Progress Report

Project #: 3675

Progress Report Year: 2 of 3

Title: Enhancing Resistance to Snow Mold Diseases in Winter Wheat

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Executive summary: Field plots were established 2016 at three locations in WA and one in Tetonia, ID to test advanced breeding lines and three new doubled-haploid populations for snow mold resistance and agronomic performance. Snow cover persisted for well over 100 days in WA and disease development was good enough to collect useful data on disease reaction. Field plots were planted again in 2017 for evaluation in spring 2018, depending on disease development. Wheat samples for fructan analysis were collected from field and growth chamber experiments. Methods for analysis of the sugars were revised and are being optimized with a goal to complete the analyses by the end of February and complete data analysis in 2018. Results of these studies will be used to improve growth chamber screening for resistance. Controlled environment testing won't replace field testing, but it will allow us to make progress on genetic studies throughout the year and eliminate very susceptible lines from field testing.

Impact: During this funding cycle, validation of molecular markers for snow mold resistance in a Xerpha x Munstertaler population was completed and preparation of a manuscript is in progress. Results were presented at one scientific meeting.

The source of resistance in the three new double haploid populations is new to Washington and may result in more effective resistance to the snow mold diseases than exists now.

Successful completion of these objectives will provide growers with a greater selection of high-yielding snow mold-resistant varieties and the development cycle for future varieties will be shorter compared to the conventional methods now used. Results generated in this project are communicated to farmers and field consultants at field days, other meetings, and publications such as Wheat Life. Results are communicated to other scientists directly and through publication in appropriate journals.

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Project PI(s): T.D. Murray, A. Carter, D. Skinner, K. Garland-Campbell, J. Marshall
Project initiation date: July 1, 2016
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Objective	Deliverable	Progress	Timeline	Communication
1. Field test new doubled-haploid populations to identify resistant lines for breeding program, identify new genes and associated molecular markers.	Data on snow mold resistance of genetic populations that will be used to identify new genes and make selections for the breeding program.	**2016**: Three doubled haploid populations were created in three different backgrounds all using PI173438 as the parent. There are two soft white parents and one hard red parent adapted to the PNW. Populations were planted in Waterville and Mansfield, as well as in Tetonia, ID for snow mold screening. Plots had good stand establishment in the fall, and data was collected in the spring of 2017 for snow mold tolerance. **2017:** The populations were planted again in Waterville and Mansfield, as well as in Tetonia, ID for snow mold screening. Waiting for data collection in spring 2018.	Field testing will be conducted in 2017 and 2018. More years of testing may be needed depending on the level of snow mold in each year. One of the three populations will be genotyped in 2018 using GBS and the other two will be used for validation.	Results of this work will be presented at field days, variety plot tours, other grower and industry talks, and on the WSU Wheat and Small Grains website.

2. Field test advanced breeding lines and new varieties to determine their reaction to snow mold diseases.	Provide data on snow mold resistance of advanced selections and new varieties. Expand variety ratings in the seed buyer's guide.	**2016:** The winter wheat breeding program planted 246 advanced breeding lines for testing in the spring of 2017 under snow mold conditions. We were able to identify many breeding lines with excellent resistance to snow mold. Many of these have come up through the program with continual selection under snow mold conditions. The establishment of excellent lines with snow mold resistance indicates that selection under natural conditions is an appropriate method for development of new lines. We also evaluated a diversity panel of 480 soft white lines for further genetic understanding of snow mold resistance. **2017:** In the fall of 2017 we planted the diversity panel of 480 lines in both Waterville and Tetonia for evaluation. Our breeding lines were planted in two locations in Waterville. We planted ~300 breeding lines for evaluation. We also planted ~40 populations for early generation selection, and have started including Kim Campbell's club wheat (both early and late generation) in our planting designs to improve club wheat performance to snow mold.	Field plots will be established in fall 2016 and rated in the spring of 2017 for reaction to snow mold. This will continue each year of the project.	Results of this work was presented at field days, variety plot tours, other grower and industry talks, and on the WSU Wheat and Small Grains website. Data will be used to provide ratings in the seed buyer's guide.
	Prepare an article for Wheat Life during the three-year project summarizing results to date.	**2017:** No progress. A new schedule was developed for 2018 articles and snow mold was not included.	An article will be submitted in late 2018 near the end of the project.	

3. Measure fructan concentrations in winter wheat crowns of breeding populations and identify genes involved in its production to determine their association with snow mold resistance.	Methods and data that can be used to screen breeding populations efficiently and determine whether fructan accumulation can be used to indirectly select for resistance to snow mold diseases.	**2016:** Samples were collected in 2016 from both field and growth chamber experiments. Sample preparation has been completed, and are now being run to determine fructan concentrations in the different lines. Data should be ready for analysis in early 2017. These lines have also been screened for cold tolerance and snow mold tolerance in order to correlate results. Two populations are being screened. One looking at different levels of cold and snow mold tolerance between lines, and the other is a set of isolines varying for the VRN alleles. **2017:** Samples were collected from field and greenhouse experiments. Work is in progress now to optimize methods for measuring the fructans. The goal is to have all analyses completed by the end of February 2018.	Multiple years of data will be needed to reach conclusions, so this work will be conducted each year of the project. Growth chamber plants were harvested in 2016 and will continue into 2017. Field collections occurred in 2017 and analyses are in progress.	Results of this work will be presented at field days, variety plot tours, and other grower and industry talks. When completed, results will be published in Wheat Life, scientific journals, and the WSU Wheat and Small Grains website.
4. Establish protocols for screening large numbers of breeding lines for snow mold resistance under controlled environment conditions.	A method of screening for snow mold resistance in growth chambers.	**2016:** Waiting for results from fructan studies to identify critical environmental conditions to identify resistance. **2017:** Growth chamber experiments were conducted in 2017 to collect samples for carbohydrate analyses. These data will be used to develop growth chamber screening methods.	Growth chamber experiments to measure fructan accumulation will begin in 2016 and continue each year of the project.	Results of this work will be presented at field days, and other grower and industry talks. When completed, results will be published in Wheat Life, scientific journals, and the WSU Wheat and Small Grains website.