Breeding Spring Wheat for Disease Resistance

South Dakota Wheat Commission
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Karl D. Glover
Professor / Spring Wheat Breeder
Rm. 113G, Seed Technology Bldg.
South Dakota State University
2380 Research Park Way
Brookings, SD 57006
605-688-4769
Karl.Glover@sdstate.edu

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 2016, 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 2017 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:
Rasul, Golam, Karl D. Glover, Padmanaban G. Krishnan, Jixiang Wu, William A. Berzonsky, and Bourlaye Fofana. 2017. Genetic analyses using GGE model and a mixed linear model approach, and stability analyses using AMMI bi-plot for late- maturity alpha-amylase activity in bread wheat genotypes. Genetica. 145:259–268.

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.

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.

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Data:

TABLE 1. 2016 UNIFORM REGIONAL SCAB NURSERY FOR SPRING WHEAT PARENTS. MEANS AND RANKS OVER FOUR LOCATIONS.

ENTRY	SEVERITY		INDEX		FDK		OVERALL
	%	Rank	%	RANK	ppm	RANK	RANK
SD4587	78.3	1	22.6	5	9.0	4	3
MN13515-8	84.0	4	18.5	1	11.2	10	5
LNR14-0747	79.8	2	18.7	2	12.1	17	7
ND824	85.2	5	24.3	8	9.4	8	7
SD4621	82.7	3	30.7	20	8.5	3	9
SD4675	87.1	8	26.2	13	9.2	7	9
ND825	90.2	19	20.1	3	10.7	9	10
ND828	88.5	14	29.6	17	7.9	2	11
MN11394-6	87.7	10	30.7	19	9.2	6	12
MN13056-7	86.9	7	34.6	23	9.0	5	12
LNR14-0677	87.3	9	28.7	16	11.3	12	12
ND822	88.3	12	22.6	6	14.3	26	15
SD4645	89.8	16	28.4	15	11.4	13	15
LNR14-0679	90.0	17	21.8	4	13.9	25	15
SD4589	88.5	13	24.8	11	13.4	23	16
09S0018-2	91.3	23	24.5	10	12.0	15	16
ND2710	90.4	20	27.8	14	11.5	14	16
LNR14-1868	90.0	18	33.1	21	11.2	11	17
Bacup	85.6	6	30.5	18	17.1	29	18
ND820	91.9	24	25.9	12	12.8	22	19
09S0084-14	93.2	27	24.3	9	13.4	24	20
09S0054-5	89.4	15	38.0	26	12.6	20	20
MT1401	94.7	29	48.1	32	7.0	1	21
09S0118-10	91.9	25	23.7	7	19.0	31	21
LNR14-1774	87.9	11	37.2	25	16.7	27	21
MN10261-1	90.4	21	35.3	24	12.3	19	21
MT1316	91.9	26	43.0	30	12.0	16	24
09S0055-1	96.7	30	34.3	22	12.7	21	24
MN13064-2	93.5	28	38.2	27	12.2	18	24
2375	90.4	22	40.4	28	17.5	30	27
N10	97.1	33	40.6	29	23.6	32	31
UI Stone	98.1	37	45.7	31	16.9	28	32
IDO1601S	96.9	32	53.6	34	26.1	33	33
Norm	96.9	31	51.5	33	30.3	37	34
IDO1403S	97.9	36	54.0	35	27.4	35	35
IDO1405S	97.5	35	55.1	36	27.6	36	36
Oslo	97.3	34	56.3	38	31.8	38	37
MT1348	99.4	39	69.1	40	26.8	34	38
Wheaton	98.7	38	55.7	37	47.9	40	38
IDO1603S	99.6	40	57.9	39	40.8	39	39
Average	91.1		35.7		16.5		