

**Washington Grain Commission**  
**Wheat and Barley Research Annual Progress Reports and Final Reports**  
*Format*  
*Updated November 2013*

**Project #: 3019-3564**

**Progress Report Year:**       2   of   3   (*maximum of 3 year funding cycle*)

**Title: Fusarium Crown Rot on Wheat: Prebreeding and Development of Tools for Genetic Disease Management**

**Investigators: M. Pumphrey, K. Garland-Campbell, and T. Paulitz**

**Cooperators: R. Smiley, Yvonne Manning, Chris Mundt, OSU; Grant Poole, Syngenta.**

**Executive summary:**

- We screened the 2015 and 2016 WA winter soft winter wheat variety trials adapted in greenhouse trials for resistance to *F. culmorum*. In each nursery screened, we were able to identify 4-5 lines with better resistance than others. 23 lines were significantly more tolerance to FCR compared to the susceptible check, ‘Madsen’ ( $\alpha = 0.05$ ). No genotypes were significantly less tolerant to FCR than ‘Madsen’ ( $\alpha = 0.05$ ).
- The nine genotypes with the best tolerance were Xerpha, 04PN096-2, IDN01-10704A, ARS20060126-35C, Eltan, 09PN062#18, LOR-334, KWS-034, LWW14-71195.
- We rated naturally inoculated field screening trials at Reardan, Creston, Lamont, Ritzville, Mansfield, Harrington, and Connell.
- There were positive correlations among genotype FCR ratings between Lamont and Ritzville, Reardan and Harrington, and Lamont and Harrington. These locations are close to each other in distance near the Channeled Scablands of Eastern Washington, and are all in rainfall zones of less than 406 mm yr<sup>-1</sup>
- Correlations between field and greenhouse screening trials were weak, likely because the field trials had mixed populations of soil borne disease. This is likely due to the presence of other pathogens, variation in soil type, FCR disease severity and climatic factors. The pathogen most likely to cause a discrepancy in field screening is Eyespot, caused by *Ocumacula* spp., which is widely distributed in the dryland wheat areas of the Pacific Northwest. The root symptoms are similar, except that eyespot also causes characteristic ‘eye-shaped’ lesions on the stems
- We repeated these trials in the greenhouse and collected stems from additional locations to rate the incidence of eyespot to determine where mixed infections were prevalent.
- The spring wheat mini-core collection, developed from the Spring wheat germplasm of the National Small Grains collection was rated in the greenhouse for resistance to FCR. Association mapping for FCR resistance will be conducted in 2017 to identify new sources of resistance.
- A population segregating for resistance to lesion nematodes also has resistance to Fusarium and a QTL for resistance to multiple soil borne diseases was identified on chromosome 5A, derived from the wild wheat breeding line.

**Impact:**

- New sources of resistance have been identified. We are combining sources of resistance in winter wheat
- Development of resistant varieties will reduce losses from Fusarium crown rot and improve the economic and environmental sustainability for Washington growers
- The main goal is to provide genetic resistance to common soil borne diseases present in the Intermountain wheat growing area.
- Mixed infections of FCR and Eyespot means that breeding efforts must be dedicated to both pathogens. Our additional goal is to separate genetic resistance to FCR from genetic resistance to Eyespot so that we can better select for resistance to both pathogens.

**Communication****Refereed papers**

Thompson, AL, Mahoney, AK, Smiley, RW, Paulitz, TC, Hulbert, S, Garland-Campbell, K, 2017. Resistance to multiple soil-borne pathogens of the Pacific Northwest is co-located in a wheat recombinant inbred line population. In press..

**Abstracts**

Thompson, Y.A., Garland-Campbell, K.A., Paulitz, T.C., 2016. Differential Response of Wheat (*Triticum aestivum* L.) to Fusarium culmorum. Crop Science Soc. of America Annual Meeting, Phoenix AZ, Nov. 2016.

Larkin, D., Paulitz, T.C., and Garland-Campbell, K.A., 2016. Comparison of Greenhouse and Field Rating Systems for Fusarium Crown Rot in Winter Wheat (*Triticum aestivum* L.). Crop Science Soc. of America Annual Meeting, Phoenix AZ, Nov. 2016.

Larkin, D., Paulitz, T.C., and Garland-Campbell, K.A., 2016. Comparison of Greenhouse and Field Rating Systems for Fusarium Crown Rot in Winter Wheat (*Triticum aestivum* L.). National Assoc. of Plant Breeders. Aug. 2016. Raleigh NC.

**Popular Press****Web****Presentations**

WGC project number: **3019-3564**  
WGC project title: **Fusarium Crown Rot on Wheat: Prebreeding and Development of Tools for Genetic Disease Management**  
Project PI(s): **M. Pumphrey, K. Garland-Campbell, and T. Paulitz**  
Project initiation date: **7/1/2015**  
Project year: **Year 3**

What measurable impact will your project have in the next three years? **A list of the most tolerant and susceptible varieties in current use.**

Objective	Deliverable	Progress	Timeline	Communication
<b>Objective 1. Perform association mapping on spring and winter core collections to identify further sources of resistance.</b> <b>Objective 2. Screen all variety and regional nurseries for resistance in greenhouse screening.</b> <b>Objective 3. Expand field testing to two locations, and test variety and regional nurseries. Evaluate new seed treatments, since there is little information on how seed treatments may protect against this disease.</b>	Resistant sources that can be used for variety development.	A mini-core collection was developed for the spring core collection. Phenotyping and screening of mapping population in the greenhouse has been completed.	Greenhouse screening (phenotyping) completed. Association mapping still needs to be done.	Articles in Wheat Life, grower presentations, abstracts, conference proceedings, refereed scientific articles
	Ratings of varieties for Fusarium tolerance in the the WSCIA seed buyers guide and other publications.	WSU winter variety trials are being screened in the Wheat Plant Growth Facility. We completed screening the complete winter wheat soft variety collection in both 2015 and 2016.	Ongoing, every year. Completion of that year's greenhouse trials by August.	Articles in Wheat Life, grower presentations, abstracts, conference proceedings, refereed scientific articles
	Ratings of varieties for Fusarium tolerance in the the WSCIA seed buyers guide and other publications. Evaluation of seed treatment chemicals for efficacy against Fusarium crown rot.	Because of the widespread incidence of Fusarium crown rot in field locations in 2015, we sampled from WSU winter variety trials at Reardan, Creston, Ritzville, Harrington, Lamont and St. Andrews. We also planted an inoculated winter wheat trial at Mansfield and inoculated spring wheat trial at Lind. These are currently being rated. Initial results from these trials have identified SY107, ORCF103, and WA8227 with more susceptibility to Fusarium crown rot and Coda, IDN-06-18102A, WA 8202, WB-1070CL, and ARS010679-1C with more resistance to Fusarium crown rot than other lines. We will compare these results to the greenhouse assays to determine how predictive the greenhouse assays are of field results. In 2016, stems were collected from seven variety testing locations in Washington, and are currently being evaluated.	Nursery evaluation will be ongoing with data analysis completed by Jan. of each year following the field trial.	Articles in Wheat Life, grower presentations, abstracts, conference proceedings, refereed scientific articles