Washington Grain Commission
Wheat and Barley Research Annual Progress Reports and Final Reports

Project #: 6195

Progress Report Year: *_1_ of _3__*

Title: Field Breeding Soft White Winter Wheat

Investigator/Cooperators: **AH Carter,** TD Murray, XM Chen, KG Campbell, CF Morris

Executive summary: A new club cultivar, developed in coordination and collaboration with the USDA breeding program, was approved for release in 2015 and will be named Pritchett. This is targeted to replace Bruehl, with improved disease resistance, yield potential, and cold hardiness. In the 2015 VT trails, Jasper was in the top five yielding lines in production zones with greater than 12" annual precipitation. All foundation seed was sold of this line. Puma was in high demand in the fall of 2015 and thousands of bushels were sold for commercial production. Puma was in the top three yielding cultivars across the four production regions determined by the Variety Testing program, and was the number one yielding line in the 12-16" and 16-20" rainfall zones. We are excited to see this line in production in 2016. Otto, a 2011 release from this program, continues to grow in demand. In 2015 it was estimated to be planted on 221,000 acres, making it the most widely planted cultivar in the state. Eleven advanced breeding lines were entered into WSU's Variety Testing (VT) Program, five in the low rainfall zones and six in the high. Over 1,000 unreplicated yield-trial plots were evaluated at either Pullman or Lind and thousands of F4 head rows were evaluated in Pullman, Lind, and Waterville. High selection pressure is continually placed on disease resistance, emergence, flowering date, end-use quality, straw strength, etc. Multiple screening locations have been established to evaluate germplasm for: stripe rust resistance, foot rot resistance, snow mold resistance, good emergence, aluminum tolerance, soil borne wheat mosaic virus resistance, Cephalosporium tolerance, and nematode resistance. The program has also employed efforts to develop herbicide resistant cultivars and advanced lines have been entered into Variety Testing. Many lines have been performing every well and some are on breeders seed increase in preparation for variety release proposal. We continue to put a strong emphasis on soft white wheat in the program, and have begun to modify our breeding schemes to account for marker-assisted selection, genomic selection, and doubled-haploid production.

Impact: Traditionally, over 85% of the wheat crop in our state is winter wheat. Even very small reductions of required grower input and/or increases in productivity can mean millions of dollars to the growers, grain trade and allied industries. By providing genetic resistance to diseases and increasing agronomic adaptability, input costs will be reduced and grain yield increased. WSU white cultivars are grown on approximately 35% of the acres. This continues to increase each year. Measured impact is demonstrated with the strong growth of Otto, becoming the #1 cultivar in the state after three years. The interest in Puma and Jasper for production also measures the impact of the program. Not only do these lines provide high yield potential, but also excellent end-use quality and genetic resistance to major diseases.

WGC project number: 6195
WGC project title: Field Breeding Soft White Winter Wheat
Project PI(s): AH Carter
Project initiation date: July 1, 2012
Project year: 1 of 3

Objective	Deliverable	Progress	Timeline	Communication
Develop soft white winter wheat cultivars	New cultivars released for production in WA	We released Otto in 2011. Puma (WA8134) was released in 2012. Jasper was released in 2014. Otto became the #1 grown cultivar in the state in 2015, replacing much of the Eltan acres. Puma was sold in high demand in the fall of 2015 and will be on commercial production in 2016. Jasper was sold out of foundation seed in 2015 and prodcution and interest continues to increase. Released lines have high yield potential, excellent disease resistance, and very good end-use quality. We also co-released a club line in 2015 in collaboration with the USDA. This line is intended to replace Bruehl. We have 5 breeding lines in statewide testing for consideration under low rainfall production systems and 6 in statewide testing for consideration under high rainfall production. One of these lines is a two-gene imazamox resistant lines. We have over 10,000 plots and 40,000 rows of soft white material under evaluation at various stages of the breeding process.	Each year we evaluate germplasm at each stage of the breeding process. Each year lines are entered into statewide testing for final release consideration. A cultivar is released, on average, every two years.	Progress will be reported through field days, grower meetings, commission reports, annual progress reports, and peer-reviewed manuscripts
	Agronomic traits	We have 20 locations across the state representing diverse climatic zones in which advanced breeding lines are evaluated for agronomic characteristics. Early generation material is selected for in Lind and Pullman. Specifically, this year we added head rows for selection at Lind due to the ability to screen for emergence and cold tolerance along with extra location near Waterville to screen for snow mold.	Evaluation is done annually at multiple locations across the state.	
	Disease resistance	Disease resistance is recorded on our 20 breeding locations as disease is present, with certain locations being selected specifically for disease pressure (Waterville for snowmold, Pullman for stripe rust, etc.). Additional locations are planted in cooperation with plant pathologists to screen other diseases of importance in WA	Evaluation is done annually at multiple locations across the state.	

