Progress made so far (June 2014-December 2015) for the three years research project (2014-2017)

By Shaukat Ali and Emmanuel Byamukama

Title: Upper Great Plains Wheat Pathology Collaboration: Bacterial leaf streak, root and crown rots and viral diseases of wheat

Objectives

1. *Identify sources of resistance to BLS using the established regional collaborative field nursery*
2. *Optimize the methods for screening wheat at seedling stage in the greenhouse*
3. *Examine the influence of leaf spot pathogens and fungicide applications on BLS development*
4. *Complete fungal isolation from the sub crown internodes and crown samples collected in 2015*
5. *Characterize fungi based on morphological characteristics, DNA sequence, and pathogenicity*
6. *Optimize methods for screening wheat to root rot pathogens, both in the greenhouse and field*
7. *Screen commercial cultivars and advanced breeding lines for resistance to CRR and FCR*
8. *Conduct field surveys of root rot diseases in certain regions or areas of particular interest*
9. *Develop virus characterization and diagnostic tools*
10. *Examine the epidemiology and distribution of cereal viruses in spring and winter wheat`*
11. *Determine the occurrence and distribution of cereal viruses on non-wheat hosts*
12. *Develop management strategies for viral diseases*
13. *Disseminate information to wheat growers*

Bacterial leaf streak, and root and crown diseases of wheat

- Seven spring wheat cultivars were subjected to common root rot and crown rot pathogens for seed germination and seedling mortality evaluation, respectively under greenhouse and field conditions for fungicide seed treated and non-treated seed. In greenhouse experiment, 26 to 56 % reduction in seed germination/mortality was observed in the cultivars. Advance, Briggs, Oxen, Prevail, Traverse cultivars were found to be more prone to crown rot pathogen. The cultivars Forefront and SD4189 were found to be less prone to crown rot pathogen. Similar trend was observed in seed germination in field experiment. Fungicide treatment improved the seed germination. This experiment will be repeated under both greenhouse and field conditions (Fig. 1, 2, 3). All field experiments will be repeated in the third (last year) year of the project.

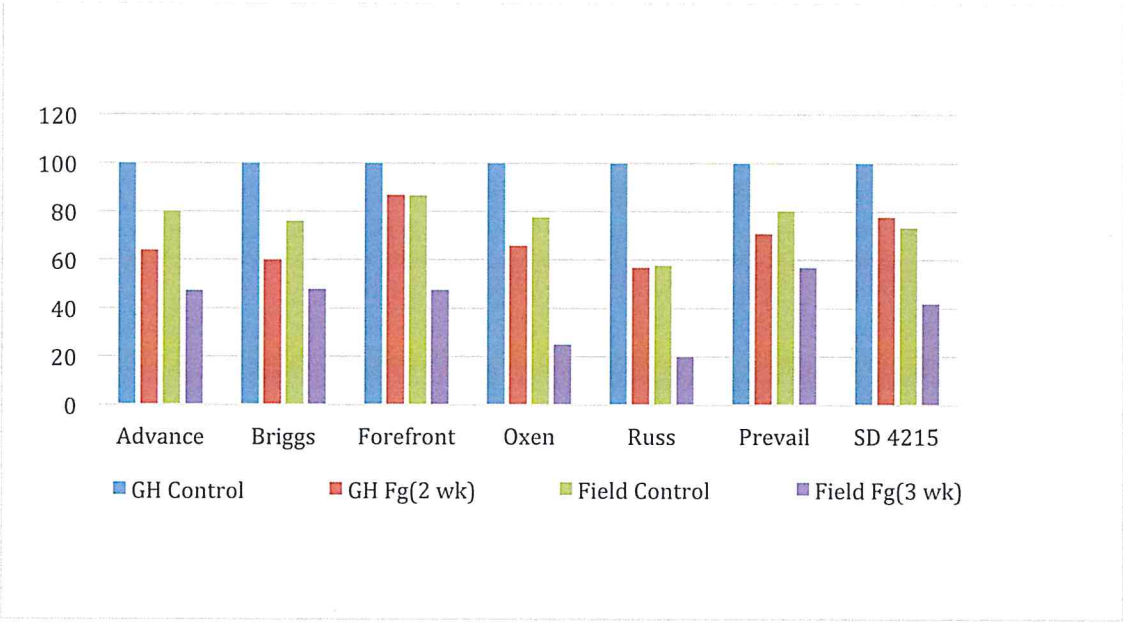

Fig. 1. Effect of *Fusarium graminearum* (crown rot) infested seed on germination of seven spring wheat cultivars under greenhouse and field (Volga) conditions.

