

## **2009-10 Washington Grain Commission Funded Research Project Summaries**

### **End-Use Quality Assessment of Washington State University Wheat Breeding Lines**

Researcher: Byung-kee Baik

*This project intends to increase the competitiveness of Washington wheat in the global market by developing wheat varieties possessing desirable end-use quality characteristics. Each year they carry out end-use quality testing of more than 1000 wheat breeding lines of WSU winter and spring breeding programs based on physical characteristics and chemical composition, milling quality and end-product performance. The data and information generated from this project are essential for developing new wheat varieties possessing superior and consistent quality attributes.*

### **Weed Management in Wheat**

Researcher: Ian Burke

*This project is working to identify improved management strategies for troublesome weeds including Russian thistle, kochia, prickly lettuce, Italian ryegrass, and downy brome in wheat and chemical fallow, through new and expanded herbicide label options, application timings, or increased knowledge of the biology and ecology of the weeds.*

### **Pursuit Carryover and Osprey Tolerance in Winter Wheat**

Researcher: Ian Burke

*This project is working to identify the amount of Pursuit soil residue necessary to cause a yield loss in winter wheat in a legume/winter wheat rotation, and identify susceptible wheat varieties and the environmental conditions that cause Osprey injury to winter wheat.*

### **Evaluation of and Selection for Cold Tolerance in Wheat**

Researcher: Kim Garland Campbell

*The purpose of this project is to assay cereal variety trials and regional nurseries for cold tolerance. In addition, the project will assay breeder samples for cold tolerance. They have completed the initial testing of the WA winter wheat extension trials and the Western Regional Winter Trials. The project is starting to test winter wheat breeder samples (ID, OR, WA, and ARS). The goal is to improve winter survival of winter wheat in the Pacific Northwest.*

### **Development of Winter Wheat Varieties Resistant or Tolerant to Fusarium Crown Rot Resistance**

Researcher: Kim Garland Campbell

*The purpose of this project is to identify breeding lines and cultivars with better performance in fields infected with Fusarium crown rot. Methods to assay Fusarium tolerance in the seedling and adult plant stages have been developed. They are completing screening of two mapping populations that will identify the number and*

*location of genes for Fusarium resistance in the Australian wheat cultivar, Sunco. They are backcrossing several sources of Fusarium resistance into adapted PNW breeding lines and these populations will be screening using the newly developed methods starting in the fall on 2009. The second year of the project they will complete a large survey of Fusarium species present in the PNW. This information will be useful so that they can target breeding efforts to locations where Fusarium is present and to quantify the amount of Fusarium present in fields.*

### **Club Wheat Breeding**

Researcher: Kim Garland Campbell

*The purpose of this project is to develop soft white club wheat cultivars for the PNW with resistance to multiple diseases and end use quality desired by importers. They planted trials in 11 locations in WA, ID and OR. They have abandoned two locations (Lind and Harrington) due to poor stands because of extreme dry conditions at planting but have good stands at all other locations. They are conducting marker assisted selection for resistance to stripe rust, strawbreaker foot rot, preharvest sprouting, barley yellow dwarf resistance, and to Hessian fly. They are completing our early generation evaluation of club end use quality. Two breeding lines, with excellent end use quality, resistance to stripe rust and strawbreaker foot rot and competitive grain yield and test weight, ARS970075-3C (soft white club) and ARS960277L (soft white common) have been approved for preliminary breeder seed increase at Othello in 2009.*

### **Evaluation of Wheat Breeding for Management of Hessian Fly in the PNW**

Researcher: Kim Garland Campbell

*The purpose of this project is to screen the Western Regional Nurseries and advanced breeder nurseries for resistance to Hessian Fly. They are currently subsampling those nurseries and working out evaluation dates. They will screen them this summer. The object of the project is to provide data so that wheat breeders can introgress different sources of resistance to Hessian Fly into their cultivars and to document the extent of Hessian Fly infestation on spring wheat at locations in Idaho and Eastern Washington.*

### **Control of Stripe Rust, Leaf Rust, and Stem Rust of Wheat**

Researcher: Xianming Chen

*The research goal is to prevent major losses in wheat yield and quality caused by stripe rust, leaf rust, and stem rust, and assures stable, sustainable wheat production. They conduct both basic and applied studies to understand how rust epidemics occur and develop integrated strategies to control the diseases. Their specific studies include monitoring disease development and rust race changes; developing forecasting models for better predict rust epidemics; identifying new chemicals for use to reduce damage; and more effort on identifying new sources and genes for rust resistance, developing molecular markers for resistance, understanding how resistance works, and supporting breeding programs for developing new cultivars with adequate and durable resistance.*

### **Marker-Assisted Background Selection to Transfer 'CLEARFIELD' Herbicide Resistance and Other Important Traits into Washington Wheat Cultivars**