	End-use quality	All F4 and greater material is subjected to end-use quality screens to evaluate performance. Lines with poor quality are discarded from the breeding program and from selection in 2016.	Each year, all head rows are evaluated for end-use quality and lines predicted to have superior quality advanced. Each yield trial is submitted for quality evaluations and those with high performance are advanced in the breeding process.	
	Herbicide resistance	Multiple soft white lines have been developed for herbicide resistance and are being evaluated under replicated trials across the state. Two lines have shown very good promise and are on increase for seed production in 2016.	Evaluation is done annually at multiple locations across the state.	
Introgress novel genes for essential traits	Incorporation of novel genes into adapted germplasm for evaluation under WA environments			Progress will be reported through field days, grower meetings, commission reports, annual progress reports, and peer-reviewed manuscripts
	Rht and photoperiod genes	Crosses have been made to include non-traditional Rht and photoperiod genes into our soft white winter wheat germplasm for testing under PNW conditions.	Crosses made through the project #5195 will be evaluated under field conditions upon MAS completion.	
	Stripe rust genes	We constantly have material coming out of the MAS program for stripe rust. In 2015 we evaluated multiple populations in both early and preliminary yield trials. Material includes new genes identified from Eltan, Coda, and novel genes.	Crosses made through the project #5195 will be evaluated under field conditions upon MAS completion.	
	Foot rot genes	We have many populations being screened for foot rot resistance.	Crosses made through the project #5195 will be evaluated under field conditions upon MAS completion.	
	Cephalosporium	No markers are currently being used for this introgression. All selection is being done under field conditions. We recently completed an association mapping study, and have identified numerous markers which can be used for selection, as well as germplasm which can be used for crossing and pyramiding QTL together.	Evaluation will be done in field locations in WA in 2014	
	Aluminum tolerance	Field screening of breeding lines for aluminum tolerance is being conducted under field conditions. We recently completed an association mapping study, and have identified numerous markers which can be used for selection, as well as germplasm which can be used for crossing and pyramiding QTL together.	Evaluation will be done in field locations in WA in 2014	

	End-use quality	Seed of bi-parental mapping populations have been submitted for quality analysis and an association mapping panel for end-use quality was grown for analysis in 2015.	Seed will be collected in 2014 and sent for quality evaluations, after which analysis will be performed and markers identified.	

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Washington Grain Commission
Wheat and Barley Research Annual Progress Report

Project #: 5665

Progress Report Year: 3 of 3 (2015)

Title: Control of Wheat and Barley Rusts

Cooperators: K. Campbell, A. Carter, S. Guy, S. Hulbert, K. Murphy, M. Pumphrey, & D. See

Executive summary: During the third year (2015) of the project, studies were conducted according to the objectives of the project proposal and all objectives specified for the third year have been successfully completed. In addition to the major accomplishments and their impacts listed below, this project results in genetic resources and techniques for further studying the biology and genetics of the pathogens and mechanisms of interactions between the pathogen and plants.

Impact: 1) Stripe rust was accurately forecasted in 2015. Rust updates and advises were provided on time to growers based on the forecasts using prediction models and field surveys, which reduced disease pressure in the early spring and prevented unnecessary use of chemicals in the late growth season the State of Washington. 2) We identified 28 races of wheat stripe rust and 2 races of barley stripe rust in the US, of which 21 and 2 were detected, respectively in Washington. The virulence information is used to guide breeding programs for using effective resistance genes in developing resistant varieties and selected predominant races with different virulence patterns are used in screening breeding lines for stripe rust resistance. 3) We used molecular markers developed in our lab to study the stripe rust pathogen and determined the population changes in the past and present. 4) We evaluated more than 35,000 wheat and 2,000 barley entries for resistance to stripe rust. From the tests, we identified new sources of resistance and resistant breeding lines for breeding programs to release new varieties for growers to grow. In 2015, we collaborated with breeders in releasing, pre-releasing, or registered 6 wheat and 4 barley varieties. The germplasm evaluation data were also used to update the Seed Buyer's Guide for growers to choose resistant varieties to grow. 5) We completed studies for mapping 6 genes for stripe rust resistance in two wheat lines and identified molecular markers. We officially named one stripe rust resistance gene, and published 6 papers on molecular mapping stripe rust resistance genes in 6 wheat varieties. 6) We provided seeds of our recently developed new wheat germplasm lines to several breeding programs in the US and other countries for developing stripe rust resistant varieties. Use of these lines by breeding programs will diversify resistance genes in commercial varieties. 7) We tested 19 fungicide treatments for control of stripe rust and provided the data to chemical companies for registering new fungicides. We tested potential yield loss due to stripe rust and increase from fungicide application for 23 winter wheat and 15 spring wheat varieties currently grown in Washington. The data of the fungicides and varieties are used for guiding the integrated control of stripe rust. 8) We published 21 journal articles and 8 meeting abstracts in 2015.