

## Washington Grain Commission

### Wheat and Barley Research Annual Progress Reports and Final Reports

**Project #:** 3019 3162

**Progress Report Year:** 3 of 3 (maximum of 3 year funding cycle)

**Title:** Improving Spring Wheat Varieties for the Pacific Northwest

**Cooperators:** Mike Pumphrey, Vadim Jitkov, Wycliffe Nyongesa, Josh DeMacon, Sheri Rynearson

#### **Executive summary:**

The WSU spring wheat breeding program's elite material and recently released varieties continue to be the top performers in statewide variety trials and for growers. Two varieties were approved for release/Foundation seed increase in 2021. *Hale* hard red spring wheat is a superior, broadly adapted replacement for dryland spring wheat acres. *Roger* spring club is early and high yielding and will be the first in its class with Hessian fly resistance. A new 2-gene Clearfield spring club wheat released in 2020, *Hedge Cl+*, had Foundation seed produced in 2021. Hard red spring *Net Cl+* was grown on ~9,000 acres during its first year available in 2021 and seed stocks have been further multiplied. Each variety has very good to excellent end-use quality, which is a primary goal of our program to help maintain and increase the value of Washington wheat.

*WSU soft white spring wheat varieties accounted for 95% of certified soft white spring wheat production acres in Washington in 2021. Our widely available soft white spring wheat varieties, Ryan, Seahawk, Tekoa, and Melba, have broad adaptation, superior all-around disease, grain and agronomic traits, most desirable end-use quality, and top yield performance. They have been widely adopted by seed dealers in the PNW and Ryan was by far the leading variety in the state with over 220,000 acres planted in 2021. Glee, Chet, and Alum are leading dryland hard red spring wheat varieties, and Net CL+ has been rapidly adopted. WSU spring wheat varieties collectively were planted on 80% of the certified spring wheat production acres in Washington in 2021. The consistency, broad adaptation, disease and pest resistances, sound grain traits, most desirable end-use quality, good falling numbers, and overall performance of these varieties reflects the outputs of comprehensive wheat breeding and genetics research effort supported primarily through funding from this project. In fact, 64% of all spring wheat acres in 2021 were planted to varieties developed/released through our program over the past 6-7 years.*

#### **Impact:**

The WSU spring wheat breeding program is in a unique position to focus on grower opportunities and challenges, large to small. We identify and develop traits, technology, germplasm, and release varieties to meet the needs of the majority of Washington producers, whether the needs are localized or widespread. We emphasize traits like stable falling numbers, Hessian fly resistance, stripe rust resistance, and aluminum tolerance, and hold the entire industry to a greater standard for yield, yield protection, and end-use quality. Our latest releases package excellent yields with superior quality and key yield protection traits. Public wheat breeding programs at WSU and across the country consistently pay back on research dollars invested. *With 80% or more of the spring wheat acres in Washington planted to WSU spring*

*wheat varieties in 2021, growers continue to realize a substantial return on research dollars invested in this program.* The yield of our top three released soft white spring wheat varieties (Ryan, Seahawk, Tekoa) averages 105-108% of the top three varieties from other programs, using 2 to 5-year average data from over 70 variety trials across precipitation zones from 2017-2021.

The core staff and operations of the WSU spring wheat breeding program have allowed us to be very successful in leveraging extramural funding over the past three years. The Pumphrey program has active funding, that relies on leverage from this project, from either USDA or FFAR currently totaling \$3,442,243 (see current and pending support). In addition, royalty revenue to WSU from seed sales of our spring wheat varieties in Idaho, Oregon, and Montana generate additional revenue that is re-invested in breeding in Washington. For example, Ryan, Seahawk, and Dayn have led soft white and hard white spring wheat acres (and in the top ten regardless of growth habit or class) in Idaho for several years.

Additional impact over the past funding cycle includes publication of scholarly papers, generation of high-quality data for aluminum tolerance, falling numbers, planting and management of many variety trial locations, significant involvement in extension program and information delivery, and assisting numerous collaborating scientists with execution of field and greenhouse experiments for other extramurally funded projects or to develop preliminary data for extramural grant applications. The Pumphrey program has authored or co-authored ~25 peer-reviewed scholarly publication over the past three years that are associated with our breeding efforts.

**Outputs and Outcomes: File attached**

WGC project number: 3019 3162

WGC project title: Improving Spring Wheat Varieties for the Pacific Northwest

Project PI(s): Mike Pumphrey

Project initiation date: 2019

Project year: 3 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 varieties that are superior to existing varieties. This effort includes all four market classes of spring wheat and all precipitation regions in Washington state.	WSU released varieties generated significant positive economic impact for PNW growers in 2021 by our varieties being planted on 80% of spring wheat acres. Multi-year yield trial data for the top three WSU SWS wheat varieties across all locations demonstrates that our market-leading varieties produced 105-108% of the top three varieties from other breeding programs. A Hessian fly resistant club wheat, Roger, and a hard red spring wheat, Hale, were approved for release/Foundation seed production in 2021. Our 2-gene Clearfield breeding efforts have matured, and we have released Hedge and Net CL+ to date. Our attention to aluminum tolerance, stripe rust resistance, Hessian fly resistance, and stable falling numbers over the past few grant cycles has resulted in selection of superior lines for these traits.	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, Trade tours/international buyer groups.  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 2021. A continued focus in 2021 was backcrossing new Hessian fly resistance genes into spring wheat germplasm. Extensive crossing blocks for irrigated hard red spring wheat germplasm development were also completed. Two large fall-seeded spring wheat trials were conducted in 2021 with irrigation. Backcrossing of the AXigen trait for CoAXium wheat production system was continued into both soft white and hard red spring wheat germplasm.	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.	
Discover/improve/implement scientific techniques and information to enhance current selection methods.	Current projects 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 geneomic selection, screening for tolerance to aluminum, development of facultative wheat, and the development of high-throughput field phenomics selection methods.	Several specific trials and locations were again evaluated in 2021 to help long term breeding efforts. Scientific products of our efforts through multiple projects over the 3-year project cycle include ~25 publications in high-quality international scientific journals. Information from these research efforts help guide specific germplasm development efforts focused on Hessian fly, stripe rust, genomic selection, high-throughput phenotyping, genomic selection, marker-assisted selection, drought tolerance, heat tolerance, yield, test weight, gluten strength, etc.	This work 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.	