

Minnesota Wheat Research and Promotion Council

RESEARCH PRE-PROPOSAL GRANT APPLICATION

1. NAME AND ADDRESS OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE Name: Regents of the University of Minnesota Address: Sponsored Projects Administration 454 McNamara Alumni Center, 200 Oak Street SE Minneapolis, MN 55455-2070		
2. TITLE OF PROPOSAL Variation in response to nitrogen and sulfur among spring wheat genotypes grown on irrigated and non-irrigated soils		
3. PRINCIPAL INVESTIGATOR(S) Daniel Kaiser	4. PI #1 BUSINESS ADDRESS 439 Borlaug Hall 1991 Upper Buford Circle Saint Paul, MN 55108	
PI# 2 Name: Jochum Wiersma		
PI# 3 Name:		
5. PROPOSED PROJECT DATES (calendar years) 1/01/2015 – 12/31/2016 Note: Research Reports are Due November 15th of Each Year	6. TOTAL PROJECT COST \$33,286	7. PI #1 PHONE NO. 612-624-3482
8. RESEARCH OBJECTIVES: (List objectives to be accomplished by research grant) 1) Study the effect of sulfur rate on spring wheat grain yield and protein concentration and quality. 2) Determine whether spring wheat varieties differ in the potential response to sulfur fertilizer. 3) Evaluate if plant tissue analysis (flag leaf samples collected at anthesis) can indicate the responsiveness of spring wheat varieties to N or S 4) Determine the economic optimum nitrogen rate for spring wheat grown under irrigation. 5) Plant, maintain and harvest one location of Jasper Teboh's project. Location will be Staples, MN under irrigation.		
Attach a 2-page detailed discussion of importance of the proposal to wheat profitability; how study complements previous research in area; procedures to be used; and competency of the research group in achieving research objectives. (Please keep the proposal concise, only 2 pages will be provided reviewers).		

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RESEARCH PRE-PROPOSAL

(2-pages maximum)

Project Title: Variation in response to nitrogen and sulfur among spring wheat genotypes grown on irrigated and non-irrigated soils

Importance of this project to the profitability of wheat producers: Sulfur is increasingly become a yield limiting factor for commodity crops. Research on corn in Minnesota has shown a clear link between soil organic matter and crop response to sulfur fertilizer. In those studies yield response was more likely when soil organic matter concentration was less than 3.0% in the top six inches. A total of six research trials were established between 2008 and 2009 in the Red River Valley studying sulfur response in spring wheat (Kaiser and Severson, 2008 & 2009). Within those studies there was no clear response in grain protein or yield from the sulfur rates applied. However, there were established differences in baking quality when sulfur was applied (Liu et al., 2011) likely as a result of changes in protein composition in the grain. These studies were conducted on field areas with organic matter concentration greater than 3.0 percent and included a single variety, 'Glenn', which tends to be high in grain protein. It is not known whether using a variety with a lower protein concentration would have changed the results or whether varieties differ in their response to sulfur.

A project was recently completed that studied variation in tissue nutrient concentration among varieties across environments (Kaiser et al., 2013). As part of the study we conducted stability analyses to determine the potential response of a genotype to a nutrient. It was noted that some varieties tended to respond greater than the average of varieties in environments where nitrogen or sulfur concentrations were greater and some responded less. Typically tissue concentration is considered to be a measure of plant nutrient availability. It can be questioned whether the stability analysis truly would be indicative of the responsiveness of a variety to a particular nutrient. Further investigation of sulfur rates and multiple varieties would be beneficial to determine if varieties respond differently to sulfur fertilizer. Additional research would also be beneficial to determine if plant analysis could be an effective tool for screening genotypes for their responsiveness to applied nutrients.

Current fertilizer suggestions for nitrogen do not specify nitrogen suggestion for spring wheat grown under irrigation. In fact, little research can be found on nitrogen management for irrigated wheat in Minnesota. While acreage is small, the potential for nitrogen deficiency is great and N loss from over-application is high on coarse textured soils. Rate studies with nitrogen split applied would be beneficial to provide guidance on specific N rate requirements for irrigated wheat.

Procedures: Small plot sulfur fertilization studies on non-irrigated soils will be established alongside two spring wheat variety trials. The proposed locations are near Crookston or Stephen and Fergus Falls or Kimball. Six wheat varieties will be selected using the stability analysis conducted for spring wheat flag leaf tissue among varieties in 2011 and 2012. Variety selection will not be based on current planting trends or popularity. Two varieties will be selected that were considered in the high, average, and low response to sulfur categories and that vary in protein and yield potential. The varieties selected are Faller, Vantage, Select, Glenn, Mayville, and RB07. Sulfur rates used will be a non-fertilized control (0 lb S), 7.5, and 15 lbs S per acre. Sulfur will be applied to the soil surface at planting. The source of sulfur will be ammonium sulfate (21-0-0-24). Nitrogen will be applied to balance the rate of nitrogen applied with the high rate of ammonium sulfate. Nitrogen, phosphorus, and potassium will be kept at non-limiting rates according to current recommendations.

An irrigated wheat site will be located at the Central Lakes College Ag and Energy Center at Staples. The irrigated site will consist of a third sulfur site as outlined previously and a nitrogen study. The nitrogen trial will consist of only three of the varieties utilized in the S study (Faller, Mayville, and RB07) and six nitrogen rates (0, 60, 120, 180, 240, and 300 lbs of N per acre). Nitrogen will be applied as urea (46-0-0) and applied at two times with half of the nitrogen applied after seeding but before emergence and the remaining applied near jointing. Additional nutrients (P, K, and S) will be applied as a pre-plant application. The varieties selected were done so based on previous flag leaf tissue data for N similar to selection characteristics outlined the preceding paragraph.

