PROJECT NO: BJKX26

TITLE: Developing Soft White Winter Wheat for Idaho

PERSONNEL: Paul McDaniel, PSES Department Head (208-885-7012)
Collaborator: Jean-Bruno Beaufume, Limagrain Cereal Seeds (LCS)

ADDRESS: PSES Department, University of Idaho, 875 Perimeter Drive, MS 2339, Moscow, ID 83844-2339; paulm@uidaho.edu

JUSTIFICATION:
Soft white winter wheat is one of the major agricultural commodities in Idaho. To maintain producer profitability, new soft white winter wheat cultivars need to be produced that reduce input costs and increase return to producers through increased yield. Input costs can be reduced by incorporating resistance/tolerance to abiotic stresses like low winter temperatures or drought and biotic stresses such as diseases and insects. Increased return to the producers can be achieved by increasing yield and increasing demand for Idaho wheat through incorporation of superior end-use quality. To achieve these objectives, the breeding project will use a collaborative approach utilizing an "*Innovative Partnership*" with Limagrain Cereal Seeds (LCS) and individuals from various disciplines incorporating both conventional breeding and newer plant molecular techniques. In the third year of the Innovative Partnership, F_1 populations from 293 new parent cross combinations are currently being increased in the glasshouse. Progeny from 855 F_2 and F_3 crosses were planted in field trials, along with 15,000 head-row selections, and 1,012 advanced selections (F_5^+). Foundation seed was planted of (03-29902A), and Breeders seed planted from three advanced breeding lines (01-10704A, 02-088706A, and 02-29001A). Pre-breeders seed was planted for 04-00405A and three possible 2-gene IMI tolerant lines. The Scientific Aide support position was filled (Bradley Pakish), however, a Research Support Scientist position still needs to be filled early in 2014.

HYPOTHESIS & OBJECTIVES:
The primary hypothesis of this research is that the recombination of desired genotypes (genes) followed by multi-year, multi-site evaluation in the field and the laboratory will lead to the development of new cultivars of soft white winter wheat with increased yield, improved agronomic characteristics and superior end-use quality, that can be produced with reduced grower input costs. The following objectives relate to the identification, recombination, selection, and evaluation of genes, genotypes and breeding lines with the desired characteristics/traits.

1) Develop new soft white winter wheat cultivars with increased yield, improved agronomic traits, abiotic resistance/tolerance, disease resistance, and end-use quality.
2) Improve the level of disease resistance in the soft white winter wheat program's germplasm for Pseudocercosporella foot rot and Cephalosporium stripe.
3) Develop and evaluate lines with herbicide resistance to be used as a tool to control grassy weeds in wheat.

PROCEDURES:

Breeding Improved Soft White Winter Wheat Cultivars: Research will be conducted in the field, greenhouse, and laboratory. Primary research emphasis will be on cultivar development. New sources of germplasm will be evaluated for traits of interest from programs in the Pacific Northwest and around the world (LCS). Crosses between desired genotypes will be made in the greenhouse. F_1 seed from select crosses can be moved into LCS's double haploid program. Top-crossing and backcrossing will be utilized to transfer specific genes of interest from non-adapted germplasm into Pacific Northwest germplasm. Genotypic screening of top cross and backcross lines will be conducted using molecular markers associated with the trait to insure lines being advanced carry the genes of interest. Early generation material (F_2 – F_3) will be evaluated in the field for disease resistance, agronomic traits, and seed quality. F_4 head-row selections will be evaluated in Washington managed by LCS, in addition to being evaluated in Moscow. Intermediate generation material (F_5 - F_6) will be evaluated for the same adaptation traits yield, test weight, milling quality, starch quality, starch color, noodle color, and baking quality. F_5 lines will be evaluated in Moscow by the UI and at one site in Washington by LCS. F_6 lines will be evaluated at four locations in Idaho by the UI and two locations in Washington by LCS. Lines selected in the F_5 and F_6 generations will also be evaluated for resistance to stripe rust, Pseudocercosporella foot rot and Cephalosporium stripe using a combination of molecular markers and in inoculated nurseries. Lines selected for advancement from the F_5 to F_6 generation will be screened for falling number to identify lines with high and or low falling number scores. Advanced generation material (F_7 -F_8) will be evaluated for stability of these traits across six dryland locations in northern Idaho, five dryland locations in Washington and Oregon, two irrigated locations in southern Idaho, and four irrigated locations in Washington. The southern Idaho locations will be grown in Aberdeen, managed by J. Chen, and in Kimberly managed by J. Marshall. The locations in Washington and Oregon will be managed by LCS. Stripe rust resistance evaluation will be done on the advanced generation material in cooperation with X. Chen, USDA-ARS. In cooperation with K. O'Brien, F_5 and advanced generation lines will be tested for domestic and foreign end-use quality. A tri-state cooperative irrigated trial will be grown in Parma and Aberdeen to evaluate lines for superior performance under irrigation. The tri-state irrigated trial is in cooperation with B. Brown's replacement, J. Chen, and public and private breeders in the Pacific Northwest. Breeding lines that are superior in the advanced trials will be entered into the Western Regional White Winter Wheat Nursery. After two years in the regional trial and prior to cultivar release, superior advanced lines are entered in the Idaho extension trials conducted by B. Brown's replacement, J. Marshall and Kurtis Schroder. These lines are also tested at this time in extension trials in Washington, Oregon and in private trials conducted by The McGregor Company and Crop Production Services. Prior to release, elite lines are submitted to the Pacific Northwest Wheat Quality Council for evaluation. Based on yield performance and quality evaluation, elite lines are then released as cultivars for producers in Idaho and the Pacific Northwest.

