

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

Project #: 3163

Progress Report Year: 1 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 with project 3162, establishes our core breeding efforts. Program efficiency is significantly increased, by evaluating early generation lines for quality and eliminating those with poor quality characteristics before further field testing. This allows for increased testing of superior material in the field program and 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 Chet, Alum, Seahawk, Tekoa, Melba, Ryan, and Net CI+. 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. A new release, Net CI+, will provide growers a top-performing two-gene Clearfield spring wheat variety beginning in 2020, and a two-gene Clearfield spring club variety is planned for release and Foundation seed increase in 2020.

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: 1 of 3

Objective	Deliverable	Progress	Timeline	Communication
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.	One Wheat Life article was written/contributed in 2019, as well as supporting other articles. Axigen trait introgression continued in 2019, and we have made BC2 materials with this new herbicide tolerance to date. Nineteen DNA markers were applied to elite selections, crossing parents, and early generation lines for selection. Four hessian fly resistance genes were backcrossed into elite germplasm to the BC3 or BC4 stage and those derived lines were tested in yield trials in 2019. Fusarium head blight MAS lines, and other MAS populations were advanced in 2019	Activities recur annually. The two-gene Clearfield™ breeding effort resulted in a hard red spring wheat release in 2019. Activities are cyclical and occur annually throughout the normal breeding cycles.	Pumphrey attended/presented at numerous 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.	By January 2020, we completed evaluation of ~3200 headrow selections for several end-use quality traits. Over half of selections without superior quality related values were discarded, ensuring very high quality lines are advanced. These have been advanced to a greenhouse generation advance and will be evaluated as F5:6 lines in 2020.	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 have continued to successfully develop and advanced hundreds of crosses for selection in breeding populations. The primary focus in 2019 was Hessian fly resistance selection in club wheat, Axigen wheat backcrosses, and introgression of new Hessian fly resistance genes in elite backgrounds,	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.	