

RESEARCH PROPOSAL GRANT APPLICATION

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|---|---|---|
| <b>1. NAME AND ADDRESS OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE</b><br><br><b>Name:</b> Regents of the University of Minnesota<br><b>Address:</b> Sponsored Projects Administration<br>450 McNamara Alumni Center, 200 Oak Street SE<br>Minneapolis, MN 55455-2070   |   |   |
| <b>2. TITLE OF PROPOSAL</b><br><br><p style="text-align: center;"><b>Protein and yield response to nitrogen fertilizer and variation of plant tissue analysis in wheat.</b></p>   |   |   |
| <b>3. PRINCIPAL INVESTIGATOR(S)</b><br><br><p style="text-align: center;">Daniel Kaiser</p>   | <b>4. PI #1 BUSINESS ADDRESS</b><br>Department of Soil, Water, and Climate<br>University of Minnesota<br>439 Borlaug Hall<br>1991 Upper Buford Circle<br>Saint Paul, MN 55108 |   |
| PI# 2 Name: Jochum Wiersma  |   |   |
| PI# 3 Name:   |   |   |
| <b>5. PROPOSED PROJECT DATES (calendar years)</b><br><br>Jan 1 2011 to December 31 2012<br>Note: Research Reports are Due November 15th of Each Year  | <b>6. TOTAL PROJECT COST</b><br><br><p style="text-align: center;"><b>\$ 27,954</b></p>   | <b>7. PI #1 PHONE NO.</b><br>612-624-3482 |
| <b>8. RESEARCH OBJECTIVES:</b> (List objectives to be accomplished by research grant) <ol style="list-style-type: none"> <li>1) Study protein and yield response using nitrogen rate trials in Northern and Southern Minnesota</li> <li>2) Evaluate economic optimum nitrogen rates for spring wheat</li> <li>3) Evaluate the variability in plant tissue collected from the fully extended flag leaves</li> <li>4) Compare variability in nutrient composition of plant tissue for spring wheat between varieties and locations in well fertilized trials.</li> </ol> <p>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).</p> |   |   |
| <b>Signature Of Principal Investigator</b><br><br>   | <b>Date</b><br>12/1/2010  | <b>Phone Number</b><br>612-624-3482       |
| <b>Signature Of Authorized Representative</b>   | <b>Title</b>  | <b>Date</b>                               |
| <b>Address Of Authorized Representative</b><br>Kevin McKoskey, Branch Mgr., McNamara Bldg. Suite 450, 200 Oak St<br>Minneapolis MN 55455-2070   |   | <b>Phone Number</b>                       |

# Minnesota Wheat Research and Promotion Council

## RESEARCH PROJECT PROPOSAL

### (2-pages maximum)

**Project Title:** Protein and yield response to nitrogen fertilizer and variation of plant tissue analysis in wheat.

**Importance:** Proper nitrogen management in wheat is important since it is a key component in chlorophyll which affects starch production and nitrogen is a part of amino acids which is included in protein. Insufficient nitrogen can limit both yield and protein which can limit the potential profit for producers and if some fertilizer is applied not enough may be available to maximize both yield and protein. For example, spring wheat nitrogen rate studies in 2008 and 2009 found that 150 lbs of available N was enough to nearly maximize yields but not protein. In addition, past research has been conducted looking at wheat response to N, but no effort has been made to incorporate all available, and relevant, data to construct a database looking at long-term nitrogen needs of spring wheat. This type of data is important in order to evaluate current recommendations and provide wheat producers with the most up to date data on what nitrogen rates to apply in order to maximize yields and also to keep protein levels from falling to levels seen in 2008 and 2009 which severely affected the value of grain being sold at the elevator. In addition, a greater number of trials would allow for researchers to study if response to nitrogen varies across a region. This is important since data exists such that more nitrogen is applied in some regions of the Red River Valley than others. At this time the reason for this is unclear but with more trials a database could be put together to look at this as well as other nitrogen management issues.

