Spring Wheat Breeding

South Dakota Wheat Commission
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Total project period: (Continuous)
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Research Summary:
The general objective of this research program is to develop and release new and improved hard red spring wheat cultivars to regional producers in SD, MN, and ND. This objective has been successfully accomplished through the release of four cultivars since 2013 (i.e., 'Prevail', 'Focus', 'Boost', and 'Surpass'). Each cultivar possesses unique agronomic, disease resistance, and end-use quality characteristics, but are all known for their regionally competitive levels of grain production.

Introduction:
Specific objectives of this program are to 1). continually create and evaluate hard red spring wheat germplasm populations for eventual derivation of experimental breeding lines, 2). further evaluate experimental breeding lines for agronomic performance potential, resistance/tolerance to biotic and abiotic stresses, and end-use quality characters through conducting replicated performance trials, and 3). ultimately new cultivar release at a rough frequency of one every other year.

Description of Accomplishments:
During this reporting period, 340 unique wheat hybridizations were created. These are known as F_1 populations and should result in the same number of segregating F_2 populations next year. Operations within the program are cyclical and continuous, so that a subset of materials from within selected first year segregating populations (i.e., F_2's) in 'year x' become F_3 materials which are evaluated in 'year x+1'. Likewise, lines from within selected F_3's, evaluated in 'year x+1', are evaluated as F_4's in 'year x+2'. During the 2017 growing season, field trial plots of about 320 F_2, 640 F_3, and 600 F_4 populations were grown at two locations and tested for grain yield potential, volume weight, protein content, Fusarium head blight resistance, and several end-use quality characteristics. At the end of 'year x+2', focus then shifts from within segregating populations to individual experimental breeding lines by selecting the best 72 F_4 entries for continued evaluation as Preliminary Yield Trial (PYT) entries for a single year. Lines tested as PYT entries in 2017 were grown

at seven locations throughout the SD spring wheat production region. Upon completion of PYT examination each year, several lines are then chosen for perpetuation as Advanced Yield Trial entries. Typically, AYT entries are examined for three or four years prior to release as a cultivar. During each year, poorly performing AYT entries are removed from consideration which allows for new entries to be admitted each year. In 2017, 36 lines were tested along with 12 check cultivars. Trials were grown in nine SD locations, two in ND, and as part of a collaborative research agreement with a European seed company, and one location in England with another European seed company. Lines in the AYT are tested for grain yield potential, volume weight, protein content, resistance to Fusarium head blight and other diseases, as well as numerous end-use quality characteristics. Comparisons over years and locations are made with respect to check cultivars. When line performance over two or three years suggests there is potential for consideration as a cultivar release, steps are initiated for more wide-spread agronomic testing, usually via SDSU Crop Performance Testing, and seed increase which takes place in conjunction with SD Foundation Seed Stocks Division.

Projections:
During fall 2017 no advanced experimental breeding lines were proposed for release. One advanced experimental breeding line known as SD4539 will, however, be proposed for release as a new cultivar in November 2018. One additional advanced experimental breeding line, SD4625, will also undergo large-scale increase in California to create sufficient seed for potential release in fall 2019.

Publications:
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Kandel, D. R., K. D. Glover, W. A. Berzonsky, J. L. Gonzalez-Hernandez, S. Ali, S. Chao, and S. J. Bhusal. 2017. Flanking SSR markers for alleles involved in the necrosis of hybrids between hexaploid bread wheat and synthetic hexaploid wheat**.** J. Crop Improvement. 31:879-892.

Eldakak, Moustafa, Aayudh Das, Yongbin Zhuang, Jai S. Rohila, Karl Glover, and Yang Yen. 2018. A Quantitative Proteomics View on the Function of Qfhb1, a Major QTL for Fusarium Head Blight Resistance in Wheat. Pathogens. 7(3), 58; https://doi.org/10.3390/pathogens7030058

Yabwalo, Dalitso N., William A. Berzonsky, Daniel Brabec, Thomas Pearson, Karl D. Glover, and Jonathan L. Kleinjan. 2018. Impact of Grain Morphology and the Genotype by Environment Interactions on Test Weight of Spring and Winter Wheat (Triticum aestivum L.). Euphytica. 214: 125. https://doi.org/10.1007/s10681-018-2202-7

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architecture of genome-wide recombination rate variation in alopolyploid wheat revealed by nested association mapping. The Plant Journal. https://doi.org/10.1111/tpj.14009

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