University of Minnesota Wheat Breeding Program

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Research Questions

The objectives of this proposal are to i) develop improved varieties and germplasm combining high grain yield, disease resistance, and end-use quality; and ii) provide performance data on wheat varieties adapted to the state of Minnesota.

Results

During the 2015/2016 crossing cycle, 290 crosses were made. The State Variety Trial, which contained 38 released varieties, 11 University of Minnesota experimental lines, and 2 experimental lines from other programs was grown at a total of 15 locations in 2016. During the 2016 growing season, another 213 advanced experimental lines were evaluated in advanced yield trials at 11 locations. An additional 468 lines were evaluated in preliminary yield trials at 2 locations. A total of 7,077 yield plots were harvested in 2016. Fusarium-inoculated, misted nurseries were established at Crookston and St. Paul. Inoculated leaf rust nurseries were conducted at Crookston and St. Paul and a stem rust nursery was also conducted at St. Paul. The disease nurseries involve collaboration with agronomists and pathologists at Crookston and with personnel from the Plant Pathology Department and the USDA-ARS. Data from the yield and disease nurseries are summarized and published in *Prairie Grains* and the MAES's 2016 Minnesota Field Crop Trials bulletin.

MN11325-7 (Faller//00H04*J3/MN03130-1-62) was released as 'Shelly' in 2016. Shelly is a mid-late maturity hard red spring wheat that is competitive for grain yield with the highest yielding varieties in the region, but with higher protein. Shelly is moderately resistant to important diseases such as leaf rust, bacterial leaf streak, and Fusarium head blight. Straw strength is average, rated as a '5'. Shelly is resistant to preharvest sprouting and has exhibited acceptable end-use quality characteristics. Another advanced experimental line that is a candidate for release in the next year is MN10261-1. Data summaries of MN10261-1, recent U of MN releases, and popular varieties are shown in Table 1.

Application/Use

Experimental lines that show improvement over currently available varieties are recommended for release. Improved germplasm is shared with other breeding programs in the region. Scientific information related to efficiency of breeding for particular criteria is presented at local, regional, national, and international meetings and published.

Material and Methods

All yield nurseries are grown in small, replicated plots (typically 40-75 sq. ft. harvested area per plot). Fusariuminoculated nurseries at Crookston and St. Paul consist of single 4 to 6 ft. rows, with 1 to 3 replications. Fusarium infected corn seed or spray-applied macroconidia are used as inoculum. The plot areas are misted periodically to maintain a high humidity environment for at least three weeks after anthesis. Leaf and stem rust nurseries are spray inoculated with spore suspensions and surrounded by a border seeded to mixture of susceptible varieties to further increase disease pressure.

Economic Benefit to a Typical 500 Acre Wheat Enterprise

Choice of variety is one of the most important decisions growers make each year. The development of high-yielding varieties that are resistant to the prevalent diseases and have good end-use quality are necessary to increase grower profit and protect against constantly changing pathogens and pests. As an example, a new variety that yields 4% higher will produce 3 extra bushels in a field that averages 75 bu/A. At current market prices that equates to approximately an additional $7,000- in gross revenue for a 500 acre wheat enterprise.

Related Research

These funds provide general support for our breeding/genetics program. Additional monetary support for breedingrelated research in 2016 came from the Minnesota Agricultural Experiment Station, and the U.S. Wheat and Barley Scab Initiative via USDA-ARS.

Recommended Future Research

We will continue to operate the breeding program using similar methodologies in the future, but are also exploring the integration of genomic selection with DNA markers to more efficiently select for important traits and speed our rate of genetic progress. If successful, I anticipate genomic selection being a routine feature of our breeding program, using even lower cost DNA marker systems in the future.

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Publications

Anderson, J.A. J. Wiersma, R. Dill-Macky, J. Kolmer, M. Rouse, and Y. Jin., M. Smith, and L. Dykes. 2016. Hard Red Spring Wheat. In Minnesota Field Crop Trials, University of Minnesota Agricultural Experiment Station.

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Rawat, N., M.O. Pumphrey, S. Liu, X. Zhang, V.K. Tiwari, K. Ando, H.N. Trick, W.W. Bockus, E. Akhunov, J.A. Anderson, and B.S. Gill. 2016. Wheat Fhb1 encodes a chimeric lectin with agglutinin domains and a pore-forming toxin-like domain conferring resistance to Fusarium head blight. Nature Genetics. doi:10.1038/ng.3706.

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Table 1. Comparison of Bolles, MN10261-1, and Shelly with the most popular varieties in Minnesota. Varieties are sorted from highest to lowest yielding based on 3 Year yield.

		%	State Yield											
	Release	2016 MN	2016	2 yr	3 Yr	Test Wt (lbs/bu)	Protein (%)	Straw Str.	Baking Quality	PHS	Leaf Rust	Stripe Rust	Bact. Leaf Str.	Scab
Entry	Yr.	Acreage	bu/A			2 yr	2 Yr	1-9	1-9	1-9	1-9	1-9	1-9	1-9
SY Valda	2015	3.0	90	93	–	60.2	13.8	4	–	3	–	2	–	4
LCS Albany	2009	1.6	89	92	91	59.9	13.3	5	6	4	2	3	6	4
Shelly	**2016**	**0.5**	**88**	**90**	**88**	**60.1**	**13.8**	**5**	**5**	**1**	**4**	**1**	**4**	**4**
Prosper	2011	10.2	82	86	87	59.9	13.6	6	5	2	5	5	4	5
Faller	2007	6.0	80	85	86	59.6	13.4	5	5	1	5	5	4	4
SY Ingmar	2014	3.1	88	87	85	60.7	14.7	4	2	2	3	2	3	4
MN10261-1	**N/A**	**N/A**	**82**	**86**	**85**	**61.2**	**14.7**	**5**	**3**	**1**	**1**	**1**	**3**	**3**
SY Soren	2011	4.6	84	84	82	59.5	14.7	4	4	2	2	2	4	5
Forefront	2012	2.4	77	82	82	60.6	14.6	6	5	3	2	2	3	3
Bolles	**2015**	**8.8**	**79**	**82**	**81**	**59.4**	**15.9**	**4**	**1**	**1**	**1**	**1**	**4**	**4**
WB-Mayville	2011	13.1	81	83	81	59.7	14.6	3	3	3	3	3	6	7
Linkert	2013	27.85	77	83	80	60.4	15.0	2	1	2	4	1	4	5
Rollag	2011	2.4	76	81	79	60.8	14.8	3	6	1	4	1	4	3