

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

Project #: 3163

Progress Report Year: 2 of 3 (*maximum of 3 year funding cycle*)

Title: **Greenhouse and laboratory efforts for spring wheat variety development**

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

Executive summary:

This project is integral to core efforts of the Spring Wheat Breeding program. This project provides funding to make crosses and develop breeding populations in the greenhouse, staff support for management and selection of breeding materials in the field and greenhouse, and supports/enables the most effective end-use quality selection procedures for development of superior Washington spring wheat varieties. In addition to routine early-generation grain quality selection carried out through this project, we apply DNA marker technology to elite breeding materials, and conduct research projects of direct relevance to our breeding efforts. This project also supports our two-gene Clearfield and AXigen breeding efforts, Fusarium head blight resistance gene introgression, Hessian fly resistance gene introgression, and expanded irrigated hard red spring wheat breeding efforts. Our progress in each of these areas is consistent, and these outputs shape our overall breeding efforts.

Impact:

This project is critical to the spring wheat breeding program and establishes our core breeding efforts. Program efficiency is increased by evaluating early generation lines for quality and eliminating those with poor quality characteristics before further testing. Increased testing of superior material in the field program protects resources from being used to further test lines that are inferior in terms of quality, lack adequate pest resistance, and numerous other DNA-marker selectable traits. Spring wheat varieties with complex stripe rust resistance, Hessian fly resistance, aluminum tolerance, superior end-use quality, and broad adaptation are critical for Washington wheat producers by adding millions of dollars of annual return. Over the past five years, we have released Seahawk, Tekoa, Melba, Ryan, Net Cl+, and Hedge CL+. They have been rapidly adopted by seed dealers and growers and are top-volume sellers through the Washington State Crop Improvement Association Foundation Seed program. 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. Two new releases are planned for 2021 and will provide growers a top-performing Hessian fly resistant club spring wheat variety (WA8325) and a broadly adapted hard red spring wheat (WA8315) with excellent yield, disease resistance, quality, and slightly higher protein than our current top-end dryland varieties beginning in 2022.

Outputs and Outcomes: File attached

WGC project number: 3019 3163

WGC project title: Greenhouse and laboratory efforts for spring wheat variety development

Project PI(s): Mike Pumphrey

Project initiation date: 2019

Project year: 2 of 3

| Objective | Deliverable | Progress | Timeline | Communication |
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| Develop DNA markers and select breeding lines by marker-assisted selection with stripe rust resistance, Hessian fly resistance, and two-gene Clearfield™ herbicide tolerance as well as other traits when desirable. | Elite variety candidates will result, in part, due to these molecular selection activities. Many of these populations will be ideal for marker optimization, new genetic mapping studies, and potentially the basis of new competitively funded projects. | Two Wheat Life articles were written/contributed in 2020, as well as supporting other articles. Axigen trait introgression continued, and we have made BC3 materials with this new herbicide tolerance to date. We have developed new DNA markers for a previously undocumented Hessian fly resistance locus that allow us to track resistance in most of our germplasm for the first time. KASP assays have been developed. Our second backcrossed, marker-assisted selection, doubled haploid, two-gene Clearfield variety was released in 2020, in a JD background. | Activities are cyclical and occur annually throughout the normal breeding cycles. | Pumphrey attended/presented at numerous virtual WSU field days, workshops/meetings, PNW wheat Quality Council, WSCIA Annual Meeting (presentation), WSCIA Board Meetings, WA Grain Commission meetings, industry tours. |
| Select early-generation breeding lines with good end-use quality potential by eliminating inferior breeding lines prior to expensive and capacity-limited yield tests. | Elimination of lines with inferior end-use quality. This ensures only lines with acceptable end-use quality are tested in the field and maximizes efficiency in field operations. Current analyses include: NIR-protein, NIR-hardness, SKCS-hardness, SDS micro-sedimentation, PPO, and micro-milling. | Another year of selection was successfully completed in 2020, with approximately 2400 lines evaluated through the various quality tests. Markers for PPO and waxy alleles were validated and applied to breeding materials. | Return on investment is realized each year, since lines with poor end-use quality are not tested in expensive and capacity-limited yield tests. This allows for additional yield testing of lines with good end-use quality and more efficient variety development. | |
| Conduct greenhouse operations required for variety development, including crossing, doubled haploid development, generation advancement, and seedling assays such as herbicide screening, and stripe rust screening. | Lines for field testing that contain desirable and novel characteristics. This is where new varieties are born. Greenhouse operations also allow more rapid breeding cycles by advancing F1 and F5 generations every year as part of our routine breeding efforts. Seedling evaluation of stripe rust resistance and herbicide tolerance screening are also major greenhouse activities. | We continue to use the expanded greenhouse space to our advantage to increase breeding and research materials, make crosses, and conduct experiments. COVID-19 has some, but minor impact on our ability to conduct this day to day work. | Greenhouse multiplication and crossing is completed annually, including two large crossing blocks and thousands of early generation lines tested for stripe rust and herbicide tolerance. | |