Recently, plant tissue analysis has been offered to producers as a way to assess for nutrient deficiencies which may not be visually evident. In 2010 many tissue analysis reports found that copper may have been low. While this type of data is interesting there are no clear guidelines for widespread use of tissue analysis for determining nutrient application. Tissue nutrient concentrations can be significantly impacted by environmental conditions or other factors affecting plant growth. Also, most micronutrients are not mobile in the plant so depending on the availability of the nutrient and the time and place where the sample was taken erroneous data could be generated that would recommend a particular nutrient be applied even though there really was no evidence that yield was limited. A survey of plant tissue analysis of multiple varieties across multiple locations would be beneficial in order to give producers information on the efficacy of plant tissue testing for making nutrient management decisions.

**Background:** The current N management guidelines recommend applying nitrogen based on the yield goal of wheat minus any N credits from a previous crop or from soil nitrate (Rehm, 2002). This recommendation has served wheat growers for many years and is constant no matter where you are in the Red River Valley. For southern Minnesota table values are recommended for wheat because soil nitrate does not play as big of a role in recommendations. The idea of single sets of recommendations for large areas of the state are coming into question as farmers have adopted more precision agriculture technologies and have the ability to apply variable rates of crop inputs across fields and can collect yield data from individual field areas. In order to provide the information to make these recommendations data must be collected from multiple locations, especially if researchers want to better provide farmers with data that may provide differences between specific regions even within the larger regions within the state.

Plant tissue analysis has become more increasingly offered to wheat and other crop growers as a way to assess the nutrient status within the plant at a particular time that may ultimately be related back to yield. Crop uptake generally follows a consistent pattern; however, nutrients vary in when they are taken up and where they may go in the plant. Therefore, if environmental conditions exist that may limit uptake certain elements may be deficient in some areas of the plant. For example, elements such as sulfur or zinc are taken up into the plant and are not remobilized into other plant tissues if the supply in the soil becomes low. Therefore, plant tissue analysis can be problematic and may not accurately reflect yield at the end of the season if the cause of the temporary deficiency is corrected. Also, varieties may differ in their growth patterns ultimately affecting crop uptake of nutrients and the concentrations in plant tissues. Therefore, particular normal values may be only normal for particular varieties in specific locations rather than a one size fits all number for a tissue concentration. No recent work has been published that shows variety to variety variation across locations. Therefore work should be undertaken to provide farmers with an idea of what their tissue analysis really means.

**Relationship To Past Projects:** The nitrogen rate work builds on other work done in Minnesota. Work on nitrogen is not uncommon but many projects focus on not only rates but also timing and fertilizer sources. It's

our goal to eventually take some of the data from past research and combine this with new data, such as proposed with this project, to develop a database of N rate response to both yield and protein similar to that for corn that is used for the online N rate calculator. With enough data we can potentially separate regions of the state to determine if more or less nitrogen is needed in a particular area. For the plant analysis portion there have been many studies that have looked at various plant parts for their nutrient analysis. This study is unique in that its main focus is to look at variability in varieties across locations to get an idea if either of these two variables factors into what a normal value for a tissue concentration should be.

**Procedures:**

Nitrogen rate studies: Small plot trials will be conducted at two to three locations in conjunction with the on-farm variety trials. Small plot studies replicated four times will include seven to eight nitrogen rates starting at 0 and ranging in 30 lb increments up to 180 to 210 lbs of N per acre. All nitrogen will be applied as broadcast urea incorporated prior to planting. Additional P, K, and S will be applied in order to make sure these nutrients will not limit yield or protein response. For trials in Northern Minnesota a single variety will be planted across locations. Yield will be determined after harvesting the entire plot with a small plot combine and protein will be determined with a NIR. Soil samples will be taken from 0-6" and 6-12" depths for P, K, pH and nitrate. Yield data will be analyzed to determine the amount of nitrogen required to maximize agronomic yield as well as determine economic optimum nitrogen rates.

