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,** KG Campbell, XM Chen, TD Murray

Executive summary: The year 2021 provided many opportunities in the program to evaluate materials under both severe drought and high temperature conditions. Coming off 2020 which had some of the best growing conditions, it was quite the extreme shift. The advantage of these contrasting years allowed us to view material under very different climatic conditions and identify varieties that could perform well under both conditions. There were many lines in the program that were able to perform well even under the drought conditions and were advanced in the breeding program. Several of these lines were also prepared for Breeder seed production in Othello. Lines with the Axigen trait used in the CoAXium system were further evaluated in 2021 and lines with release potential were advanced to seed production. These will undergo their last year of qualification testing in 2022 and will be proposed for approval to be used in the CoAXium system. We hope to be able to release a number of these lines, that have fit in all the production regions in Washington. We also continue to work with novel herbicide resistance traits to bring new options for weed management into production. The breeding programs continues to maintain a high number of lines within testing at all levels of the program. Double haploid lines are continuing to be produced, along with lines produced under single-seed descent, which is less technically intensive. We continue to have multiple locations where yield testing occurs, along with numerous sites dedicated to testing stress resistance such as snow mold, stripe rust, and low pH soils. Planting into dry conditions in 2021 allowed for extreme pressure on emergence, and screening continues to identify lines with excellent emergence potential. In 2021, no new lines were proposed for release. Many of the lines released in 2019 and 2020 continue to have strong demand for commercial planting, and we continue to work with seed dealers to get these cultivars into the hands of growers. These recent releases all have high grain yield, good disease resistance, and good end-use quality. We anticipate additional releases in 2022 of lines which continue to fit into multiple cropping systems in Washington.

Impact: Traditionally, over 85% of the wheat crop in Washington is soft white 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, Xerpha, Otto, Puma, Jasper, Purl, Curiosity CL+, Mela CL+, and Resilience CL+. Measured impact is demonstrated with performance of past cultivars, upcoming production of recent cultivars (Pritchett, ARS-Castella, Stingray CL+, Devote) and strong interest in new cultivars (Piranha CL+ and Sockeye CL+).

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WGC project title: Field Breeding Soft White Winter Wheat
Project PI(s): AH Carter
Project initiation date: July 1, 2009
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 the soft white lines Otto, Jasper, Puma, Purl, Stingray CL+, Devote, Piranha CL+, and Sockeye CL+. Collaborative releases include Curiosity CL+, Mela CL+, Resilience CL+, Pritchett, ARS-Castella, and ARS-Cameo. 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 2020 and 2021. We have over 18,000 plots and 15,000 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 18 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 2021 we communicated results of this project through the following venues: 21 peer-reviewed publications; 1 virtual field day recordings; 4 field day abstracts; various field days and grower interactions; 8 poster presentations; 1 popular press interviews; 1 podcasts; 2 grower meeting presentations; and 4 seed dealer presentations;
	Disease resistance	Disease resistance is recorded on our 18 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 2021.	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 and field tested 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 2021 we evaluated multiple populations in both early and preliminary yield trials, but there was limited disease pressure. 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. Both Phc1 and Pch2 are being evaluated. 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 were done in field locations in WA in 2021	
	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 2021.	Evaluation were done in field locations in WA in 2021	

	Hessian Fly	In collaboration with Dr. 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 were planted for field evaluations in 2021. Many lines were selected for good agronomic performance and are being further evaluated.	Additional populations were developed in 2021. Current populations were be field evaluated in 2021.	
	Nematodes	Nematode screening has been done in collaboration with Dr. Paulitz and Dr. Campbell.	Lines with resistance continue to be advanced in the breeding program.	
	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 were available for selection in 2021.	

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