

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

Project #: 3193

Progress Report Year: 3 of 3

Title: Field Breeding Hard White and Red Winter Wheat

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

Executive summary: One hard red winter wheat line was released in 2015. Sequoia (WA8180) is a standard height hard red winter wheat targeted to the <12” rainfall zones of Washington. This line has good end-use quality, average protein content, very good test weight, good stripe rust resistance, and good yield potential. What makes this line stand out from other lines is its ability to emerge from deep planting and dry soils. This line will be a benefit to growers in the low rainfall zones in moisture limiting conditions. This variety has replaced many of the Farnum acres and was in commercial production in 2018. Apart from this line, there are additional lines being testing in variety testing for release potential, under both low and high rainfall conditions. WA8268 is a hard red line adapted to the high rainfall zones of the state with excellent yield potential, disease resistance, and aluminum tolerance. In 2017 and 2018, WA8268 was in the top significant group for yield with newly released cultivars LCS Jet and LCS Rocket. As such, we have begun seed increase of this line. Additionally, WA8289 was a top yielding line in both WSU and OSU VTP trials. Continued emphasis has been placed on selecting breeding lines with superior quality and disease resistance. We also have a strong interest in developing hard lines with excellent emergence capabilities, and continually screen material to this end. Efforts have been initiated and are ongoing to develop hard cultivars with herbicide tolerance, snow mold resistance, and aluminum tolerance. We have identified lines with aluminum tolerance and are testing them for release potential. We maintain about 10% of the hard material as hard white and apply heavy selection pressure to ensure adapted material is advanced. Some of these hard white lines have been tested under irrigation in Southern Idaho and have performed very well. One of these, WA8252, appears to have very high market potential in Idaho under irrigation. Our next main target is to develop hard red cultivars with herbicide resistance. These include lines with imazamox tolerance, CoAxiom resistance, and some novel traits identified within the WSU weed science program. These lines have the potential for large market share within the state to improve wheat cropping systems.

Impact: Sequoia replaced many of the Farnum acres in the state due to its excellent emergence capability and high yield potential under low rainfall and deep planting conditions. Emergence capabilities are a desired trait to reduce risk to planting failures under deep planting conditions when moisture is limited. WA8268 and WA8289 are two WSU hard red lines targeted to high rainfall conditions and will provide growers with a high yielding line with good disease resistance adapted to PNW growing conditions. WA8252 is a hard white winter wheat line which is being tested by different companies for performance potential and is under consideration for release. Current and future hard red and white lines are targeted to lead to and maintain a sustainable production of hard wheat in the PNW.

WGC project number: 3193
WGC project title: Development of hard red winter wheat
Project PI(s): AH Carter
Project initiation date: July 1, 2016
Project year: 3 of 3

Objective	Deliverable	Progress	Timeline	Communication
Develop hard red and white winter wheat cultivars	New cultivars released for production in WA	In 2015 we released Sequoia, and was in commercial production in 2018, replacing many of the Farnum acres. We have 3 low rainfall and 3 high rainfall hard red breeding lines in statewide testing for release consideration. WA8268 has been performing very well in high rainfall trials and WA8248 has shown excellent aluminum tolerance. WA8289 has shown good potential in WA and OR VTP trials. We had over 3,500 plots and 10,000 rows of hard material under evaluation at various stages of the breeding process for 2018. Some hard white winter lines have been submitted for testing in Southern Idaho and have had very good performance under irrigated conditions. These continue to be evaluated for release potential. Focus has been on developing lines with herbicide tolerance as well.	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 is reported through field days, grower meetings, commission reports, popular press, and peer-reviewed manuscripts, and through the annual progress reports
	Agronomic traits	Field trials and agronomic data was conducted and collected at 16 locations in 2018. This includes emergence, winter survivability, heading date, test weight, plant height, and grain yield. Our Kahlotus and Ritzville trial gave a very good screen for emergence potential. Our snow mold locations gave a good rating of snow mold tolerance. All other locations had very good stand establishment gave us very good information for selection. Similar numbers of entries, locations, and data were planted in 2018 for 2019 evaluation	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.
	Biotic and Abiotic stress resistance	Lines were screened for emergence, cold tolerance, snow mold, stripe rust, eyespot foot rot, nematodes, Cephalosporium stripe, SBWMV, and aluminum tolerance.	Evaluation is done annually at multiple locations across the state.	

	End-use quality	All breeding lines with acceptable agronomic performance in plots were submitted to the quality lab. Those with acceptable milling characteristics were advanced to baking trials. Data should be back in early 2019. Lines with inferior performance will be discarded from selection in 2019. We screened nearly 1200 early generation lines for end-use quality 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	Trials were conducted in Lind, Walla Walla, and Pullman for herbicide resistance. The hard red material had a lower priority for development when we started compared to the soft white germplasm, but now since that material has matured more emphasis is on the hard red material. Imazamox material is in final screening and lines for release potential should be identified in 2019. Other material will be coming out of the greenhouse for future screening in 2019	Evaluation is done annually at multiple locations across the state	
Field test adapted germplasm with novel genes introgressed for essential traits	Incorporation of novel genes into adapter germplasm for evaluation under WA environments			Progress is reported through field days, grower meetings, commission reports, popular press, and peer-reviewed manuscripts, and through the annual progress reports
	Rht genes	Populations have been developed and are under field evaluation for Rht1 and Rht8, as well as standard height cultivars.	Crosses made through the project #5195 will be evaluated under field conditions upon MAS completion.	
	Stripe rust genes	Multiple different stripe rust resistance genes have been introgressed into out germplasm which are under evaluation in Mount Vernon, Central Ferry, and Pullman.	Crosses made through the project #5195 will be evaluated under field conditions upon MAS completion.	
	Foot rot genes	Pch1 has been selected for and is under evaluation in field trials in Pullman.	Crosses made through the project #5195 will be evaluated under field conditions upon MAS completion.	
	Low PPO genes	Initial selection for lines with low PPO enzyme activity are ongoing and will continue to be tested in 2019.	Crosses made through the project #5195 will be evaluated under field conditions upon MAS completion.	

	CoAxiom herbicide resistance	Crossing has begun and markers are currently being used for confirm resistance. Once confirmed, field testing will occur to select lines with release potential.	Crosses made through the project #5195 will be evaluated under field conditions upon MAS completion.	
	GPC-B1 and Bx7oe	These two genes have been incorporated into many hard breeding lines. These are being tested for agronomic performance in the field. Some lines have already been returned to the breeding program as parents for additional crosses.	Crosses made through the project #5195 will be evaluated under field conditions upon MAS completion.	

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