End-use quality research is in cooperation with K. O'Brien. Grain protein, hardness, milling quality, noodle color, and baking quality of intermediate and advanced lines will be evaluated at the Aberdeen Wheat Quality Laboratory. SRC (solvent retention capacity) testing of intermediate and advanced material will be done in cooperation with K. O'Brien. Stirring number testing will be done on intermediate material to evaluate lines for LMA (late-maturity amylase).

Improving Disease Resistance in Soft White Winter Wheat: Disease resistance research will utilize molecular markers for resistance genes for Pseudocercosporella foot rot. Lines will be tested using an improved molecular marker for the *Pch1* resistance gene developed by a joint UI – OSU - USDA-ARS effort to identify intermediate and advanced lines to select lines with resistance to Pseudocercosporella foot rot.

Field screening for disease response in inoculated (Pseudocercosporella foot rot and Cephalosporium stripe) or naturally infected fields (stripe rust and dwarf bunt) will also continue.

Advanced lines have been submitted to WSU for Pseudocercosporella foot rot and Cephalosporium stripe, and snow mold screening; to the USDA for stripe rust and cold hardiness screening; to OSU for SBMV screening and to LCS for SBMV, LR, SR, YR, cold tolerance, and snow mold screening.

Crossing will continue to combine the best genetic sources for Cephalosporium stripe resistance/tolerant from lines developed at Washington State University, Oregon State University and the University of Idaho to pyramid genes for resistance to this disease.

Development of Herbicide Resistant Soft White Winter Wheat: Development of one gene and two gene imazamox resistant wheat cultivars will be developed with the goal to release adapted herbicide resistant cultivars for use in managing grassy weeds such as jointed goatgrass and downy brome in wheat. Two gene resistance lines for imazamox resistance were tested in fields 2012-2013 and further testing will continue in 2013-2014. Doubled haploid technology is being utilized with the two gene herbicide resistant wheat program to rapidly develop homozygous resistant two gene lines. Research is currently underway to develop a more accurate and efficient method to identify homozygous two gene resistant lines using a Pyromark Q24 sequencer. This work will be completed in collaboration with J. Kuhl.

DURATION: 5 years (2012-2016)

COOPERATION:

Katherine O'Brien	Cereal Chemist	UI-Aberdeen
Craig Morris	Cereal Chemist	USDA-ARS Pullman
Kim Campbell	Wheat Breeder	USDA-ARS
Jianli Chen	Wheat Breeder	UI-Aberdeen
David Hole	Wheat Breeder	Utah State University
Arron Carter	Wheat Breeder	Washington State University
Oscar Riera-Lizarazu	Wheat Geneticist	OSU-Corvallis
Kurtis Schroder	Extension Agronomist	UI-Moscow
Douglas Finkelnburg	Extension Agronomist	UI-Lewiston
Brad Brown's replacement	Extension Agronomist	UI- Parma
Juliet Marshall	Extension Agronomist	UI-Idaho Falls
Stephen Guy	Extension Agronomist	WSU-Pullman
Michael Flowers	Extension Agronomist	OSU-Corvallis
Donn Thill	Weed Science	UI-Moscow
Roy Patten	Farm Manager	UI-Moscow
Xiaming Chen	Mycologist	USDA-ARS Pullman
Chris Mundt	Mycologist	OSU-Corvallis