Grain yield will be measured for all plots and a sub-sample of grain will be collected and analyzed for protein concentration by NIR. Grain samples for the S study will be analyzed for total N and S.

Regional linkage to other research activities: None

Research Group: Daniel Kaiser, Soil Fertility Specialist University of Minnesota, Jochum Wiersma, Small Grains Specialist University of Minnesota.

Relationship to past projects: This project has linkages with two previous projects funded by the MN Wheat Research

and Communication Council. The first linkage is to a project funded in 2008-2009 that studied the effect of sulfur rate, source, and timing on spring wheat protein concentration and grain yield. The new project differs in that we are interested in determining differences in response among varieties which was not previously studied. We also want to further study the effects on amino acid concentration in the grain to determine if and how sulfur may affect cysteine and methionine concentration and the potential ramifications for baking quality. The second linkage is to a project funded in 2011-2012 where we studied differences in tissue concentration among varieties. The tissue samples collected will help us further address the stability analysis findings from the 2011-2012 study to further determine if the values obtained have any value for aiding in making management decisions on fertilizer application.

The MN Wheat Research and Communication Council funded previously funded the outlined S study for the 2014 cropping season. The original proposal submitted in 2014 did not include the N study. However, the N study was included at the Staples site in 2014. The work involved with the N study did not add much to the cost such that it was included in 2014. There was a response to S at the staples site. There were no clear interactions between variety and sulfur or nitrogen but more locations are needed to better examine this interaction. Two additional years with 9 total locations (over 3 years total including 2014) would give us better data for examining the interaction if we can locate additional responsive sites.

Estimate the budget requirements: \$16,643 for 2015 and \$16,643 for 2016 (2-year total \$33,286)

List current or potential other funding sources for this project: There is no current or pending funding for the research work outlined in this proposal. If funded by the Minnesota Wheat Research and Communication council, we will submit for funding through AFREC for 2016 for further quality analysis of the grain samples collected in 2015 and 2016. We are interested in the effects on amino acids in the grain, including sulfur containing amino acids such as cysteine and methionine. Similar work is being completed on samples taken during the 2014 growing season. In-kind analysis was provided by the USDA Grain Quality lab in Fargo on a portion of the 2014 samples. The number of samples generated makes it difficult to run analysis on samples and receive the data in a timely manner. Additional funding would allow us to speed up analysis on this portion of the study and is needed since Grain Quality lab cannot process all of the samples collected in the study.

List your programs current and pending support: Current (10 projects funded through 2015) Support \$465,083
Pending (requested) Support for 2015 \$931,884

References:

Kaiser, D.E. and R Severson. 2008. Examining sulfur rates for wheat and split applications versus broadcast. p 46-52 In., Minnesota Association of Wheat Growers, On-farm cropping trials northwest and west central Minnesota and 2008 Minnesota Wheat Research Reviews.

Kaiser, D.E. and R Severson. 2009. Examining sulfur rates for wheat and split applications versus broadcast. p 77-81 In., Minnesota Association of Wheat Growers, On-farm cropping trials northwest and west central Minnesota and 2009 Minnesota Wheat Research Reviews.

Kaiser, D.E., J.J. Wiersma, and J.A. Anderson. 2013. Genotype and environment variation in elemental composition of spring wheat flag leaves. Agron J. Accepted/In-press.

Liu, Y., J.B. Ohm, G. Hareland, J. Wiersma, and D.E. Kaiser. 2011. Sulfur, protein size distribution, and free amino acids in flour mill streams and relationship to dough rheology and bread making traits. J. of Cereal Chemistry 88(2): 109-116.

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RESEARCH PRE-PROPOSAL BUDGET

PROJECT TITLE: Variation in response to nitrogen and sulfur among spring wheat genotypes grown on irrigated and non-irrigated soils			
Principal Investigator(s) / Project Directors(s) Daniel Kaiser – University of Minnesota Jochum Wiersma – University of Minnesota	<u>Funds Requested For</u>		
	Year 1 (2015)	Year 2 (2016)	Year 3 (2017)
A. Salaries and Wages	\$	\$	\$
1. Co-principal Investigator(s)			
2. Senior Associates			
3. Research Associates - Post Doctorate			
4. Other Professionals			
5. Graduate Students			
6. Prebaccalaureate Students	\$3,000	\$3,000	
7. Secretarial - Clerical			
8. Technical, Shop and Other	\$2,500	\$2,500	
B. Fringe Benefits	\$658	\$658	
C. Nonexpendable Equipment (Planting and harvesting equipment use)			
D. Materials and Supplies	\$2,000	\$2,000	
E. Travel	\$2,000	\$2,000	
F. Publication Costs			
G. Computer Costs			
H. All Other Direct Costs (Attach supporting data)	\$6,485	\$6,485	
TOTAL AMOUNT OF THIS REQUEST (per year)	\$16,643	\$16,643	\$

Other Direct Costs

\$500 per year for equipment rental for planting and harvesting the trials

\$5,985 per year to pay for analysis of preliminary soil samples taken prior to treatment application, flag leaf samples collected from both the N and S studies to examine sulfur rate effects on accumulation of N or S in the leaves, NIR analysis for total protein concentration in grain, and Total N and S on samples collected from the sulfur study that are being used to fine tune NIR data for potential detection of S and amino acids on grain.