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

**Project #:** 3061-5746

**Progress Report Year:** 2 of 3

**Title:** Pre-breeding for Root Rot Resistance

**Researchers:** Scot Hulbert, Pat Okubara

**Cooperators:** Timothy Paulitz, Deven See, Karen Sanguinet

**Executive summary:**

The aim of this project is to characterize resistance or tolerance to *Rhizoctonia* and other green bridge-promoted diseases identified from five synthetic wheat lines and transfer the resistance to the cultivar Louise. We have now developed several backcross two (BC2) lines for each of the five sources. In the past year all of the BC2 lines were amplified and tested in a field trial in a Pullman site with disease pressure from a green bridge environment. All but two of the 43 lines yielded better than Louise in this trial. Preliminary yield trials were also conducted at the Wilke and Lind farms, but seed was limited. The trials allowed us to discard most of the lines that carried poor traits, like late maturity and poor test weight, from the resistance donor parents. We now have a set of 15 lines, three from each resistance source that we will thoroughly evaluate in 2017. In year 2 of the project, we also completed field resistance evaluation of two large populations of BC1-F5 derived lines from the CIMMYT 3104 and Syn172 sources. The resistance of these lines has also been evaluated in greenhouse assays, but the evaluation of the second population is not yet completed. In collaboration with Deven See, several hundred genetic markers were scored on the CIMMYT 3104 x Louise population using genotype by sequencing (GBS) in the past year. The marker data was then used to create a genetic map on which to integrate the resistance data. Genomic locations (QTL) on three chromosome arms were identified in which resistance from the CIMMYT 3104 parent mapped. GBS mapping of the Synthetic 172 x Louise population has been initiated will be completed in 2017/2018. We are testing for root growth traits that can be used to predict root rot resistance, with the hope that future breeding efforts will not have to rely on the green bridge assay.

**Impact:**

In the past year, the main impact of project was to advance the resistance to Rhizoctonia and green bridge associated diseases to wheat lines adapted to PNW wheat production. Genetic resistance is a cost-saving resource for controlling plant pathogens, but this resource is not available to wheat breeders and growers for *Rhizoctonia* anywhere in the world. Yield loss of wheat and barley due to *Rhizoctonia* and other soilborne pathogens is estimated at 10%, but can be as high as 40% in direct seeded systems in field with high inoculum levels. The resistance to stunting in synthetic wheats is apparently due to multiple genes with small effects, as indicated by our mapping data with the CIMMYT 3104 x Louise population. These lines carry the first known mappable genetic resistance to *Rhizoctonia* in wheat. Given its multigenic nature, resistance is expected to be durable, but will not be simple to move between lines. Genetic improvement of wheat and barley resistance to root rot will contribute to current management by rotation, fungicides and green bridge control, and will enhance profitability and sustainability of dryland cereal cropping.

**WGC project number: 5746**
**WGC project title: Pre-breeding for Root Rot Resistance**
**Project PI(s): Scot Hulbert & Pat Okubara**
**Project initiation date: July 1, 2015**
**Project year: Report for year 2 of 3**

| Original Objectives | Deliverable | Progress | Timeline | Communication |
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| 1) Advance resistance in our five top synthetic wheat lines and test BC2 derived lines from each of the five sources of resistance in multi-location yield trials to determine which resistances provide the best benefits in different types of field environments. | A set of novel Rhizoctonia/ green bridge associated disease resistant lines that can be used to develope PNW spring wheat cultivars. | Multiple (four to 13) BC2 lines from each of the five sources of resistance were selected and amplified this year. Replicated plots were examined in two locations in 2016. | final tests on performance of the advanced lines will be conducted in 2017/2018 at multiple field sites, greenhouse and lab tests. | Progress will be reported at the wheat research review and the Cook Chair review. A germplasm release article will be written in 2018 and the lines will be released to breeders. |
| 2) Map the resistance genes to identify linked DNA markers. | Chromosomal locations and markers for the genes controlling resistance to assist future breeding efforts. | Mapping genes from the CIMMYT 3104 parent is completed and the Syn172 parent in progress. | Genes for resistance from both parents will be complete in 2018. | An article was published in 2016 in the journal Phytopathology and a second will be submitted in 2017. Results were presented at an international wheat conference in 2016. |
| 3) Develop rapid greenhouse assays for Rhizoctonia resistance to reduce time from 14-21 days to 7-10 days, and with less resources. | A more rapid and economical means of selecting and advancing *Rhizoctonia* resistant plants. | This objective has been completed. | This objective has been completed. | A manuscript by Okubara et al. has been published in Plant Disease. |
| 4) Characterize and compare root morphology traits correlated to resistance in advanced lines from each of the five sources of resistance. | Information on whether the synthetic wheats carry true resistance or tolerance, and how similar or unique root morphology traits are in two mosted advanced of the five sources of resistance in the Louise background. | Rigorous and reproducible assays for monitoring root growth variables were developed, and BC2 derived lines have been developed. | Deliverables will be produced at the end of FY18. | In FY16, results were reported at a regional meeting of the American Phytopathological Society and in the WSU Dryland Field Day Abstracts. |