

**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 2019. Scorpio (WA8268) is a semi-dwarf, high yielding cultivar targeted to the intermediate and high rainfall zones of the state, including regions of Northern Oregon and Idaho. This line has excellent stripe rust resistance and is tolerant to low pH soils where there are high amounts of free aluminum. The end-use quality of the line meets export and domestic standards, and is being considered by Shepherd's Grain for approval in their system. Scorpio is competitive with other hard red cultivars on the market for yield potential, and has the increased benefit of improved disease resistance. In 2019 we tested multiple other hard red winter lines. Another line which is being considered for release is WA8289, an awnless cultivar which has shown very high yield potential in the PNW. This line is targeted to the intermediate and high rainfall production areas. WA8310 is a hard red winter wheat cultivar targeted to the lower rainfall production areas. This line is a semi-dwarf line, but still shows excellent emergence from deep planting and in dry soils. WA8310 has high yield potential and also maintains a higher grain protein content than other lines at a similar yield potential. In addition to these two lines, we have also submitted to the variety testing program a hard red winter wheat line with 2-gene resistance to imazamox. This line is targeted to the low and intermediate rainfall zones of the state, and is targeted to replace acres of SY Clearstone CL2. We continue to make crosses in the market class and develop them through DH methods. 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 with herbicide resistance.

**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. Scorpio is a recent WSU hard red cultivar targeted to high rainfall conditions and will provide growers with a high yielding line with good disease resistance adapted to PNW growing conditions. Current and future hard red and white lines will continue to lead to 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, 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	In 2018 we released Scorpio, and will be on large commercial production in 2020. This line is intended to replace many of the current hard red cultivars to do high yield potential, and excellent disease resistance. Mainly, this line has excellent stripe rust resistance and tolerance to low pH soils. Additionally, there has been interest from Montana on a breeding line WA8248AL, which also had very good tolerance to low pH soils and is agronomically adapted to production in Montana. We had over 2,800 plots and 12,000 rows of hard material under evaluation at various stages of the breeding process for 2019. 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 15 locations in 2019. 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 and we are looking forward to a good year of screening the germplasm.	Evaluation is done annually at multiple locations across the state.	In 2019 we communicated results of this project through the following venues: 6 peer-reviewed publications; 2 field day abstracts; 3 invited speaker presentations; 5 poster presentations; 3 popular press interviews; 2 grower meeting presentations; 1 wheat workshop presentations; 10 field day presentations; 3 seed dealer presentations; participation in the Tri-State Grain Growers Convention; and hosted 4 trade teams.
	Biotic and Abiotic stress resistance	Lines were screened for 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 2020. Lines with inferior performance will be discarded from selection in 2019. We screened nearly 1,000 early generation lines for end-use quality 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	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. Crossing has been initiated to incorporate novel herbicide resistance into hard red lines.	Evaluation is done annually at multiple locations across the state	We have entered one hard red line into variety testing with 2-gene resistance to imazamox
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.	
	SBWMV	Crosses are initiated and being evaluated for resistance to SBWMV, mainly first through marker analysis and then under field trials in Walla Walla.	Crosses made through the project #5195 will be evaluated under field conditions upon MAS.	
	Stripe rust genes	Multiple different stripe rust resistance genes have been introgressed into our 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.	
	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.	
	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.	

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