

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

Project #: 3573

Progress Report Year: ___3_ 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, which has progressed nicely. Approximately 2600 early generation lines were evaluated for end-use quality with ~1000 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 2015.

Impact:

This project is critical to the spring wheat breeding program and works seamlessly with project 3571. 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 'Diva', 'Louise', 'Whit', 'JD' and 'Babe' accounted for ~72% of the soft white spring wheat acres planted in the state in 2015.* WSU varieties 'Kelse' and 'Glee' were leading hard red spring wheat varieties in 2015. *In total, >57% of the 2015 Washington spring wheat acres were planted to WSU spring wheat varieties.* Over the past three years, we have released Chet, Alum, Seahawk, 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. Our newest soft white spring wheat, WA8214, which will be released in 2016, is a very exciting release that we anticipate broad adoption.

Outputs and Outcomes: File attached

WGC project number: 3019 3573

WGC project title: Molecular selection of pest resistance, agronomic and grain quality traits for spring wheat variety development.

Project PI(s): Mike Pumphrey

Project initiation date: 2013

Project year: 3 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.	Clearfield™ spring wheat breeding lines have been developed using our most advanced and elite genetic backgrounds. Three hard red spring, WA8220, WA8241, WA8242, two spring club, WA8236 and WA8237, and one common soft white, WA8238, Clearfield+ lines were included in the 2015 Variety Trials. These lines were created using the double haploid method and marker assisted backcrossing. All performed fairly well. We have made swift progress in only a few short years and have several more candidates for the 2016 Variety Trials for hard and soft types. Seahawk soft white spring wheat Foundation seed raised in 2015 (off-season and main season). Seahawk was selected by markers to have a combination of Yr5 and Yr15 seedling stripe rust resistance genes. New DNA markers for Yr5 and Yr15 were developed and validated.	The two-gene Clearfield™ breeding effort is in full swing, ~800 lines were planted at Pullman in plots in 2015. Three Clearfield™ sites were planted in 2015 at Pullman, Dayton, and Plaza. These trials were replicated and designed using the BASF testing protocol. Several of these lines performed well and will be in the 2016 WSU Variety Testing trials.	Pumphrey attended/presented numerous WSU field days workshops/meetings, PNW wheat Quality Council, WSCIA Annual Meeting (presentation), WSCIA Board Meetings, WA Grain Commission, industry tours in Pullman.
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.	Early generation grain quality analyses were employed to select and advance experimental lines with increased likelihood of having superior quality. In 2015, ~2600 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 2016 F5:F6 nursery evaluation. Current analyses include: NIR-protein, NIR-hardness, SKCS-hardness, SDS micro-sedimentation, PPO, and micro-milling.	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.	Nasseer, A. M., J. M. Martin, H.-Y. Heo, N. K. Blake, J. D. Sherman, M. Pumphrey, K. D. Kephart, S. P. Lanning, Y. Naruoka, and L. E. Talbert. Impact of a Quantitative Trait Locus for Tiller Number on Plasticity of Agronomic Traits in Spring Wheat. Crop Science. in press

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>Another successful and ambitious year of greenhouse multiplication and crossing was completed, including two large crossing blocks and thousands of early generation lines tested for stripe rust and herbicide tolerance. The addition of the new wheat greenhouse facility expanded our capacity and we were not as limited by plant growth space.</p>	<p>Annually</p>	<p>Sherman, J. D., N. K. Blake, J. M. Martin, K. D. Kephart, J. Smith, D. R. Clark, M. L. Hofland, D. K. Weaver, S. P. Lanning, H.-Y. Heo, M. Pumphrey, J. Chen, and L. E. Talbert. 2015. Agronomic Impact of a Stem Solidness Gene in Near-Isogenic Lines of Wheat. <i>Crop Science</i>. 55:514-520.</p>