

Developing Adapted Spring Wheat Cultivars to Better Serve MN Wheat Growers

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Research Questions

Applied breeding for superior spring wheat cultivars remains the focus of the North Dakota State University breeding program. A higher proportion of selection pressure is placed on environments in eastern North Dakota, and western Minnesota. The primary objectives for the breeding program include:

- High grain yield and balanced end-use quality to maintain international competitiveness as a spring wheat market class.
- Strong straw and shorter plant height to withstand higher input management, and higher rainfall environments common to the target region.
- Maintenance of high levels of resistance to Fusarium head blight, and work to integrate both Type I (resistance to infection) and Type II resistance (resistance to infection spread throughout the head) in our germplasm.
- Durable resistance to leaf diseases, including leaf rust, stripe rust, and bacterial leaf streak.

Results

The experimental line ND825 has been approved for pre-release. The line is half 'Glenn' by parentage, and possesses high levels of FHB resistance, but is shorter than Glenn, with stiffer straw. It has slightly lower yield potential than high yielding cultivars like 'Faller' and 'Prosper', but it has shown very strong grading characteristics in experimental testing, with consistently high grain protein, grain virtuousness, and test weight. A release decision will be made in January 2017. Seed has been increased and will be available, if released.

In 2016, around 600 breeding populations were evaluated and advanced through phenotypic selection in eastern North Dakota. 150-200 crosses were made targeting eastern ND and western MN during the spring crossing cycle, and around 300 are expected during the current greenhouse crossing cycle. These crosses were made with goals of shorter plant height, greater straw strength, FHB resistance, and high end-use quality.

Funds provided also helped to supplement the shuttle breeding program for early generation materials. Our program currently grows segregating populations in Yuma, Arizona, Christchurch, New Zealand, and Puerto Rico. Our winter nurseries are bigger this year than ever in the past.

Funds provided also supported two yield trials of elite breeding material at Alvarado and Wolverton, MN. Results

from these trials, as well as three locations in eastern ND, are presented in the Appendix.

Application and Use

Information collected from line and variety testing can be used in two primary ways. First, data is used in the breeding program to make selections which are targeted for the geographic region of interest. Secondly, the published data from state variety trials in eastern North Dakota can be used for variety selection by producers. Publicizing data can also be of use to fellow researchers as they ask and answer relevant agronomic questions about current variety offerings.

Materials and Methods

Early generation materials - Segregating populations are currently all grown at two locations in Cass County, ND. Beginning in 2017, three segregating generations will be grown exclusively in a winter shuttle program. This will greatly expedite the creation of new experimental lines.

Yield testing - Elite yield trials are grown at seven locations in North Dakota, and two locations in Minnesota.

Disease screening- All experimental lines are screened for resistance to stem rust and leaf rust. All lines and advanced segregating populations are also screened in a misted, inoculated Fusarium head blight nursery. Opportunistic notes for other diseases and abiotic conditions are also recorded.

Uniform nursery - The breeding program submits materials to the USDA Uniform Regional Nursery, and Uniform Regional Scab Nursery. Reports from these nurseries are available publically. Our program grows three locations of the Uniform Regional Nursery.

Quality evaluation A great strength of our program lies in our cooperation with the NDSU Wheat Quality Lab, led by Dr. Senay Simsek. Following is a summary of quality tests, by year in the breeding program.

Preliminary Yield Trial - Grain Protein, Test Weight

Intermediate Yield Trial - Grain Protein, Test Weight, Mixograph

Advanced Yield Trial - Grain Protein, Test Weight, Mixograph, Mill and Bake

Elite Yield Trial - Grain Protein, Test Weight, Mixograph, Farinograph, Mill and Bake

Our goal is to release high quality varieties which consistently grade well, to protect producers from discounts. Particularly for our target geographic area our goal are lines with consistently high grain protein, even in years with exceptional yield potential. Maintaining and improving upon the milling and baking quality of released varieties will help protect the integrity of the market class for all spring wheat producers. High test weight and grain protein, along with consistent yield potential, helps to manage risk at the point of sale.

Averages for preliminary quality data are included in the Appendix data for the MN and ND locations.

Economic Benefit to a Typical 500 Acre Wheat Enterprise

Acreage of NDSU developed varieties is down in relation to previous years, due increased acreage of quality offerings from the University of Minnesota breeding program, like Linkert and Bolles. Still, an estimated 16.74%

of the MN wheat acreage was sown to NDSU varieties in 2016. Based on an estimated farm value of \$4.50 per bushel, this represented a value of over \$1 million. Having a strong testing program in the target region ensures that producers have competitive choices which are well adapted to their area.

Perhaps more importantly, the use of NDSU developed germplasm and testing results should help other public breeding programs, like University of Minnesota. In past years, germplasm exchange has been limited, but it is the goal of our program to work cooperatively with other breeding programs in the region, particularly the public programs.

Related Research

Agronomic data and preliminary quality data for eastern ND Red River Valley testing sites from the ND State variety trial are presented in the Appendix.

