

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

**Project #:** 3193

**Progress Report Year:**   1   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. Foundation seed has been produced and was sold in the fall of 2016. Apart from this line, there are additional lines being testing in variety testing for release potential, under both low and high rainfall conditions. After extensive selection of crosses targeted for the high rainfall zones of the state, the first material derived from DH is in statewide testing. This material comes through crossing to European material and is well adapted to Washington with high yield potential. We are very excited about these crosses. 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. After some renewed interest in hard white wheat, we had increased our efforts for crossing, but after further discussion with the Commission, have reduced this again due to a market shift. 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. There is interest to release these lines for production under irrigation in Idaho. Our next main target is to develop hard red cultivars for the high rainfall areas of the state, as well as develop herbicide resistance in the hard red germplasm.

**Impact:** Hard winter wheat is an important crop to farmers and the Ag economy in Washington State. For the past five years, hard red winter wheat production in the state has been fairly steady at about 220,000 acres. There was a slight increase in 2016 to 240,000 acres. Minimal increases are seen until new markets are developed or improved cultivars released. Input costs are constantly increasing, thereby lowering the return on crop production. Due to the extreme environmental conditions in this part of the state, average grain yield potentials are difficult to calculate. However, as an example, a modest increase in average grain yield of two bushel per acre of \$5.00 wheat would mean nearly \$2.2 million more per year for these growers and the state’s economy. Enhanced stress resistance such as aluminum tolerance, herbicide tolerance, and increased agronomic adaptability and emergence potential, along with improved nitrogen use efficiency would yield similar dollar benefits. This is being realized with current releases such as Sequoia, and upcoming experimental lines targeted to both the low and high rainfall zones.

**WGC project number:** 3193  
**WGC project title:** Development of hard red winter wheat  
**Project PI(s):** AH Carter  
**Project initiation date:** July 1, 2013  
**Project year:** 1 of 3

Objective	Deliverable	Progress	Timeline	Communication
Develop hard red and white winter wheat cultivars	New cultivars released for production in WA	Sprinter was released in 2013 and was grown on about 13,000 acres in 2015. In 2014, Earl, a hard white winter wheat line was approved for release. In 2015 we released Sequoia, and Foundation seed was sold in 2016. We have 3 low rainfall and 3 high rainfall hard red breeding lines in statewide testing for release consideration. We had over 4,000 plots and 20,000 rows of hard material under evaluation at various stages of the breeding process for 2016. Some hard white winter lines have been submitted for testing in Southern Idaho and have had very good performance under irrigated conditions. These will be evaluated for release next summer.	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 18 locations in 2016. 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. All other locations had very good stand establishment and we are looking forward to a good year of screening the germplasm.	Evaluation is done annually at multiple locations across the state.	
	Biotic and Abiotic stress resistance	Lines were screened for snow mold, stripe rust, eyespot foot rot, 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 2017. Lines with inferior performance will be discarded from selection in 2017. We screened nearly 800 early generation lines for end-use quality 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	Trials were conducted in Lind, Walla Walla, and Pullman for herbicide resistance. Crossing has been initiated to incorporate novel herbicide resistance into hard red lines.	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, 2, and 8.	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.	
	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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