Project #: 3061-3548
Progress Report Year: 3rd of 3rd (maximum of 3 year funding cycle)

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

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Executive summary:

- We have taken the data from the Fusarium field surveys funded by the previous grant, and did an extensive analysis and modeling to look at relationships of species with climatic and cropping factors in the dryland area of PNW. Isolates of Fusarium spp. were obtained from 99% of 105 fields sampled in 2008 and 97% of fields in 2009. Results of the factor analysis showed that the distribution of *F. pseudograminearum* occurred in a greater frequency in areas of the PNW at lower elevations with lower moisture and higher temperatures, whereas *F. culmorum* occurred in greater frequency from areas at higher elevations with moderate to high moisture and cooler temperatures.

- We have screened 293 adapted spring and winter wheat lines 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. The lines with the best resistance in these trials included spring wheat lines Nick, WB-1035CL, WA8193, WA8195, LNR10-0551, WA8163, UC1742, and Louise, and winter wheat lines SY Ovation, OR2070870, and ARS010302-5C. These results will have to be confirmed with additional trials, due to the variable nature of the disease.

- A mini-core collection was developed for the Spring wheat germplasm of the National Small Grains collection. These lines were increased and being evaluated for Fusarium resistance in the greenhouse screening in 2014/2015. Genotype data is available for this collection.

- Synthetic wheat lines from CIMMYT were screened and three of them were identified as resistant. These lines have been crossed to adapted spring wheat germplasm.

- We evaluated 90 Spring breeding lines and cultivars from the Washington State spring wheat Extension Trials and the Western Regional Spring wheat nurseries for resistance to *F. culmorum* in the field and Lind. The disease pressure was lower than optimal, likely due to the drought, but we were able to discern some lines with better resistance than others, including LCS-Buck Pronto, and Otis, Patwin515, Scarlet, Tarra 2002, WA8219, WB-1035CL, WB-Fusion, and Zak. These results need to be confirmed in trials with heavier disease pressure and results need to be correlated to the greenhouse trials.
Impact:

- Fusarium crown rot is widely distributed throughout all cropping zones, in levels causing economic loss. Different zones however, have a predominance of one species. This is important information for deployment of resistance/tolerance genes in the future.
- The variability of this disease is such that multiple replications and experiments are needed to accurately rate resistance. With the further refinement of our screening systems, we are able to rate several hundred lines in greenhouse and field screening sites on a routine basis. New sources of resistance have been identified.
- Development of resistant varieties will reduce losses from Fusarium crown rot and improve the economic and environmental sustainability for Washington growers.
- Methods for field screening are essential to accurately evaluate response to root disease. We have developed a method that is working to evaluate varieties at Lind, and collaborated with others to expand the number of testing locations. With these field trials, plus our more rapid greenhouse trials, we have identified some breeding lines and cultivars with better than average resistance. These can be intercrossed to accumulate resistance genes with minor effects.
### Objective 1. Confirm resistance of 3B QTL against *Fusarium culmorum*.
- **Deliverable**: Verification of resistance with the same gene.
- **Progress**: Fusarium screens were conducted at the WSU Plant Growth Facility using *Fusarium culmorum*. The nurseries screened were the WSU wheat variety trials as well as the Western Regional Nurseries. We have identified approximately 40 lines with better resistance, but this disease is highly variable. We need to repeat these trials under heavier infection pressure in order to confirm resistance.
- **Timeline**: Will be completed after year 3.
- **Communication**: Articles in Wheat Life, grower presentations, abstracts, conference proceedings, refereed scientific articles. See attached page for 2013 communications.

### Objective 2. Optimize field inoculation techniques (millet seed vs seed coating) and develop natural disease nurseries. Test advanced lines and PNW winter and spring wheat varieties for tolerance and resistance in inoculated field nurseries. Use the field screening sites to evaluate and select germplasm resources from other regions of the US, from the USDA-small grains germplasm bank, and from international nurseries.
- **Deliverable**: Efficient screening system that mimics real life farmer experiences with *Fusarium*.
- **Progress**: Inoculated field screening trials were planted at Lind. The winter wheat trial at Pullman was complicated by infection of eye spot making it difficult to rate the entries so that site was not used for Fusarium. The spring wheat trial at Lind had good infection but the disease pressure was low, likely due to the drought. For the future, we will conduct field screening for Fusarium resistance at Lind using irrigation and higher inoculum rates. We were able to distinguish some differences among varieties.
- **Timeline**: Development of screening systems will be completed after year 3. Variety testing will be ongoing.
- **Communication**: Articles in Wheat Life, grower presentations, abstracts, conference proceedings, refereed scientific articles. See attached page for 2013 communications.

### Objective 3. Validate the 3B QTL in additional segregating populations with Sunco as a parent and prebreeding development of germplasm using germplasm resources from international CIMMYT nurseries introgressed into the best locally adapted winter and spring wheat cultivars.
- **Deliverable**: New breeding lines with moderate resistance to Fusarium that are derived from combinations of Australian and US germplasm.
- **Progress**: Segregating populations have been planted in the greenhouse for inoculation and screening this spring. A mini-core representing 1/100 of the National Small Grains Spring wheat collection was identified. Seed was increased and screening for Fusarium resistance is currently being conducted in the GH. The data obtained from evaluation of the spring mini-core will be used with existing genotype data to conduct association mapping for Fusarium resistance, to identify new sources of resistance.
- **Timeline**: Will be completed after year 3.
- **Communication**: Articles in Wheat Life, grower presentations, abstracts, conference proceedings, refereed scientific articles. See attached page for 2013 communications.
Communications for Washington Wheat Commission Grant 2012-2014

Refereed Publications, Popular Press Articles (partially supported with Wheat Commission funding):

2012


2013


Presentations and Reports:

2012


Poole, G. J., Smiley, R. W., Paulitz, T. C, and Campbell, K. G. 2012. Identifying QTL for Fusarium crown resistance (*F. pseudograminearum*) in field, terrace, and


2013


2014

