Project title: Sustainable Disease Management for Profitable Wheat Production

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Summary

Multiple diseases (leaf spots, rusts, ergot, FHB, etc.) throughout the growing season attacked wheat. Knowledge of important pathogens and their associated diseases in the region; availability of sources of resistance for developing disease resistant cultivars, genetic variation in the pathogen for virulence and fungicide resistance is crucial for developing robust, sustainable, and profitable disease management strategies. Leaf spotting (e.g., tan spot, Stagonospora leaf blotch, rusts) and head (FHB and ergot) diseases can cause significant yield losses and reduce crop productivity and profitability. In this grant proposal, we propose the following objectives: screening wheat germplasms for their reaction to leaf diseases (leaf rust, stem rust tan spot, BLS, etc.) and develop an integrated approach that combines diagnosis, basic epidemiology of ergot, disease forecasting, fungicide application, and rand producer education for effective and sustainable wheat diseases management. The information obtained from this research project will directly help in increasing the crop productivity and profitability hence enhance the income of wheat producers and improve their livelihood.

Objectives

1. **Determine diversity and fungicide sensitivity in leaf spot causing pathogens (Ali and Byamukama)**
   Wheat leaves infected with leaf spot (tan spot and Stagonospora nodorum blotch) and heads infected with FHB were collected from SDSU research Stations located at the Volga, Aurora, near South Shore, and SDSU wheat breeding nurseries located at Selby, and Ideal. Forty Single spore isolates of *Pyrenophora tritici-repentis* (tan spot) and thirty

Fusarium graminearum (FHB) isolates recovered from the samples. All forty *P. tritici-repentis* isolates were phenotypes for their race structure on a set of wheat differentials in the greenhouse. The evaluated isolates were grouped under race 1. Our preliminary results indicate no change in the pathogen population from our previous study (Abdullah et al. 2016). We developed a microtiter plate method for testing *P. tritici-repentis* and *F. graminearum* isolates for their fungicide sensitivity. The technique is being evaluated for its reliability and repeatability. A graduate student works on this project. Due to hot and dry 2017 wheat growing season, leaf and head diseases were at a minimum level so we could not collect many samples. We will collect more samples in 2018 growing season and recover more *P. tritici-repentis* (Tan spot) and *F. graminearum* (FHB) and test them for their virulence and fungicide resistance.

2. **Host SDSU Small Grain Disease Forecasting (Byamukama)**
   The forecasting system was available during the growing season and was accessed by the crop consultants and wheat growers. The tool was accessed 537 time and the county with highest access was Codington county. The 2017/2018 growing season was generally dry therefore few growers applied fungicides to need to access the tool.

3. **Screen CPT, AYT spring wheat and winter wheat material against leaf rust, stem rust, and leaf disease at seedlings in the greenhouse (Ali)**
   Thirty-nine winter wheat and 46 spring wheat genotypes included in the crop performance (CPT) were screened for leaf rust, tan spot, and Stagonospora nodorum leaf blotch under greenhouse conditions and the results shared with the SDSU agronomist and wheat breeders. Also, I took disease notes of CPT winter wheat and spring wheat trials located at four SDSU research farms (Volga, South Shore, Selby, Ideal) and shared the results with the SDSU Agronomist. Additionally, I took disease notes (leaf spot, rusts, FHB, and ergot) of spring wheat AYT, PYT, and PPY trials located at Selby, South Shore. Some of the evaluated genotypes evaluated potentially released as cultivars in the coming years.
4. **Test new chemicals for their efficacy for fungal and bacterial leaf and head diseases (Byamukama)**
   A fungicide timing study was done to determine the most efficacious fungicide timing. Treatments included a fungicide applied at tillering, flag leaf, flowering or tillering + tillering. Fungicides applied at flowering reduced leaf spot and FHB at the Volga location but not at Northeast Research Farm near Southshore. Fungicides applied at tillering alone did not have a significant impact on yield. A combination of a FHB moderately resistant cultivar and a fungicide applied at 50% flowering was more effective in controlling FHB than a fungicide applied to a susceptible cultivar.

5. **Establish regional (MNU, NDSU, and SDSU) Bacterial leaf streak (BLS) nursery at Brookings (Ali)**
   A regional spring wheat bacterial leaf streak nursery was established in the experimental area at Brookings. One hundred-twenty wheat genotypes from UM, NDSU, SDSU, and private sectors

were planted and inoculated with BLS causing bacterial cells suspension and rated for their reaction to BLS. Of the 20 lines submitted from SDSU breeding program evaluated, 7 lines were resistant, 2 were moderately resistant, and 11 were moderately susceptible. The data were submitted to Dr. Ruth Del-Macky (University of Minnesota) who shared the results with the participants. The results of BLS screening obtained from multiple locations will enhance confidence in selecting genotypes with better BLS resistance and ultimately help in increasing crop productivity and increase farmers income.

Fig 1. Regional bacterial leaf streak nursery established at Brookings SD in 2017

6. **Monitor foxtail millet for its role as a source of inoculum for wheat blast and evaluation of commercial wheat cultivars against wheat blast (Ali and Byamukama)**
   Due to dry and hot weather conditions in 2017 growing season, we did not observe much blast symptoms on foxtail. We will monitor more foxtail millet fields for blast symptoms and collect isolates. We established disease nursery for ergot and wheat blast at the Volga research farm. Forty-eight (CPT) wheat cultivars/lines were planted and inoculated individually with *Claviceps pupuria* (Ergot) and *Pyricularia griseae* (blast pathogen) at flowering stage. The ergot and blast symptoms did not develop may be due to unfavorable weather conditions for disease development. We will repeat this experiment in 2018. Eight genotypes of each of spring wheat and winter wheat were evaluated against wheat blast using *Pyricularia griseae* (blast pathogen) recovered from foxtail millet. All evaluated sixteen genotypes exhibited resistance to the disease. These preliminary results indicate that *P. griseae* infects may not be virulent on wheat. We will evaluate more wheat genotypes and the fungal isolates from foxtail millet for their reaction to blast at leaf stage in the greenhouse during fall 2018 and spring 2019.

7. **Provide opportunities for producers to learn about disease diagnosis and management of wheat diseases (Byamukama and Ali).**
   Wheat disease alerts and progress was communicated to growers, agronomists, and crop consultants throughout the season. Information on the Small Grains Disease Prediction Tool was given out at the start of the wheat growing season. Eighteen extension articles

and 6 radio interviews were produced to provide stakeholder with information to manage wheat diseases effectively.

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