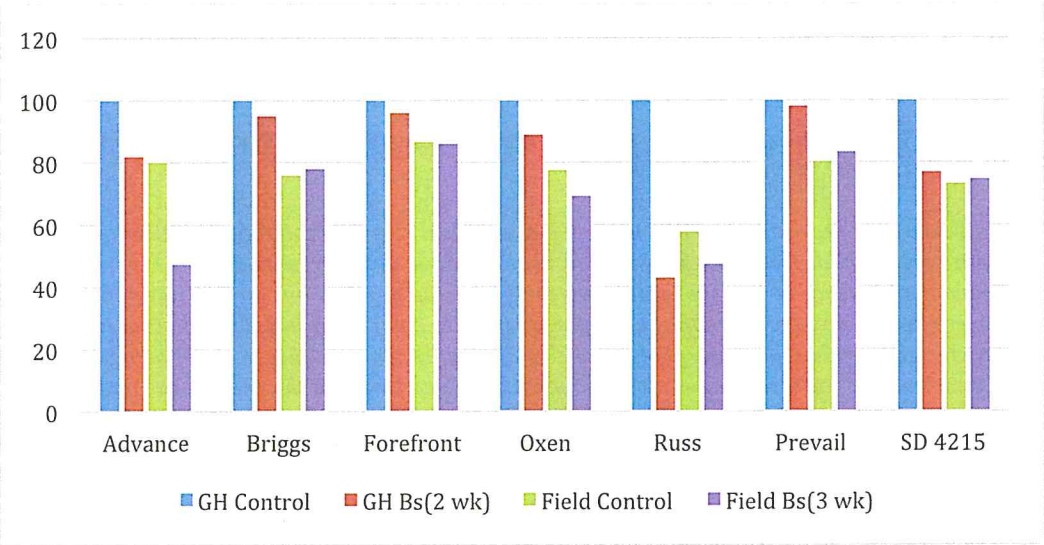

Fig. 2. Effect of *Bipolaris sorokiniana* (common root rot) infested seed on germination of seven spring wheat cultivars under greenhouse and field (Volga-2015) conditions.

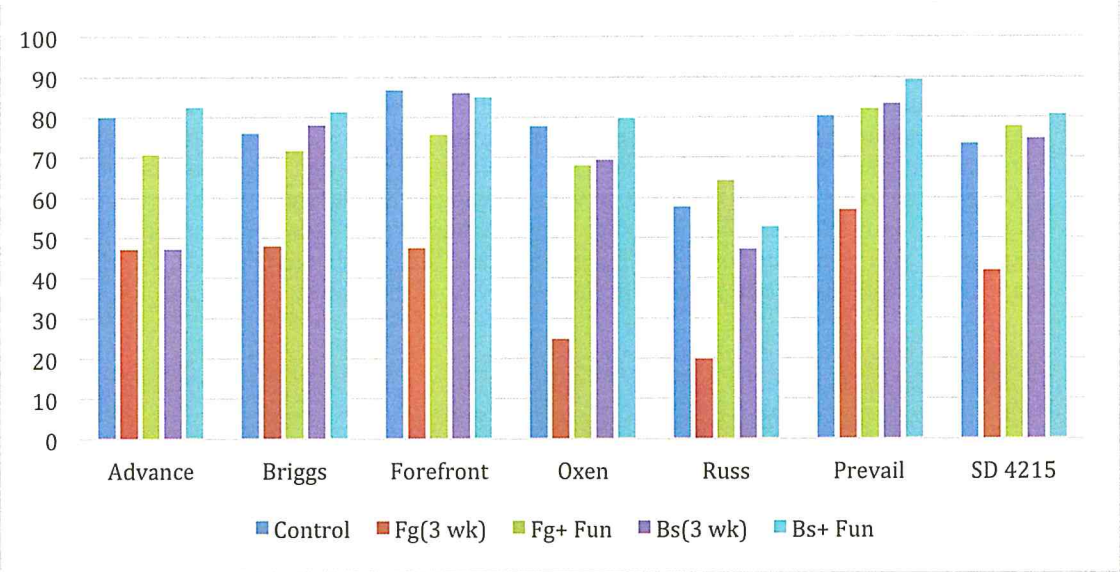

Fig. 3. Effect of *F. graminearum* (crown rot) and *B. sorokiniana* (common root rot) infested seed **with and without fungicide treated** on germination under field conditions (Volga-2015)

- BLS cooperative nursery was established, at Brookings, for identification of sources of resistance during 2014, 2015 summer. 113 and 120 spring wheat genotypes developed by SDSU, NDSU, UM, CIMMYT, and private sector were evaluated. The resistance/susceptibility data was recorded and communicated back to the breeders in the various institutions. Some BLS resistant wheat genotypes, developed at CIMMYT, were identified and shared with our SDSU wheat breeders.
- Thirty-seven wheat root samples were collected from various wheat fields for root pathogens identification. So far, 31 samples were analyzed and *Fusarium graminearum/acuminatum* was recovered in high frequency as compared to common root rot pathogen, *Bipolaris sorokiniana*. A few samples were harbored with Take-All pathogen, *Gaeumannomyces graminis*. Wheat root samples collected in summer 2015 are still being processed out.
- A graduate student was recruited and she began working to accomplish the proposed research objectives in spring 2015. The student also presented the greenhouse root rot/seed germination experiment results at 2015 NC APS meeting held at East Lansing, MI.

