Breeding Wheat for Intensive Management in Western Minnesota and Eastern North Dakota

Andrew Green, Dept. of Plant Sciences, NDSU

Research Questions

Our research questions were: 1) Can we quantify yield change with use of foliar fungicide and 2) Can we quantify the increase in grain protein with a post-anthesis application of UAN (28-0-0), and does that application of fertilizer increase the functionality of the protein, as measured by milling and baking? The experiments were also planned as a screening nursery for Bacterial leaf streak, which would not be affected by foliar fungicide. These experiments were done with experimental wheat lines in the NDSU breeding program, with the idea that selection under typical intensive management would be beneficial to MN wheat producers even if the additional research questions could not be answered.

Results

There were almost no disease symptoms observed at either location in 2017, with the exception of a low incidence of Fusarium head blight in East Grand Forks. Minimal Bacterial leaf streak (*Xanthomonas translucens* pv. *Undulosa*) was observed at both locations. As a result, no statistical difference was observed between the grain yield of the intensive and standard management blocks across locations. Average grain yield, protein, and test weight were also found to be similar between management treatments. Averages for yield, test weight, grain protein, flour extraction, and mixogram score by treatment (Standard, Intensive Management) at each location are presented in Table 1. There were nominal differences observed between managements, and additional locations and/or years could potentially increase the differences between treatments. Data were also analyzed by individual locations. Results from the Analysis of Variance is presented in Table 2. At East Grand Forks, Mixogram score was found to differ between management treatments, but grain protein did not. Test weight was also different between management blocks. Grain protein and test weight both differed between management treatments at Wolverton. Varieties in the trials significantly differed for all traits at each location. At the time of this report, the full baking quality data had were not available. Mixogram can be used to estimate dough and baking quality, and lines with low mixogram scores are generally poor for dough and baking quality.

In conclusion, this preliminary data suggests that with a larger dataset, differences in protein and mixogram score could potentially be observed, which may better address the effectiveness of the post-anthesis UAN. Data in 2017 varied by location, for research question 2. In a year with very low disease pressure, it could be expected that yield did not vary between the block treated with fungicide and the untreated block. Further analysis of the response of the experimental lines in this study may help us identify potential new varieties which respond well to intensive management.

Application and Use

We hope to use this research in the breeding program to identify new varieties which will perform well in these management practices. If we are able to help quantify how different varieties and their end-use quality perform under the two management programs, this information can be used for making economically sound decisions for his or her farm, and for the market class as a whole.

Materials and Methods

Split-plot trial at Wolverton, MN and East Grand Forks, MN. Three replicates. Whole plot factor was management, with standard (no fungicide, no post-anthesis UAN) and intensive (foliar fungicide at flag leaf emergence and 20 gal/acre of 28-0-0, post-anthesis). Sub-plot factor was genotype, with 12 checks and 37 experimental lines being tested. Plots were planted at Wolverton on 5/1/17 and East Grand Forks on 5/8/17.

Economic Benefit to a Typical 500 Acre Wheat Enterprise

1) Fungicide applications, as in our intensive management treatment have become relatively routine. However, public breeding programs are still placing a great deal of emphasis on genetic resistance to pathogens which may not require a fungicide due to cost savings and effectiveness. Additionally, in some years such as this one, there is very little disease pressure to justify an application of fungicide. Quantifying the response of the fungicide on varying genotypes will add to the collection of research to help the farmer identify when it is an economical decision to apply fungicide.

2) The quality of protein is what is being measured by customers of spring wheat, which means that we need to understand how it is affected by practices such as post-anthesis UAN. In the breeding program, we can tailor our selection for these varying management schemes, and identify new varieties which will may be successful under the predominant farming practices. ✒✒

Ultimately, the two academic questions addressed by this project will help producers make more informed decisions, but conducting these trials under these practices will help breed better wheat varieties for these areas even if these questions are not fully answered.

Recommended Future Research

Because of the low number of locations, an additional year of data would bring some clarity to the data. It is also somewhat unfortunate that neither location received any disease pressure in order for us to evaluate our primary research question. A full report will also be available once the full set of baking tests are completed on these lines. This will help answer the question of whether protein functionality (quality) is affected by the UAN treatment, which is aimed at increasing protein content (quantity).

Appendix

Table 1. Average values for select traits across Standard and Intensive Management for East Grand Forks and Wolverton locations, 2017

	East Grand Forks		Wolverton	
	SM	IM	SM	IM
Grain Yield (bu/ac)	97.1	102.7	75.5	76.9
Test Weight (lbs/bu)	62.2	62.9	60.1	60.6
Grain Protein (%)	14.8	15.1	14.4	15.2
Flour Extraction (%)	53.2	53.3	51	50.2
Mixogram Score (1-9)	4.4	4.8	3.8	4

Table 2. Probability values associated with analysis of variance for individual locations in 2017 and overall. Colors denote levels of significance, shown below. Lower numbers indicate higher confidence in declaring a significant difference for that factor.

East Grand Forks	**Grain Yield**	**Test Weight**	**Grain Protein**	**Flour Extraction**	**Mixogram**
Treatment (SM[1]/IM[2])	0.3567	0.0763	0.2615	0.4558	0.0216
Varieties	0.0001	0.0001	0.0001	0.0001	0.0161
Treatment *Variety	0.9288	0.992	0.7306	-	-

Wolverton	**Grain Yield**	**Test Weight**	**Grain Protein**	**Flour Extraction**	**Mixogram**
Treatment (SM/IM)	0.7467	0.0004	0.0136	0.1017	0.2252
Varieties	0.0001	0.0001	0.0001	0.0004	0.00001
Treatment *Variety	0.9876	0.3635	0.9795	-	-

Overall	**Grain Yield**	**Test Weight**	**Grain Protein**	**Flour Extraction**	**Mixogram**
Treatment (SM/IM)	0.8566	0.7287	0.1442	0.8672	0.5524
Varieties	0.0001	0.0001	0.0001	0.0014	0.0001
Treatment *Variety	0.9991	0.9751	0.9652	0.3242	0.6383

0.1<p, not a significant factor
0.05<p<0.1, significant factor with lower confidence
0.01<p<0.05, significant factor with high confidence
p<0.01, significant factor with very high confidence

1) SM=Standard management. No fungicide, no post-anthesis UAN
2) IM= Intensive management. Applied foliar fungicide, 28-0-0 applied post-anthesis.