University of Minnesota Wheat Breeding Program

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Research Questions

The objectives of this research were to:

1. Develop improved varieties and germplasm combining high grain yield, disease resistance, and end-use quality
2. Provide performance data on wheat varieties adapted to the state of Minnesota

Results

During the 2017/2018 crossing cycle, 261 crosses were made. The 2018 State Variety Trial, which contained 38 released varieties, 16 University of Minnesota experimental lines, 4 experimental lines from other programs, and 3 long term checks was grown at a total of 15 locations. During the 2018 growing season, another 183 advanced experimental lines were evaluated in advanced yield trials at 10-11 locations. An additional 353 lines were evaluated in preliminary yield trials at 2 locations. A total of 6,307 yield plots were harvested in 2018. Fusarium-inoculated, misted nurseries were established at Crookston and St. Paul. An inoculated leaf and stem rust nursery was 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 2018 Minnesota Field Crop Trials bulletin.

MN10201-4-A (MN97695-BYDV/Sabin) is a variety release candidate that has shown stable yields over 6 years of statewide testing. It has good straw strength (3 on 1-9 scale), and overall good disease resistance. Straw strength is the main reason that Linkert is the no. 1 variety in the state. MN10201-4-A has better straw strength than our recent releases Bolles (4), Shelly (5), and Lang-MN (5). Importantly, MN10201-4-A contains the *bdv2* gene for resistance to Barley Yellow Dwarf Virus (BYDV) that no other existing spring wheat variety contains. The grain protein of MN10201-4-A is lower than average, but its overall baking quality is acceptable and better than other lower protein varieties. Data is summarized in Table 1.

MN14105-7 (Sabin/01S0377-6//Linkert) is similar to Lang-MN in many respects, but higher yielding and with better straw strength. In the 2017 Uniform Regional Nursery it ranked no. 3 for yield out of 36 test entries (data not shown). Of the 4 entries with the highest grain yield in that nursery, it had the highest protein and best straw strength. MN14105-7 has good baking quality (3) and disease resistance, among the best for bacterial leaf streak (3) and moderately resistant to scab (4).

Application and 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.

Economic Benefit to a Typical 500 Acre Wheat Enterprise

Choice of variety is one of the most important decisions

Table 1. Comparison of MN10201-4-A and MN14105-7 with recent MN releases and

			Grain yield				
	Release	% MN	% of mean			Heading	Height
Entry	Yr.	Acreage	2018	2 Yr	3 Yr	d	in.
SY Valda	2015	8.9	108	110	110	50.3	30.3
Shelly	2016	8.2	105	106	107	53.2	29.5
TCG-Spitfire	2016	3.1	105	106	104	52.5	30.8
MN14105-7	-	-	105	104	-	51.8	31.7
MN10201-4-A	-	-	100	102	102	51.3	29.5
Lang-MN	2017	4.4	102	100	100	52.3	32.5
WB9479	2017	9.6	96	98	-	49.5	27.5
Sy ingmar	2014	3.7	100	98	101	51.1	28.8
WB-Mayville	2011	3.5	94	97	98	47.6	27.4
Linkert	2013	27.3	91	95	95	50.2	27.8
Bolles	2015	10.5	91	94	95	53.3	31.3

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 $7,500 in gross revenue for a 500 acre wheat enterprise.

Materials and Methods

All yield nurseries are grown in small, replicated plots (typically 40-75 sq. ft. harvested area per plot). Fusarium-inoculated 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 a mixture of susceptible varieties to further increase disease pressure.

Related Research

These funds provide general support for our breeding/genetics program. Additional monetary support for breeding-related research in 2018 came from the Minnesota Agricultural Experiment Station, and the U.S. Wheat and Barley Scab Initiative via USDA-ARS.

Publications

Anderson, J.A. J. Wiersma, S. Reynolds, N. Stuart, H. Lindell, R. Dill-Macky, J. Kolmer, M. Rouse, and Y. Jin. 2017. Spring Wheat. *In* Preliminary Report 24: 2017 Wheat, Barley, and Oats Variety Performance in Minnesota Preliminary Report, Edited by Jochum Wiersma.

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Wang, R. J. Chen, J.A. Anderson, J. Zhang, W. Zhao, J. Wheeler, N. Klassen, D.R. See, and Y. Dong. 2017. Genome-wide association mapping of fusarium head blight resistance in spring wheat lines developed in the Pacific Northwest and CIMMYT. Phytopathol. 107:1486-1495. doi.org/10.1094/PHYTO-02-17-0073-R.

Anderson, J.A., J.J. Wiersma, G.L. Linkert, S. Reynolds, J.A. Kolmer, Y. Jin, M. Rouse, R. Dill-Macky, G.A. Hareland, and J.-B. Ohm. 2018. Registration of 'Norden' hard red spring wheat. J. Plant Registrations. 12:90–96.

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J. Plant Registrations. doi:10.3198/jpr2017.08.0050crc

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Gao, L., E. M. Babiker, I. C. Nava, J. Nirmala, Z. Bedo, L. Lang, S. Chao, S. Gale, Y. Jin, J. A. Anderson, U. Bansal, R. F. Park, M. N. Rouse, J. M. Bonman, and H. Bariana. 2018. Temperature-sensitive wheat stem rust resistance gene Sr15 is effective against *Puccinia graminis* f. sp. *tritici* race TTKSK. Plant Pathol. doi:10.1111/ppa.12928

other popular spring wheat cultivars. Entries are sorted by 2018 2 year grain yield.

Straw Str.	Test Wt (lbs/bu)	Protein (%)	Baking Quality	PHS	Leaf Rust	Stripe Rust	Bact. Leaf Str.	Scab
1-9	2 yr	2 yr	1-9	1-9	1-9	1-9	1-9	1-9
5	60.1	14.2	6	3	1	2	3	4
5	60.5	14.2	5	1	3	1	6	4
3	59.7	14.0	3	3	5	-	3	5
4	60.2	15.0	3	2	2	-	3	4
3	60.2	14.2	3	1	1	2	3	4
5	60.9	15.0	3	1	1	1	3	3
3	60.5	15.5	2	3	3	-	6	-
4	60.7	15.1	2	2	2	2	3	4
3	60.3	15.4	3	3	3	3	7	7
2	60.1	15.7	1	2	3	1	5	5
4	59.6	16.1	1	1	1	1	6	4