University of Minnesota Wheat Breeding Program

James Anderson, Dept. of Agronomy & Plant Genetics, U of M, St. Paul

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 2013/2014 crossing cycle, 278 crosses were made. The State Variety Trial, which contained 31 released varieties, 15 University of Minnesota experimental lines, and 5 experimental lines from other programs was grown at a total of 15 locations in 2014. During the 2014 growing season, another 228 advanced experimental lines were evaluated in advanced yield trials at 8-11 locations. An additional 668 lines were evaluated in preliminary yield trials at 1-2 locations. A total of 7,730 yield plots were harvested in 2014. 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 scab nurseries are summarized and published in Prairie Grains and the MAES's 2014 Minnesota Field Crop Trials bulletin.

MN08165-8 (MN02268-1/MN01333-A-1) is a candidate for release and has higher protein and grain yield than Vantage (Table 1). Other advanced experimental lines that are candidates for release in the next 1-2 years are MN10261-1 and MN11325-7. Data of these two experimental lines, recent U of MN releases, and popular varieties are shown in Table 1.

continued on page 84

Table 1. Comparison of MN08165-8, MN10261-1, and MN11325-7 with other wheat varieties. Varieties are sorted from highest to lowest yielding based on 2 Yr. yield

	Year Release	MN Acreage 2014	Yield (bu/A)			Test Wt (Lb/Bu)	Protein (%)	Straw Strength	Leaf Rust	Bacterial Leaf Streak	Scab
Entry		**%**	**2014**	**2-Yr**	**3-Yr**	**2-Year**	**2-Year**	**1–9**	**1–9**	**1–9**	**1–9**
MN11325-7	–	–	84.3	88.5*	–	–	13.7*	4	4	4–5	4–5
LCS Albany	2008	6.2%	88.8	88.5	85.0	60.5	12.9	5	2	6	4
Prosper	2011	20.7%	87.8	87.2	81.0	60.3	13.5	6	5	4	5
Faller	2007		87.7	86.1	79.7	60.3	13.4	5	5	4	4
MN10261-1	–	–	83.5	82.0	–	61.5	14.4	4	1	3	3–4
Forefront	2012		82.7	80.7	77.1	60.9	14.5	5	2	3	3
MN08165-8	–	–	79.7	78.8	75.5	60.3	15.5	5	1	4	4-5
Samson	2007	3.6%	77.3	78.5	76.2	58.8	14.1	3	5	5	8
SY Soren	2011	8.3%	80.2	78.3	75.7	60.6	14.5	4	3	4	4
RB07	2007	1.9%	77.8	77.8	73.3	60.3	14.3	5	2	6	4
Norden	2012	2.3%	77.8	77.4	73.4	61.7	13.9	3	2	4	5
Vantage	2007	1.3%	75.9	76.3	71.5	61.7	15.1	2	6	7	5
WB-Mayville	2011	18.1%	75.3	75.3	73.2	59.4	14.7	3	3	6	7
Linkert	2013	3.9%	75.6	75.2	71.7	60.4	15.0	2	3	4	5
Rollag	2011	4.8%	76.7	75.0	71.4	61.1	14.9	3	4	4	3
No. Env.			15	28	41						

* Estimated based on performance in 10 AY2 trials in 2013 with Faller and LCS Albany as checks.

continued from page 83

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). 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 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.

Related Research

These funds provide general support for our breeding/genetics program. Additional monetary support for breeding-related research in 2014 came from the Minnesota Agricultural Experiment Station, the U.S. Wheat and Barley Scab Initiative via USDA-ARS, and National Research Initiative Competitive Grant no. 2011-68002-30029 (Triticeae-CAP) from the USDA National Institute of Food and Agriculture.

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.

Publications

Anderson, J.A., J.J. Wiersma, S. Reynolds, M. Green, and R. Caspers. 2014. Hard Red Spring Wheat. In Minnesota Field Crop Trials (MP119-2015), University of Minnesota Agricultural Experiment Station.

Anderson, J. J. Wiersma, S. Reynolds, R. Caspers, M. Green, R. Dill-Macky, J. Kolmer, M. Rouse and Y. Jin. 2014. Spring Wheat. In Preliminary Report 24: 2014 Wheat, Barley, and Oats Variety Performance in Minnesota Preliminary Report, Edited by Jochum Wiersma.

Kaiser, D.E, J.J. Wiersma, and J.A. Anderson. 2014. Genotype and environment variation in elemental composition of spring wheat flag leaves. Agron. J. 106: 1: 324-336.

Ovando-Martinez, M., B. Ozsisli, J. Anderson, K. Whitney, J. Ohm, and S. Simsek. 2013. Analysis of deoxynivalenol and deoxynivalenol-3-glucoside in Hard Red Spring Wheat inoculated with Fusarium graminearum. Toxins 5:2522-2532.

Wiersma, J.J., A.S. Killam, and J. Westhoff. 2014. A Retrofit for Plot Drills to Enable Automated Seed Metering. Crop Sci. 54 2:654-658 doi:10.2135/cropsci2013.05.0350