Breeding Spring Wheat for Disease Resistance

South Dakota Wheat Commission
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Research Summary:
The general objective of this research program is to generate new hard red spring wheat germplasm with improved levels of resistance to regionally prominent diseases; primarily Fusarium head blight (FHB) and Bacterial leaf streak (BLS). The germplasm is used specifically to increase the frequency of more resistant types for use as parents in the breeding program. Demonstration that the objective has been successfully accomplished with respect to FHB resistance can be illustrated by noting levels among Uniform Regional Scab Nursery (URSN) entries submitted in 2017, as an example. Among the five experimental lines submitted by this program (i.e., those designated as 'SDXXXX'), all were among the top ten most resistant with respect to Disease Index. Likewise, four were among the ten best for FDK values, and resistance to DON accumulation (Table 1). Additionally, increasing levels, and documentation of, resistance to BLS has been accomplished though continual germplasm screening activities that have taken place each year since 2012.

Introduction:
Specific objectives of this program are to 1). continuously create and evaluate hard red spring wheat germplasm populations for resistance to FHB and BLS, and 2). utilize line selections as parents to increase the frequency of resistant materials in the breeding program.

Description of Accomplishments:
During the 2018 reporting period, thousands of experimental breeding lines were evaluated for resistance to FHB and/or BLS. Roughly 3,000 lines were evaluated only for FHB and were derived from the breeding program, other cooperating breeding programs, or as evaluations of released cultivars included in the SD Crop Performance Testing program. Additional lines were tested for both FHB and BLS resistance which allows for

identification of desirable breeding parents as well as accumulation of data with which to make cultivar recommendations to growers.

Projections:
Germplasm created through this research and submitted to the URSN is available to participating breeding programs for use as parents. All germplasm created through this research is considered for use as parents within the SDSU breeding program. Procedures carried out in one year are carried out in future years. With time it is anticipated that levels of FHB and BLS resistance will continually increase, not only within this program, but throughout the region as parents used for population development are increasingly resistant to both diseases.

Publications:
Abdullah, Sidrat, Sunish K. Sehgal, Karl D. Glover, and Shaukat Ali. 2017. Reaction of Global Collection of Rye (Secale cereale L.) to Tan Spot and Pyrenophora tritici-repentis Races in South Dakota. The Plant Pathology Journal. 33:229-237.

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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

Jordan, Katherine W., Shichen Wang, Fei He, Shiaoman Chao, Yanni Lun, Etienne Paux, Pierre Sourdile, Jamie Sherman, Alina Akhunova, Nancy K.Blake, Michael O. Pumphrey, Karl Glover, Jorge Dubcovsky, Luther Talbert, and Eduard D.Akhunov. 2018. The genetic 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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Data:

TABLE 1. 2017 UNIFORM REGIONAL SCAB NURSERY FOR SPRING WHEAT PARENTS. MEANS AND RANKS OVER FOUR LOCATIONS.

ENTRY	DISEASE INDEX		FDK		DON		OVERALL
	%	Rank	%	RANK	ppm	RANK	RANK
ND2710	10.2	1	13.4	5	2.6	2	1
SD4705	10.6	2	11	4	3.1	5	2
SD4724	11.3	3	17.3	16	3.7	9	3
NDHRS16-12-31	11.4	4	16.6	15	5.3	17	4
SD4691	11.6	5	13.7	6	3.1	5	5
LNR15-1990	12.8	6	14	7	2.3	1	6
SD4710	14.1	7	14.7	10	4.6	14	7
MN14164-4	14.3	8	10.2	2	3.7	9	8
SD4741	14.7	9	8.8	1	3.6	8	9
ND833	15.5	10	15.1	11	5.2	15	10
ND830	17.6	11	18.7	18	6	21	11
MN14470-5	17.7	12	15.4	12	5.6	20	12
Bacup	18.6	13	22.7	22	4.4	13	13
NDHRS16-12-52	19	14	18.6	17	5.2	15	14
MN14138-4	19.7	15	10.6	3	3.5	7	15
LNR14-0747	21.9	16	14.1	9	2.7	4	16
2375	22.4	17	24.3	23	6.5	22	17
LNR15-1802	23	18	15.6	13	5.3	17	18
MN13304-5	23.4	19	20.1	20	5.3	17	19
MN14669-1	23.4	19	14	7	2.6	2	20
LNR15-0025	27	21	15.9	14	4.3	11	21
N10	28.3	22	38.1	24	7.3	23	22
NDHRS16-12-19	28.3	22	21.5	21	7.9	24	23
LNR15-0026	29.3	24	19.1	19	4.3	11	24
Oslo	38	25	46.4	25	10.8	25	25
Norm	44.2	26	73.9	27	20.9	27	26
Wheaton	52	27	70.3	26	14.6	26	27
Average	21.5		22.1		5.7		