Appendix

Table 1. 2016 Elite Yield Trial, averaged across MN locations at Alvarado and Wolverton.

Entry	Plant Height	Test Weight	Grain Yield	Grain Protein	Mixograph
	<i>in.</i>	<i>lbs/bu</i>	<i>bu/ac</i>	<i>%</i>	<i>1-9</i>
Barlow	30.4	62.1	55.1	14.8	5
Bolles	29.8	59.9	48.7	15.6	5
Elgin-ND	30.6	60.1	46.7	14.4	4
Faller	29.8	60.4	52.1	14.0	3
Glenn	30.6	62.9	40.3	14.5	5
Prosper	30.4	60.7	54.2	13.9	3
SY Soren	26.3	59.3	43.5	14.7	4
ND804	29.4	62.1	53.5	14.4	5
ND827	32.0	61.6	50.0	14.4	3
ND828	32.1	62.6	49.6	15.5	5
ND829	31.6	61.6	49.8	14.8	3
ND830	30.0	62.4	49.4	15.0	5
ND831	29.5	63.4	44.5	15.2	5
ND832	31.1	63.0	45.8	14.8	5
ND833	30.1	62.9	47.5	15.3	5
ND834	34.8	60.8	41.3	15.6	6
NDHRS16-12-12	34.0	62.3	45.0	15.2	5
NDHRS16-12-13	32.0	62.8	52.0	15.3	6
NDHRS16-12-16	30.0	62.6	56.8	14.2	5
NDHRS16-12-17	29.0	61.8	51.0	15.0	5
NDHRS16-12-18	31.0	63.0	42.6	14.7	5

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Table 1 *continued*

Entry	Plant Height	Test Weight	Grain Yield	Grain Protein	Mixograph
	<i>in.</i>	<i>lbs/bu</i>	<i>bu/ac</i>	<i>%</i>	<i>1-9</i>
NDHRS16-12-19	31.6	62.0	52.3	14.9	4
NDHRS-16-12-22	33.8	61.7	49.0	14.6	5
NDHRS-16-12-24	34.8	61.1	44.6	14.9	7
NDHRS-16-12-25	31.5	63.3	42.3	14.1	6
NDHRS-16-12-26	31.5	63.2	42.4	14.6	5
NDHRS-16-12-27	32.6	63.4	44.5	14.3	5
NDHRS-16-12-28	31.1	63.5	42.8	14.5	5
NDHRS-16-12-29	30.1	61.0	47.3	14.8	5
NDHRS-16-12-31	31.5	62.9	51.3	14.3	5
NDHRS-16-12-32	33.1	61.6	36.0	14.5	5
NDHRS-16-12-33	31.4	62.2	44.5	14.9	4
NDHRS-16-12-34	32.4	61.6	46.7	14.5	5
NDHRS-16-12-35	30.9	60.8	45.7	15.0	3
NDHRS-16-12-36	31.3	61.0	49.5	14.6	5
NDHRS-16-12-37	31.6	62.2	50.4	14.3	3
NDHRS-16-12-38	33.3	62.9	53.8	14.6	6
NDHRS-16-12-39	31.9	59.1	49.7	15.3	6
NDHRS16-12-4	32.4	61.3	48.2	15.0	4
NDHRS-16-12-41	31.1	61.9	47.6	14.6	4
NDHRS-16-12-42	34.3	61.2	50.4	15.8	5
NDHRS-16-12-43	30.8	63.2	41.7	15.0	6
NDHRS-16-12-44	31.8	63.2	46.1	14.5	7
NDHRS-16-12-45	30.8	61.2	42.5	14.9	6
NDHRS-16-12-46	33.3	61.4	43.9	14.5	5
NDHRS-16-12-47	29.5	61.4	38.7	14.3	5
NDHRS-16-12-48	31.4	60.3	38.0	14.6	5
NDHRS-16-12-49	32.8	62.9	41.4	15.6	5
NDHRS16-12-5	30.3	62.3	44.6	14.7	5
NDHRS-16-12-51	30.1	62.3	52.0	15.3	5
NDHRS-16-12-52	30.8	61.3	47.4	15.9	5
NDHRS-16-12-53	32.8	63.2	41.0	15.5	5
NDHRS-16-12-54	32.3	63.4	48.6	14.6	6
NDHRS-16-12-55	32.0	62.0	45.4	15.1	7
NDHRS16-12-6	28.4	59.1	45.1	14.9	5
NDHRS16-12-7	29.8	60.6	44.3	15.0	4
Average	31.3	61.8	46.8	14.8	4.6

Table 2. 2016 Elite Yield Trial, averaged across three eastern North Dakota locations.

