

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 in the non-snow mold areas, with improved disease resistance, yield potential, and cold hardiness. In the 2018 VT trials, Jasper continues to be one of the top yielding lines across >12" precipitation zones. Puma was in high demand and is now the #5 cultivar grown in the state, continuing to perform well across production zones. Otto, a 2011 release from this program, continues to maintain demand. Since 2015 it has been planted on over 200,000 acres. Nine advanced breeding lines were entered into WSU's Variety Testing (VT) Program, four in the low rainfall zones and five in the high. In 2018 we released Purl (WA8234), a SWW with excellent yield potential, high test weight, stripe rust resistance, eyespot resistance, and the first line we know of with confirmed nematode resistance and aluminum tolerance. Registered seed is being produced. WA8275CL+ (Stingray CL+) is another line which has performed very well in trials, and is on Registered seed increase as well. Over 2,000 unreplicated yield-trial plots were evaluated at either Pullman or Lind and over 41,000 F4 head rows and DH rows were evaluated in Pullman, Lind, and Waterville. Over 2,900 DH lines were planted for 2018 evaluation. 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 very 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 soft white cultivars are grown on approximately 45% of the acres. These include Bruehl, Eltan, Masami, Xerpha, Otto, Puma, Jasper, Curiosity CL+, and MelaCL+. Measured impact is demonstrated with increasing acres of past cultivars, release of new cultivars (Pritchett) and upcoming lines Purl and Stingray CL+.

WGC project number: 6195
WGC project title: Field Breeding Soft White Winter Wheat
Project PI(s): AH Carter
Project initiation date: July 1, 2017
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 is currently the #5 cultivar in the state. Released lines have high yield potential, excellent disease resistance, and market accepted end-use quality. We also co-released Pritchett in 2015 in collaboration with the USDA. This line is intended to replace some Bruehl acres. We have 4 breeding lines in statewide testing for consideration under low rainfall production systems and 5 in statewide testing for consideration under high rainfall production. One of these lines is a two-gene imazamox resistant lines, named Stingray CL+, which is under variety release consideration. We have over 10,000 plots and 30,000 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 17 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. This year we continued head row selection at Lind due to the ability to screen for emergence and cold tolerance along with an extra location near Waterville to screen for snow mold.	Evaluation is done annually at multiple locations across the state.	In 2018 we communicated results of this project through the following venues: 12 peer-reviewed publications; 4 field day abstracts; 6 invited speaker presentations; 8 poster presentations; 7 popular press interviews; 3 grower meeting presentations; 12 field day presentations; 2 seed dealer presentations; participation in the Tri-State Grain Growers Convention; and hosting of 4 trade teams.
	Disease resistance	Disease resistance is recorded on our 17 breeding locations as disease is present, with certain locations being selected specifically for disease pressure (Waterville for snow mold, 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 2018.	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. One line has shown very good promise and is on increase for seed production in 2018. Two additional lines are in variety testing for additional release consideration. Novel traits are being incorporated into germplasm through collaboration with Dr. Ian Burke. Crossing to CoAxiom resistance is ongoing and field trials will begin next year.	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 2018 we evaluated multiple populations in both early and preliminary yield trials. Material includes new genes identified from Eltan, Coda, and novel genes from GWAS analysis.	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. Field evaluations of these selections are done in collaboration with Dr. Campbell.	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 germplasm which can be used for crossing and pyramiding QTL together.	Evaluation will be done in field locations in WA in 2019	

	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 germplasm which can be used for crossing and pyramiding QTL together. Field screening has identified multiple lines that appear to have tolerance. Further screening will be done in 2019 to confirm this.	Evaluation will be done in field locations in WA in 2019	
	Hessian Fly	In collaboration with Dr. Nilsa Bosque-Perez we screened 12 F2 populations with new sources of resistance to Hessian Fly. Resistant plants were returned to the breeding program for further crossing. Populations will be screened in 2019 to confirm resistance and moved to field testing to evaluate other traits.	Additional populations will be screened in 2019 after backcrossing	
	Nematodes	Nematode screening has been done in collaboration with Dr. Paulitz and Dr. Campbell. Advanced material was screened in 2018 for cereal cyst resistance, and data was used to help make selections for what will be evaluated in 2019.	Additional populations will be screened in 2018	
	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 2016. This data will be included in genomic selection prediction models. Material continues to be screened for quality performance, with an increased effort on low PPO lines.	Validated genomic prediction models will be available for selection in 2019.	

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