 6/30/12	2	Marker-assisted breeding of fusarium head blight resistance in wheat
J. Chen	IWC	$137,227	7/01/11 – 6/30/12	30	Developing wheat cultivars for Idaho and world markets
J. Chen and J. Marshall	IWC	$41,566	7/01/11 - 6/30/12	5	Protecting Idaho and PNW Wheat and Dwarf Bunt Resistance Development

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CURRENT AND PENDING SUPPORT Form:

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Name: Juliet Marshall

NAME (List PI/PD #1 First)	SUPPORTING AGENCY AND AGENCY NUMBER	TOTAL $ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITT-ED	TITLE OF PROJECT
	Current/Active:				
Windes, J.M., Brown, B., Finkelnburg, D. and Zemetra, R.	Idaho Wheat Commission	$25,052	7/1/10 – 6/30/11	10	Extension Wheat Nurseries
Windes, J.M., Brown, B., Finkelnburg, D. and Zemetra, R.	Idaho Barley Commission	$10,810	7/1/10 – 6/30/11	10	Education for Barley Production / Extension Nurseries
Windes, J.M. and Patterson, P.	Idaho Wheat Commission	$9,746	7/1/10 – 6/30/11	5	Production Systems and Wheat Varieties for Dryland Grain
Windes, J.M.	USDA-ARS SCA	$30,158	10/1/10 – 9/30/11	25	Management of Wheat and Barley Root Pathogens in Idaho
Windes, J.M. and Blake, T.	USDA-CSREES	$514,000	10/1/10 – 6/30/11	15	Barley for Rural Development
Windes, J.M.	Bayer CropSciences, BASF, Syngenta, etc.	$58,100	8/1/10 - 7/31/11	5	Seed Treatment / Specialty Trials / Product Evaluation
Chen, J., **Windes, J.M.**, Wheeler, Zhao, W.	Idaho Wheat Commission	$11,066	7/1/09- 6/30/11	2	Marker-assisted breeding of Fusarium head blight resistance in wheat
Windes, J.M.	Idaho State Funding	$17,847	7/1/10 – 6/30/11	10	Barley Enhancement

Menalled, F., Dyer, A., Weaver, D., Smith, R., Woods, D., Eriksmoen, E., Alvarez, J.M., **Windes, J.**	CAR	$425,880 ($15,000)	10/1/10 to 9/30/11	10	R&E on the Integrated Management of Wheat Stem Sawfly, Fusarium Crown Rot, and Grassy Weeds in the Northern Great Plains
	Pending:				
Marshall, J.M. and Blake, T.	USDA-NIFA	$547,000	10/1/11 – 9/31/12	30	Barley for Rural Development
Marshall, J.M., Brown, B., Finkelnburg, D. and Zemetra, R.	Idaho Wheat Commission	$25,052	7/1/11 – 6/30/12	10	Extension Wheat Nurseries
Marshall, J.M., Brown, B., Finkelnburg, D. and Zemetra, R.	Idaho Barley Commission	$10,810	7/1/11 – 6/30/12	10	Education for Barley Production / Extension Nurseries
Marshall, J.M. and Patterson, P.	Idaho Wheat Commission	$9,746	7/1/11 – 6/30/12	5	Production Systems and Wheat Varieties for Dryland Grain
Chen, J., **J.M. Marshall,** J. Wheeler, W. Zhao	Idaho Wheat Commission	$19,066	7/1/11 – 6/30/12	2	Marker-Assisted Breeding of Fusarium Head Blight Resistance in Wheat

INTERNAL PEER REVIEW VERIFICATION

Commodity commissions/organizations require internal peer review by colleagues familiar with the subject matter. This proposal has been peer reviewed by the following individuals:

Reviewer 1: Blair Goates (Type/Print name) Blair Goates (Signature) 12/16/10 (Date)

Reviewer 2: Katherine O'Brien (Type/Print name) Katherine O'Brien (Signature) 12-16-10 (Date)

Dept. Head/ Unit Administrator James B. Johnson (Type/Print name) James B Johnson (Signature) 1 Jan. 2011 (Date)