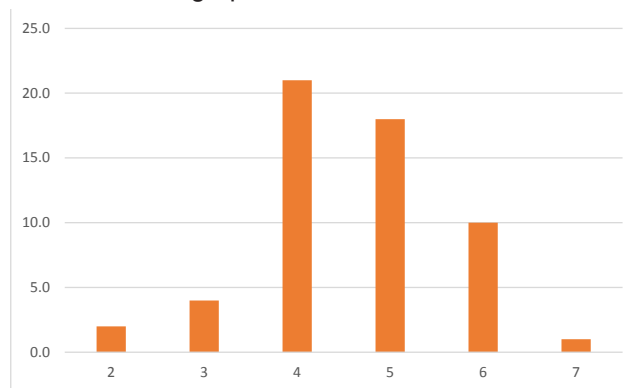
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Barlow	32.6	61.5	64.0	14.7	4
Bolles	31.4	59.7	56.7	16.5	6
Elgin-ND	33.8	60.1	61.8	14.4	4
Faller	32.4	60.8	67.8	13.5	2
Glenn	33.4	62.9	53.9	14.7	4
Prosper	33.0	60.7	67.0	13.8	3
SY Soren	29.9	59.3	54.4	14.4	4
ND804	31.9	61.9	64.6	14.3	4
ND827	34.5	61.8	64.3	14.5	4
ND828	33.7	62.4	61.0	15.3	4
ND829	34.3	61.7	62.4	14.9	3
ND830	31.8	62.2	59.7	15.1	5
ND831	32.7	63.0	56.1	15.3	5
ND832	33.8	63.1	56.7	15.0	5
ND833	32.4	62.9	59.2	15.3	4
ND834	36.5	60.2	47.7	15.6	7
NDHRS16-12-12	36.1	62.1	57.0	15.1	5
NDHRS16-12-13	33.8	62.4	60.8	15.2	6
NDHRS16-12-16	32.7	62.1	66.7	14.0	4
NDHRS16-12-17	32.0	61.7	63.1	14.3	4
NDHRS16-12-18	33.6	63.0	54.6	14.4	6
NDHRS16-12-19	33.7	61.9	64.4	14.4	3
NDHRS-16-12-22	35.9	61.3	59.2	14.5	4
NDHRS-16-12-24	36.2	60.6	54.2	15.2	5
NDHRS-16-12-25	34.1	63.0	54.2	14.4	6
NDHRS-16-12-26	34.2	63.0	54.5	15.0	6
NDHRS-16-12-27	34.4	63.0	55.6	15.1	6
NDHRS-16-12-28	33.2	63.2	53.9	15.0	6
NDHRS-16-12-29	33.3	61.0	60.8	15.1	5
NDHRS-16-12-31	33.5	62.6	62.1	14.5	5
NDHRS-16-12-32	35.4	61.5	51.3	14.8	5
NDHRS-16-12-33	33.8	62.3	58.5	15.2	4
NDHRS-16-12-34	34.6	61.7	62.1	14.3	4
NDHRS-16-12-35	33.5	60.8	60.3	15.0	2
NDHRS-16-12-36	33.5	60.9	63.4	15.0	4
NDHRS-16-12-37	33.8	61.9	60.7	14.9	5
NDHRS-16-12-38	35.3	62.6	63.0	14.8	5
NDHRS-16-12-39	33.9	59.5	61.3	15.9	6
NDHRS16-12-4	34.8	61.4	61.9	15.2	4

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Table 2 continued

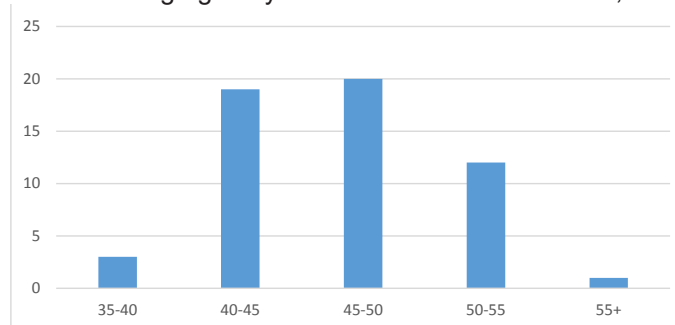
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NDHRS-16-12-49	34.4	63.1	55.0	15.7	5
NDHRS16-12-5	32.5	62.2	61.4	14.7	4
NDHRS-16-12-51	32.7	61.9	60.1	15.4	4
NDHRS-16-12-52	32.6	61.7	61.2	16.3	4
NDHRS-16-12-53	35.4	63.1	52.0	15.5	6
NDHRS-16-12-54	33.7	63.2	58.6	14.9	5
NDHRS-16-12-55	34.3	61.9	54.5	15.1	5
NDHRS16-12-6	30.9	59.3	62.2	15.0	4
NDHRS16-12-7	31.4	60.5	55.7	14.9	4
Average	33.7	61.8	58.7	14.9	5

Frequency Distribution for Mixograph at 3 Eastern ND locations, 2016 Elite Yield Trial



On a 1-9 scale, with higher numbers indicating superior baking quality. For these locations in 2016, Faller scored 2, Glenn scored 4, and Bolles scored 6.

Frequency Distribution for Average grain yield across two MN locations, 2016 Elite Yield Trial



Measured in bushels per acre. Faller averaged 52.1, Glenn averaged 42.3, and Bolles averaged 48.7.