Researcher: Kulvinder Gill

*The main objective of this project is to transfer two-gene Clearfield technology to all major wheat classes of the PNW. Eltan and Madsen lines containing the two-gene Clearfield have been selected and will be placed in the variety-testing program this year, and the process for Xerpha, Louise, and Chukar is underway. Because of the use of a large number of markers for the background selection, their lines are expected to be a lot more pure compared to similar lines produced by conventional methods.*

### **Marker Assisted Forward Breeding as a New Strategy for Wheat Improvement**

Researcher: Kulvinder Gill

*The main objective of this project is to develop a new method where we not only recover the recurrent parent (the popular variety, i. e. Xerpha) but also improve upon it in addition to transferring value added genes. As an example, they will attempt to improve quality and/or yield of Xerpha in addition to transferring Clearfield genes. In Louise they will attempt to combine adult plant and seedling resistance to stripe rust in addition to transferring the Clearfield genes.*

### **Wheat Doubled-haploid and Transformation Facility at WSU**

Researcher: Kulvinder Gill

*They are in the process of setting up a doubled haploid production facility at WSU. Eventually the DH services will be extended to barley also and wheat transformation will be added to the facility. Currently they are purchasing equipment and are in the process of hiring a lab manager. They expect the lab to be up and running in the next couple months and will be fully functional by the end of summer.*

### **Evaluation of Wheat and Barley Varieties**

Researcher: Stephen Guy

*The WSU Extension Uniform Cereal Variety Testing Program provides growers, the agribusiness industry, university researchers, and other interested clientele with comprehensive, unbiased information on the adaptation and performance of winter and spring wheat and barley cultivars across the climatic regions of eastern Washington. The number of variety trial locations are: 11 for spring barley, 21 for soft white winter wheat, 11 for hard red winter wheat, and 14 for all classes of spring wheat. Results from this program are disseminated by Extension programming to provide unbiased information about variety performance to empower clientele in making economically desirable variety selection decisions.*

### **Improving Spring Wheat Varieties for the Pacific Northwest**

Researcher: Gary Shelton (for Kim Kidwell)

*The project goal is to provide genetic solutions to production problems that plague spring wheat by incorporating genes into varieties that enhance the economic and environmental health of wheat production in Washington State. They accomplish this with the following objectives: 1) Improve agronomic characteristics of spring wheat varieties using conventional breeding strategies; 2) Improve end-use quality of spring*

wheat grain; 3) Develop hard white and spring club varieties to expand production options for WA wheat producers; and 4) Introgress and deploy novel gene(s) for essential traits into adapted germplasm.

### **Precision Breeding (ie. The Application of Biotechnology to Spring Wheat Variety Improvement)**

Researcher: Gary Shelton (for Kim Kidwell)

*The project goal is to use early generation end-use quality assessment, along with protein and DNA marker-assisted selection (MAS) strategies, to identify superior progeny for advancement, ensuring that all experimental breeding lines carry essential disease or insect resistance genes, and have superior end-use quality potential prior to field evaluation. They accomplish this with the following objectives: (1) Assess early generation breeding material for end-use quality; (2) Introgress durable stripe rust resistance genes into adapted germplasm using MAS; (3) Confirm the effectiveness of using biotechnology strategies to improve grain protein content in HR varieties; (4) Introgress novel HF resistance genes in adapted germplasm using biotechnology strategies.*

### **Field Breeding Hard White and Red Winter Wheat**

Researcher: Steve Lyon (for Steve Jones)

*This project is focused on the development of broadly adapted, high yielding hard red and hard white winter wheat varieties with high yield stability, durable disease resistance, rapid emergence, and improved end-use quality.*

### **Field Breeding Soft White Winter Wheat**

Researcher: Steve Lyon (for Steve Jones)

*The focus of this project is the development of improved varieties of soft white winter wheat. They seek to improve the sustainability of wheat production in the state through the use of increased genetic diversity, utilization of wild wheat germplasm and through changing the wheat plant itself to function better in more sustainable systems.*

### **Biotechnology for Wheat Improvement**

Researcher: Steve Lyon (for Steve Jones)

*This project is designed to identify novel sources of resistance and end-use quality that can be used in rapid forward breeding to supplement the conventional breeding program projects such as HRW, HWW, SWW and Club. Through the use of laboratory assessments such as cytogenetic evaluation, DNA amplification, sequencing, mapping, and gel-electrophoresis, we have sped up and will continue to speed up breeding.*

### **Quality of Varieties and Pre-release Lines: Genotype & Environment – “G & E” Study**

Researcher: Craig Morris

*The goal of this project is to obtain robust, statistically-valid comparisons of the quality of new varieties and pre-release lines, including those from both private and public breeding programs; build a database of quality data for different environments/regions. This is done by providing thorough and complete quality evaluation data to support*