Tim Murray	Mycologist	Washington State University
Joseph Kuhl	Molecular Biologist	UI-Moscow
Deven See	Molecular Biologist	USDA-ARS Pullman
Alexander Karasev	Virologist	UI-Moscow
Nilsa Bosque-Pérez	Entomologist	UI-Moscow

ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:
The new cultivars and germplasm released by this project will maintain or increase productivity for the wheat producers in Idaho. End-use quality will be improved, increasing the marketability of Idaho wheat, both domestically and internationally. Information on new cultivars will be made available through research publications, extension publications, commodity schools, grower meetings, extension field days and websites.

LITERATURE REVIEW:
The primary purpose of the soft white winter wheat breeding program has been the development of improved soft white winter wheat cultivars for the wheat producers of Idaho that have both improved yield potential and superior end-use quality. Examples of such cultivars are Brundage (Zemetra *et al.*, 1998) and Brundage 96 (Zemetra *et al.*, 2003). The breeding program has also emphasized maintaining and improving resistance to diseases that are problems to producers in the Pacific Northwest, specifically stripe rust, Pseudocercosporella foot rot and Cephalosporium stripe. An example of an Idaho cultivar that was developed with foot rot resistance is 'Simon' soft white winter wheat. Field selection for resistance to foot rot can be difficult but the recent development of a new molecular marker for *Pch1* by a collaborative effort of OSU, UI and USDA-ARS scientists (Leonard *et al.*, 2008) has improved efficiency of selection for strawbreaker foot rot. With Cephalosporium stripe, resistance/tolerance appears more quantitative in nature so development of resistance/tolerance to this disease is being done by crossing the best lines for Cephalosporium stripe resistance/tolerance from the three PNW winter wheat breeding program.

CITATIONS:
Leonard, J., C. Watson, A. Carter, J. Hansen, R. Zemetra, D. Santra, K. Campbell, and O. Riera-Lizarazu. 2008. Identification of a candidate gene for the wheat endopeptidase *Ep-D1* locus and two other STS markers linked to the eyespot resistance gene *Pch1*. *TAG* (116: 261-271.

Zemetra, R.S., M.L. Lauver, K. O'Brien, T. Koehler, E.J. Souza, S.O. Guy, L. Robertson, and B. Brown. 2003. Registration of 'Brundage 96' wheat. *Crop Sci.* 43: 1884.

Zemetra, R.S., E.J. Souza, M. Lauver, J. Windes, S.O. Guy, B. Brown, L. Robertson, and M. Kruk. 1998. Registration of 'Brundage' wheat. *Crop Sci.* 38:1404.

COMMODITY COMMISSION BUDGET FORM

Allocated by	Idaho Wheat Commission	during FY 2013	$ 129,337
Allocated by	Idaho Wheat Commission	during FY 2014*	$ 350,967

REQUESTED FY 2015 SUPPORT:

	Salary	Temporary Help	Fringe	Travel	OE	CO	Grad Fees	TOTALS
Idaho Wheat Commission	$ 42,000	$ 52,263	$ 18,704	$ 15,000	$ 27,000	-	$ -	$ 154,967

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 2015:	$ 154,967 *(Requested)*	$ - *(Other)*	$ 154,967 *(Total)*

BREAKDOWN FOR MULTIPLE SUB-BUDGETS:

	(PI name)	*(PI name)*	*(PI name)*	*(PI name)*
Salary	$ -	$ -	$ -	$ -
Temporary Help	$ -	$ -	$ -	$ -
Fringe Benefits	$ -	$ -	$ -	$ -
Travel	$ -	$ -	$ -	$ -
Operating Expenses	$ -	$ -	$ -	$ -
Capital Outlay	$ -	$ -	$ -	$ -
Graduate Student Fees	$ -	$ -	$ -	$ -
TOTALS	$ -	$ -	$ -	$ -

Total Sub-budgets $ -

*including capital items (Plot Combine)