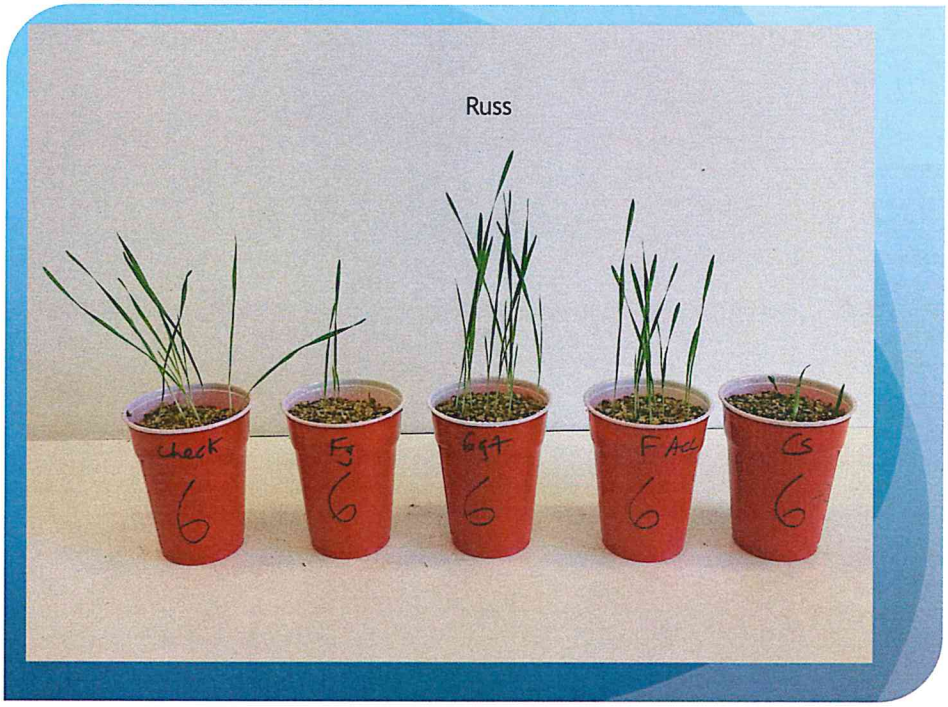

Fig 4. (L-R). Effect of *F. gramiinearum* (crown rot) (2), *G. graminis* (Take-All) (3), *F. accuminatum* (4), and *B. sorokiniana* (common root rot) infested seed of spring wheat cultivar "RUSS" on germination.

Virus Diseases of Wheat

- We tested 276 samples suspected to have wheat viruses collected this past spring and summer from 59 fields. Of the samples, 236 came from winter wheat, 32 from spring wheat and 11 were grass samples. Viruses tested were Wheat streak mosaic virus (WSMV), Triticum mosaic virus (TriMV), Barley yellow dwarf virus (BYDV), Soil-borne wheat mosaic virus (SBWMV), High Plains virus (HPV), and Brome mosaic virus (BMV).
- WSMV was the most prevalent virus having been found in 39% of the samples tested. This year had seveal fields with severe WSMV outbreak especially west river. Low moisture early spring contributed to high wheat curl mite populations. Two fields in Tripp County were plowed under due to WSMV. TriMV was found in 5% of the samples while BYDV was found in 70% of the samples suspected to have BYDV (n=75) in 30 fields. High Plains virus was 7.5% of the samples and SBWMV or BMV were not detected in any field. Only one grass (brome grass) sample from a field that had severe WSMV was positive for WSMV. One wheat sample had three viruses (WSMV+TriMV+ HPV) detected while all 16 samples positive for HPV were also positive for WSMV. Four samples out of 6 positive for TriMV were also positive for WSMV.
- Although these samples were not completely random (symptomatic leaves were sampled), these results indicate that WSMV is the most predominant virus on wheat. Moreover, samples that had other virus had WSMV as well. The reason for detecting high levels of BYDV in symptomatic leaves is because of clear symptoms that BYDV causes in wheat. We will be performing further tests to confirm the two strains of BYDV. Fields that had high WSMV were either planted into wheat stubble that had a lot of volunteer wheat that was never destroyed before planting or were planted close to a previously WSMV wheat field that volunteer wheat. Elimination of volunteer wheat and grassy weeds remains the most effect approach in managing WSMV and other wheat curl mite transmitted viruses.
- Information on disease management including virus diseases was disseminated to growers through iGrow, wheat walks, crop and pest newsletter, and field days. A youtube video on biology and management of WSMV was produced. For the third and final year, we will continue to monitor wheat viruses incidence and combine three years data to determine risk factors for virus outbreak, and continue to provide wheat disease management information to producers, agronomists, and crop consultants through wheat walks, field days, crop and pests newsletter and through other outreach programs.