

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

Project #: 6195

Progress Report Year: *_2_ 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 and was named ARS-Castella. This line has excellent stripe rust resistance and tolerance to low pH soils, and is targeted to replace many of the club wheat acres grown in the state. Stingray CL+ was released. It is the highest yielding 2-gene Clearfield line in the WSU and OSU trials when averaged over three years. Seed will be available commercially in 2020. Devote was another soft white line recently released and is targeted to the low rainfall zones of the state. This line has very good yield potential, and resistance/tolerance to stripe rust, eyespot foot rot, cold temperatures, snow mold, and Fusarium crown rot. WSU lines continue to be very competitive in the market and are well-liked by growers. Many lines were in variety testing trials in 2019, and showed excellent performance. Two of them, WA8305 CL+ and WA8306 CL+ were the highest yielding lines of the 2-gene Clearfield lines, and many times were the highest yielding lines in the trials. We are started seed increases of these two lines. Many other lines are looking promising and breeder seed has been started on them. Over 2,200 unreplicated yield-trial plots were evaluated at either Pullman or Lind and thousands of F4 head rows and DH rows were evaluated in Pullman, Lind, and Waterville. Over 2,000 DH lines were planted for 2020 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. 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 40% of the acres. These include Bruehl, Eltan, Masami, Xerpha, Otto, Puma, Jasper, Purl, Curiosity CL+, Mela CL+, and Resilience CL+. Measured impact is demonstrated with increasing acres of past cultivars, release of new cultivars (Pritchett, ARS-Castella, Stingray CL+, Devote) and upcoming lines WA8290, WA8308, WA8305 CL+, and WA8306 CL+.

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: 2 of 3

Objective	Deliverable	Progress	Timeline	Communication
Develop soft white winter wheat cultivars	New cultivars released for production in WA	We released the soft white lines Otto, Jasper, Puma, Purl, Stingray CL+, and Devote. Collaborative releases include Curiosity CL+, Mela CL+, Resilience CL+, Pritchett, and ARS-Castella. All lines are being commercially produced or are in seed increase for commercial production. We have multiple breeding lines in statewide testing for consideration of release, many of which had excellent performance in 2019. We have over 15,000 plots and 20,000 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 moved all DH production to initial 4-row selections due to the ability to screen for important traits such as emergence and stripe rust, along with our snow mold screening in Waterville.	Evaluation is done annually at multiple locations across the state.	In 2019 we communicated results of this project through the following venues: 9 peer-reviewed publications; 2 field day abstracts; 3 invited speaker presentations; 8 poster presentations; 4 popular press interviews; 2 grower meeting presentations; 1 wheat workshop presentations; 10 field day presentations; 2 seed dealer presentations; participation in the Tri-State Grain Growers Convention; and hosted 3 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/DH 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 2019.	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. We have multiple Clearfield lines, advanced lines in testing for the CoAXium system, and novel traits are being incorporated into germplasm through collaboration with Dr. Ian Burke.	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.	
	Stripe rust genes	We constantly have material coming out of the MAS program for stripe rust. In 2019 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.	
	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.	
	Cephalosporium	No markers are currently being used for this introgression. All selection is being done under field conditions. We recently made many crosses to resistant material and are now field screening them for selection of resistant material.	Evaluation will be done in field locations in WA in 2020	
	Aluminum tolerance	Field screening of breeding lines for aluminum tolerance is being conducted under field conditions. We recently made many crosses with material that was aluminum tolerant. Screening of this material will be completed in 2020.	Evaluation will be done in field locations in WA in 2020	
	Hessian Fly	In collaboration with Dr. Nilsa Bosque-Perez and Arash Rashed we screened 12 F2 populations with new sources of resistance to Hessian Fly. Resistant plants were returned to the breeding program for further crossing and segregating populations are currently being screened again for resistance. Selected lines will be advanced to field screening in 2020.	Additional populations will be screened in 2020 after backcrossing	

	Nematodes	Nematode screening has been done in collaboration with Dr. Paulitz and Dr. Campbell. Additional advanced material will be screened in 2020.	Additional populations will be screened in 2020	
	End-use quality	Lines are continually screened for end-use quality. We submitted an additional 10 lines for statewide testing to begin generating quality scores prior to release decisions.	Validated genomic prediction models will be available for selection in 2020.	

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