10.29.2013 - Version

CURRENT AND PENDING SUPPORT Form:

Name: Paul McDaniel

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:				
McDaniel, P.	USDA-Federal Hatch Funds	$11,895	10/1/11-9/30/16	20	Digital Modeling of Podzolization in Volcanic Ash Mantles Along Environmental Gradients in the Inland Northwest Region
	Pending:				
Strawn, D., Chen, J., McDaniel, P., Marshall, J	Idaho Wheat Commission	$73,907	7/01/14-6/30/15	5	Field-based study of factors affecting cadmium uptake by wheat from Idaho soils
McDaniel, P.	Idaho Wheat Commission	$154,967	7/01/14-6/30/14	5	Developing Soft White Winter Wheat for Idaho

****

INTERNAL PEER REVIEW/PRINCIPAL INVESTIGATOR VERIFICATION FORM

****

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: Joseph Kull _____ 1/6/2014
(Type/Print name) (Signature) (Date)

Reviewer 2: Kurtis L. Schroeder _____ 1/7/2014
(Type/Print name) (Signature) (Date)

Dept. Head/ Paul McDaniel _____ 1/7/14
Unit Administrator (Type/Print name) (Signature) (Date)

PROGRESS REPORT

PROJECT NO: BJKX26

TITLE: Developing Soft White Winter Wheat for Idaho

PERSONNEL: Dr. Jack Brown and Dr. Paul McDaniel

ADDRESS: PSES, University of Idaho, Moscow, Idaho 83844-2339
Phone:(208) 885-7078, E-Mail: jbrown@uidaho.edu

ACCOMPLISHMENTS: After considerable time an understanding was made of what was planted in the SWWW breeding program in fall of 2012. This was made more difficult because of the sudden death of Brad Huffman who had worked in the program before joining the Rapeseed, Canola & Mustard Breeding Group. Prior to his passing he was a considerable asset to the UI wheat breeding effort. He is dearly missed by all.

Brad Pakish was appointed as Scientific Aide in the program. However, despite advertising and interviewing candidates we failed to appoint a Research Support Scientist during the reporting period. Four UI undergraduates worked in the wheat breeding program and were trained in many aspects of the annual work routine.

Throughout the summer months plant evaluations were made on all generations of the existing breeding program, including: (1) 237 F_1 progeny from 2012 crosses; (2) 190 F_2 families; (3) 312 F_3 replicated families; (4) 20,000 F_4 head-rows; (5) 930 F_5 lines; (6) 64 F_6 lines grown at three locations; (7) 48 F_7^+ lines grown at 6 locations throughout Idaho. At harvest: selected F_1's, F_2 and F_3 bulks, 10,500 F_3 and F_4 single heads were harvested and processed, and prepared for planted in fall of 2013. In addition 3,050 yield plots were harvested, weighed, test weights recorded. UI and UI/LCS breeding lines also were sub-sampled for quality evaluated (by K. O'Brian's Quality Laboratory), selected, cleaned, treated and packaged for planting in Idaho and Washington.

F_1 seed from 306 new parent cross combinations was produced, 120 joint UI/LCS crosses between UI and LCS parents (coded as 501-520) and 186 crosses between UI and other program parents, and within UI parents (coded as 1-186). These were subsequently planted in the glasshouse and are currently being increased to produce F_2 seed for next year.

In fall of 2013, progeny from 855 F_2 and F_3 crosses were planted in field trials, along with ~10,000 head-row selections, and 1,012 advanced selections (F_5^+). Foundation Seed (planted from Breeders' Seed harvested in 2013) and re-synthesized Breeders' Seed (480 head-row selections) was planted of 03-29902A (nominally to be named 'UI Huffman'). Breeders' Seed was selected and planted from three advanced breeding lines: 01-10704A; 02-08806A; and 02-29001A (360 head-row selections plus 60 replicated head-row bulks for each line). Pre-breeders seed was planted for 04-00405B (640 head-row selections) and three possible 2-gene IMI tolerant lines: 09.DH.10; 09.DH.11; and UI.3-5-7 (240 head-row selections of each line). Varietal performance data is available through state extension programs and private company customer pages.

PROJECTIONS: This funding will allow for development and release of genetically superior UI and joint UI/LCS soft white winter wheat cultivars for Idaho and PNW growers.

PUBLICATIONS: None at time of reporting.