

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

Project #: 3677

Progress Report Year: ___2_ of _3___ (maximum of 3 year funding cycle)

Title: **Pre-breeding pest resistance, agronomic and grain quality traits for spring wheat variety development**

Cooperators: Mike Pumphrey, John Kuehner, Vic DeMacon, Sheri Rynearson, Wycliffe Nyongesa

Executive summary:

This project is an integral component of the Spring Wheat Breeding program. The objective of this project is to support/enable the most effective and efficient 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 are conducting several research projects of direct relevance to our breeding efforts. This project also supports our two-gene Clearfield breeding effort, and expanded irrigated hard red spring wheat efforts, which have progressed nicely. Approximately 1800 early generation lines were evaluated for end-use quality with ~900 retained, over 1000 marker-selected doubled haploid and backcross-derived progeny were advanced through selection in field nurseries, and molecular markers were used to characterize parental lines for disease, quality, and agronomic traits through this project in 2017.

Impact:

This project is critical to the spring wheat breeding program and works seamlessly with project 3676. 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 of adequate pest resistance, and numerous other DNA-marker selectable traits. The release of a top performing 2-gene Clearfield spring wheat varieties will be of substantial economic benefit to growers in Washington State by protecting yields where Imazamox or Imazethapyr has been heavily used. Spring wheat varieties with complex stripe rust resistance, Hessian fly resistance, superior end-use quality, and broad adaptation are critical for Washington wheat producers by adding millions of dollars of annual return. *WSU varieties 'Seahawk', 'Diva', 'Louise', 'Whit', 'JD' and 'Babe' accounted for ~68% of the soft white spring wheat acres planted in the state in 2017. WSU varieties 'Kelse' and 'Glee' were leading hard red spring wheat varieties in 2017. In total, ~54% of the 2017 Washington spring wheat acres were planted to WSU spring wheat varieties based on certified seed sales, which would be higher on an acre percentage basis due to dominance of our varieties in rain-fed production areas with lower seeding rates.* Over the past three years, we have released Chet, Alum, Seahawk, Tekoa, Ryan, and Melba. Each variety is high quality, top yielding, pest and disease resistant, and have been accepted and adopted by seed dealers and farmers with increasing acres each year. ***Outputs and Outcomes: File attached***

WGC project number: 3019 3677

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

Project PI(s): Mike Pumphrey

Project initiation date: 2017

Project year: 3 of 3

Objective	Deliverable	Progress	Timeline	Communication
<p>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.</p>	<p>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.</p>	<p>The Spring wheat breeding program discovered or optimized several DNA markers in 2017, a few of which were published in peer-reviewed scientific journals, and are now being used in our breeding efforts. The Clearfield breeding efforts are progressing nicely, with new 2 gene lines entering advanced yield trials each year. One Wheat Life article was written/contributed in 2017, as well as supporting two other articles. A new DNA marker for wheat quality was tested and validated for breeding quality in 2017. This WBM locus is present in some of our bread wheat germplasm, but interestingly is nearly fixed in most elite good quality club wheat germplasm. We believe this locus may be significantly contributing to sponge cake volume, and will conduct validation experiments in 2018. If this is proven, this would be a significant step forward in better defining our critical sponge cake quality traits from a genetic perspective, which is an area that has been lacking.</p>	<p>Activities recur annually The two-gene Clearfield™ breeding effort is in full swing, and we anticipate a release in the proposal period. Activities are cyclical and occur annually throughout the normal breeding cycles.</p>	<p>Pumphrey will attend/present at numerous WSU field days, workshops/meetings, PNW wheat Quality Council, WSCIA Annual Meeting (presentation), WSCIA Board Meetings, WA Grain Commission meetings, industry tours.</p>
<p>Select early-generation breeding lines with good end-use quality potential by eliminating inferior breeding lines prior to expensive and capacity-limited yield tests.</p>	<p>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.</p>	<p>By Nov 2017, we completed evaluation of ~1800 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 2018.</p>	<p>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. In 2017, ~1800 head-row selections were subjected to specific laboratory-based grain quality assays based on market class, and ~900 were retained for single seed descent and 2018 F5:F6 nursery evaluation</p>	

Objective	Deliverable	Progress	Timeline	Communication
<p>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.</p>	<p>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.</p>	<p>We have continued to successfully develop and advanced hundreds of crosses for selection in breeding populations. In 2017 we advanced dozens of special-purpose populations, representing nearly 10,000 distinct lines in the greenhouse. The primary focus in 2017 was Hessian fly resistance selection in club wheat, and introgression of new Hessian fly resistance genes,</p>	<p>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.</p>	