*other studies.*

### **Supplemental Support for Assessing the Quality of Washington Wheat Breeding Samples**

Researcher: Craig Morris

*This research is designed to increase the competitiveness of Washington wheat in the global market by developing and promoting agronomically superior varieties that also possess desirable end-use quality characteristics. This is accomplished by providing supplemental seasonal support for assessing the milling, baking and end-use quality of breeding samples so that a greater number of samples can be analyzed and done in a more timely basis.*

### **Control of Strawbreaker Foot Rot and Cephalosporium Stripe in Winter Wheat**

Researcher: Tim Murray

*The primary goals of this project are to evaluate advanced breeding lines and winter wheat cultivars for resistance to Cephalosporium stripe and Strawbreaker foot rot diseases in field plots, to find new sources of resistance to these diseases in wild relatives of wheat, and to identify the specific genes for resistance so they can be used by breeding programs to improve resistance. The research continues to evaluate new candidate fungicides for strawbreaker control, as well as improving performance through optimal timing based on plant growth stage. All of these activities are ongoing in the program.*

### **Enhancing Resistance to Snow Mold Diseases in Winter Wheat – Project 3670**

Researcher: Tim Murray

*This project objective is to transfer new snow mold resistance genes from the resistant Austrian variety Münstertaler into PNW-adapted winter wheat varieties using marker-assisted selection and growth chamber tests to speed-up the development of new varieties. Münstertaler has been crossed with Masami and Xerpha in the greenhouse and work is now in progress to advance generations as rapidly as possible. Advanced generations will be evaluated with molecular markers associated with resistance and tested for snow mold resistance in the growth chamber, so that only the most resistant lines are field-tested. The ultimate goal is to deliver winter wheat lines with improved resistance to snow mold that could be easily integrated into winter wheat breeding programs.*

### **Management of Root Diseases of Wheat and Barley: Pre-Breeding, Risk Assessment and Cultural Control**

Researchers: Timothy Paulitz, Patricia Okubara, and Scot Hulbert

*This multi-researcher proposal will take three approaches to management of root diseases of wheat: 1) Screen wheat synthetic hexaploids and mutational breeding lines for tolerance to Rhizoctonia; 2) develop disease thresholds to relate soil inoculum levels (measured by our molecular techniques) to disease and crop loss; 3) Continue to assess time of herbicide sprayout, stage of weed development and weed species in relation to Rhizoctonia greenbridge control.*

### **Wheat Head Army Worm**

Researchers: Keith Pike and Diana Roberts

*The wheat head army worm is an emerging pest on wheat and barley in Lincoln County, where it reduced test plot yields about 35% in 2007 and 2008. The armyworm has the potential to become damaging across all the cereal grain producing counties. In this new project, they will track the life cycle of the pest, conduct pesticide efficacy studies, and identify the beneficial parasitic species attacking wheat head army worm and their potential as biological control agents.*

### **Improving Winter Wheat Seedling Emergence from Deep Sowing Depths**

Researcher: Bill Schillinger

*The purpose of this project is to improve the seedling emergence of winter wheat planted deep into summer fallow. The project will replace the Rht1 and Rht2 dwarfing genes that impede emergence with genes from Australia or elsewhere that do not impede emergence. The goal is to provide the variety Xerpha with seedling emergence just as good as or better than the variety Moro.*

### **Wheat Commission Technician Support**

Researcher: Deven See

*The goal of the Western Regional Small Grains Genotyping Laboratory is to provide scientists, breeders and the agribusiness industry with in depth understanding of the molecular marker profiles conferring benefits to adaptation, quality and disease resistance. This project provides temporary partial support for a full time technician. The financial support will not be needed once the lab receives full federal funding support.*

### **A Genetic Arsenal for Wheat Production Under Drought: Mutation Breeding for Resistance to Drought, Rhizoctonia, and Roundup**

Researcher: Camille Steber

*The objective of this project was to use EMS treatment to increase the genetic variation and identify plants with the desired traits. Rhizoctonia root rot tolerant lines Scarlet-Rz1 and others were identified and found to resist both species of Rhizoctonia and Pythium. Drought tolerant lines were identified based on increased sensitivity to ABA. And lines giving tolerance to 2x application rates of Roundup were isolated.*

### **Testing Advanced Breeding Lines for High Production Areas in the PNW**

Researcher: Bob Zemetra

*The purpose of this research is to identify advanced breeding lines of soft white winter wheat from the breeding programs in the Pacific Northwest that are adapted to the high production areas (irrigated and high rainfall) of Eastern Washington. The objective is to develop a tri-state irrigated nursery trial with advanced wheat lines provided by the public and two private wheat breeding programs in the Pacific Northwest that would be planted in two irrigated and one high rainfall production areas in Eastern Washington.*