Washington Grain Commission

Wheat and Barley Research Annual Progress Reports and Final Reports

Project #:	**3019 3676**
Progress Report Year:	*_1___ of __3__ (maximum of 3 year funding cycle)*
Title:	**Improving Spring Wheat Varieties for the Pacific Northwest**
Cooperators:	Mike Pumphrey, John Kuehner, Vic DeMacon, Sheri Rynearson, Wycliffe Nyongesa

Executive summary:
The WSU spring wheat breeding program's elite material and recently released varieties continue to be the top performers is statewide variety trials and for growers. Foundation and registered seed of Seahawk (WA8162) soft white, Alum (WA8166) hard red, Chet (WA8165) low rainfall hard red, Tekoa (WA8189) and Melba (WA8193) spring club was produced and sold in 2016. Each variety has very good yield potential, a high level of stripe rust resistance, good-to-excellent end-use quality, and better straw strength compared to existing varieties. Melba club is intended to replace JD in >16" rainfall areas, with significantly shorter height and lower protein. Ryan (WA8214) soft white spring wheat was released in 2016, and we expect broad adoption due to early maturity, shorter height, and top yield performance. Ryan has aluminum tolerance, Hessian fly resistance, excellent rust resistance, and below average protein. Two-gene Clearfield variety candidates performed well in WSU variety testing trials, and we expect a release in the next one-two years.

Impact:
The WSU spring wheat breeding program is in a unique position to focus on grower opportunities and challenges, large and small. We identify and develop traits, technology, germplasm, and released varieties to meet the needs of the majority of Washington producers, whether the needs are localized or widespread. Our latest releases package excellent yields with superior quality and key yield protection traits. Glee hard red spring wheat was again a top performer in >12" through >20" precipitation areas, and was the leading hard red spring by acres in 2016. Diva, Louise, Whit, Babe and JD were collectively planted on the majority of soft spring wheat acres. Our newer releases should command these acres in the future due to improved potential profitability for growers. These varieties were also top performers in 2016 spring wheat variety testing trials. Public wheat breeding programs at WSU and across the country payback consistently on research dollars invested. It is commonly referenced that public wheat breeding programs consistently return > ~60% on investment. With >50% of the spring wheat acres in Washington planted to WSU varieties, growers continue to realize a substantial return on research dollars invested in this program.

Outputs and Outcomes: File attached

WGC project number: 3019 3676
WGC project title: Improving Spring Wheat Varieties for the Pacific Northwest
Project PI(s): Mike Pumphrey
Project initiation date: 2017
Project year: 2 of 3

Objective	Deliverable	Progress	Timeline	Communication
Develop biotic and abiotic stress tolerant, high-yielding, and high-quality hard red, soft white, club, and hard white spring wheat varieties for diverse Washington production environments.	New spring wheat wheat varieties that are superior to existing varieties. This effort includes all four market classes of spring wheat and all precipitation regions in Washington state.	Seahawk (WA8162) SWS, Alum (WA8166) HRS, and Chet (WA8165) HRS, Tekoa (WA8189) SWS, and Melba (WA8193) spring club continued to lead yield trials in their classes in 2016, and with greater seed availability, will have a significant positive economic impact for PNW growers. WA8214 SWS (released in 2016 as Ryan) was again a top performer in 2016 Variety Trials. We had excellent test plots across regions in 2016. Good data quality is fundamental to making solid selections.	Recurring annually	WSU Field days, Private company field days, Workshops/meetings/presentations attended/given by Pumphrey: Western Wheat Workers, WSCIA Annual Meeting, WSCIA Board, WA Grain Commission. Annual Wheat Life contributions as requested
Improve PNW spring wheat germplasm to strengthen long-term variety development efforts/genetic gain.	Enhanced germplasm. Consistent genetic gain for many desirable traits.	Multiple stripe rust, aluminum tolerance, Hessian fly, and quality traits were selected in backcross populations for long-term parent building in 2016. Continued development of a two-gene CF germplasm base is starting to really show in the perfromnce of 2 gene lines now entering yield trials. With or without herbicide application, we are seeing lines that beat our elite check cultivars in yield trials. We have specifically focused on irrigated hard red spring wheat germplasm development, and lines from those efforts are now entering yield trials. We have expanded irrigated testing in the program starting in 2016.	The payback for this work will fully be realized for many years to come as these lines continue to be crossed into existing breeding lines. We expect this effort to result in introgression of desirable variation for yield, disease resistance, and other agronomic characters.	

Objective	Deliverable	Progress	Timeline	Communication
Discover/improve/implement scientific techniques and information to enhance current selection methods.	We will continue to leverage the efficiency of the Spring Wheat Breeding Program to enhance traits and research of direct relevance to Washington producers. Current examples that will continue are development of DNA markers for useful sources of Hessian fly and stripe rust resistance, drought and heat tolerance loci, identification of superior germplasm through association mapping, screening for tolerance to aluminum, development of facultative wheat, screening for drought and heat tolerance, development and screening of mutant populations (TILLING) and the development of high-throughput field phenomics selection methods.	Several specific trials and locations were again evaluated in 2016 to help long term breeding efforts. Scientific products of our efforts through multiple projects in 2016 include: 1) Liu, W.. Genome-wide association mapping for seedling and field resistance to Puccinia striiformis f. sp. tritici in elite durum wheat. Theoretical and Applied Genetics, in press. 2) Rawat, N...2016. Wheat Fhb1 encodes a chimeric lectin with agglutinin domains and a pore-forming toxin-like domain conferring resistance to Fusarium head blight. Nature Genetics.doi:10.1038/ng.3706. 3) Turner, M.K..2016. Association mapping of leaf rust resistance loci in a spring wheat core collection. Theor Appl Genet. doi:10.1007/s00122-016-2815-y. 4) Bulli, P....2016. Genetic Architecture of Resistance to Stripe Rust in a Global Winter Wheat Germplasm Collection. G3: Genes|Genomes|Genetics. 6:2237-2253. 5) Wan, A...2016. Virulence Characterization of Wheat Stripe Rust Fungus Puccinia striiformis f. sp. tritici in Ethiopia and Evaluation of Ethiopian Wheat Germplasm for Resistance to Races of the Pathogen from Ethiopia and the United States. Plant Disease. http://dx.doi.org/10.1094/PDIS-03-16-0371-RE 6) Naruoka, Y... 2016. Identification and validation of SNP markers linked to the stripe rust resistance gene Yr5 in wheat. Crop Science. 56:3055-3065. 7). Nasseer, A. M...2016. Impact of a Quantitative Trait Locus for Tiller Number on Plasticity of Agronomic Traits in Spring Wheat. Crop Science. 56:595-602.	This works has short, medium, and long term goals. We are already using new DNA markers discovered through this work to improve selection for quality and pest resistance.	