

**Washington Grain Commission**  
**2023 Wheat and Barley Research Annual Progress Reports and Final Reports**  
**Project #: 3162**

**Progress Report Year:**     \_\_2\_\_ of \_\_3\_\_ (*maximum of 3 year funding cycle*)

**Title:**                     ***Breeding Improved Spring Wheat Varieties for Washington***

**Cooperators**             *All variety testing and evaluation-associated WSU/USDA personnel*

**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. *Hale* hard red spring wheat is a superior, broadly adapted replacement for dryland spring wheat acres and led performance in WSU and UI Variety Testing trials in 2023. *Roger* spring club wheat is early and high yielding and will be the first in its class with Hessian fly resistance. A new 2-gene Clearfield soft white spring wheat Butch CL+ was released, with Breeders and Foundation seed production in 2023. *WSU soft white spring wheat varieties accounted for 97% of certified soft white spring wheat production acres in Washington in 2023. WSU spring wheat varieties collectively were planted on ~80% of the certified spring wheat production acres in Washington in 2023.*

**Introduction**           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 2023, 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 105-115% of the top three varieties from other programs, using multi-year data from over 70 variety trials across precipitation zones from 2019-2023.

## Approach

The focus of the WSU spring wheat breeding project is to:  
 Develop biotic and abiotic stress tolerant, system-based, high-yielding, and high-quality hard red, soft white, and club spring wheat varieties for diverse Washington production environments.  
 Improve PNW spring wheat germplasm to strengthen long-term variety development efforts/genetic gain by systematically incorporating diversity and stewardship.  
 Improve and implement cutting-edge scientific techniques and information to enhance current selection methods.

### Soft White Spring- 2022 & 2023 Analysis across all WSU VTP sites

Variety	Zone Average Rank	Yield % AVG >20"	Yield % AVG 16-20"	Yield % AVG 12-16"	Yield % AVG <12"	TW	PRO
WA8351	1.0	110%	111%	109%	112%	62.0	10.5
WA8327	2.0	108%	107%	106%	109%	61.2	10.7
Tekoa	5.0	103%	100%	103%	108%	61.3	11.0
Ryan	5.5	102%	107%	103%	99%	60.9	11.0
Roger (club)	6.3	102%	102%	104%	95%	62.4	10.4
Melba (club)	7.5	100%	98%	102%	104%	60.7	10.8
TMC Lochaven	7.5	99%	100%	104%	98%	61.6	11.7
Seahawk	8.8	99%	100%	97%	100%	61.1	11.1
Butch CL+	9.0	99%	101%	101%	92%	61.7	11.3
Hedge CL+	9.3	101%	96%	93%	106%	62.0	11.4
UI Cookie	10.0	99%	102%	96%	91%	60.4	11.7
IDO19025	11.0	98%	98%	93%	99%	62.6	11.2
Louise	11.3	93%	92%	96%	103%	60.2	10.9
WB6211CLP	12.5	96%	94%	98%	89%	59.2	11.7
AP Mondovi CL2	13.5	91%	90%	94%	96%	60.2	12.4

## Results

## Impact

In 2023, 97% of all Washington soft white spring wheat acres were planted to varieties from the WSU Spring Wheat Breeding Program, and 80% of all spring wheat acres. Continued genetic gain and regular variety replacement of this important rotation crop are key to supporting farm economics, efficient use of resources, and maintaining and expanding wheat markets.

WGC project number: 3162  
WGC project title: Improving Spring Wheat Varieties for the Pacific Northwest  
Project PI(s): Mike Pumphrey  
Project initiation date: 1-Jul-22  
Project year (X of 3-yr cycle): 3 of 3 year cycle

Objective	Deliverable	Progress	Timeline	Communication
Develop biotic and abiotic stress tolerant, high-yielding, and high-quality hard red, soft white, and club 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 2023 by our varieties being planted on >80% of spring wheat acres. The top three WSU SWS wheat varieties across all locations demonstrated that our market-leading varieties produced >110% of the top three varieties from other breeding programs. A new 2 gene CL+, Butch CL+ SWS and Roger spring club underwent Foundation seed production in 2023. We anticipate release of WA 8351 SWS as well.	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 2023. Extensive crossing blocks for irrigated hard red spring wheat germplasm development were also advanced to field selection. Two large fall-seeded spring wheat trials were conducted in 2023 with irrigation. Backcrossing of the AXigen trait for CoAXium wheat production system was continued into both soft white and hard red spring wheat germplasm and numerous doubled haploid three-gene AXigen lines were evaluated in field plots.	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 genomic 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 evaluated in 2023 to help long term breeding efforts. Scientific products of our efforts through multiple projects over the past three 3 years include ~20 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, yie3d, 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.	