Plant tissue survey: Selected wheat varieties will be sampled at selected variety trial locations. This would potentially include 9 locations in Northwest Minnesota and 3 locations in central or western Minnesota outside of the Red River Valley. The preferred sampling will be conducted at Feekes 9.0 (prior to boot) in which about 20 flag leaves will be sampled out of each plot. This sampling is different from the recommended sampling of the whole plant (Overdahl, 1987) but represents a common analysis being used by farmers. Samples will be dried and sent in a single batch and analyzed for ICP for nutrient concentration. The variety trials will be ideal since yields are collected and potentially could be related back to nutrient content and conditions should be maintained with nutrients not being yield limiting. Potential the DRIS (diagnostic and recommendation integrated system) could be used to determine yield limiting factors. The DRIS system ranks nutrients in their potential for being yield limiting to the particular crop using normal values for a given region.

**Research Group:** Daniel Kaiser – Soil Fertility Specialist University of Minnesota Twin cities, Jochum Wiersma – Small Grains Specialist University of Minnesota Northwest Research and Outreach Center, Crookston.

**Regional Linkages To Other Research Activities:** Concurrent research is underway focusing on nitrogen management in wheat. Drs. Albert Sims and Jochum Wiersma are currently involved in two projects focusing on 1) nitrogen partitioning in multiple wheat varieties and the subsequent impact on protein, and 2), a survey of protein content from wheat in the Red River Valley. This trial is different in that it only focuses on simple nitrogen rate trials at more than one location. With this data we hope to be able to look at differing regional N rate recommendations, especially the new recommendation system in North Dakota, to determine if similar recommendations are feasible for Minnesota. Additional funds may be requested from other sponsors to initiate similar plant tissue surveys for corn and soybean with the ultimate goal of revising the current plant tissue analysis publication.

**Additional Sources of Funding:** Funding for the nitrogen rate study was granted through the Minnesota Fertilizer Research and Education Council for years 2008 to 2010. Due to a lack of available funds this proposal requests funding to keep the on-farm nitrogen rate trials for the next two years. No other source of funding has been requested from another agency for this trial.

**References:**

Overdahl, C.J. 1987. Plant analysis sampling and interpretation. Ext. Publ. AG-FS-3176. Univ. of MN Ext., Saint Paul.

Rehm, G., M. Schmitt, and R. Eliason. 2002. Fertilizing wheat in Minnesota. Ext. Publ. WW-03772-GO Rev. Univ. of MN Ext., Saint Paul.

# Minnesota Wheat Research and Promotion Council

## RESEARCH PROJECT PROPOSAL BUDGET

| <b>ORGANIZATION AND ADDRESS</b>   |                     |                     |                  |
|---|---------------------|---------------------|------------------|
| <b>Name:</b> Regents of the University of Minnesota<br><b>Address:</b> Sponsored Projects Administration<br>450 McNamara Alumni Center, 200 Oak Street SE<br>Minneapolis, MN 55455-2070 |                     |                     |                  |
| Principal Investigator(s) / Project Directors(s)  | Funds Requested For |                     |                  |
| Daniel Kaiser – U of M Twin Cities<br>Jochum Wiersma – NWROC Crookston  | Year 1<br>(2011)    | Year 2<br>(2012)    | Year 3<br>(2013) |
| 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  | 4,500.00            | 4,635.00            |                  |
| 7. Secretarial - Clerical   |                     |                     |                  |
| 8. Technical, Shop and Other  |                     |                     |                  |
| B. Fringe Benefits  | 396.00              | 409.00              |                  |
| C. Nonexpendable Equipment (Planting and harvesting equipment use)  | 80.00               | 80.00               |                  |
| D. Materials and Supplies   | 700.00              | 700.00              |                  |
| E. Travel   | 1,500.00            | 1,500.00            |                  |
| F. Publication Costs  | 100.00              | 100.00              |                  |
| G. Computer Costs   | 75.00               | 77.00               |                  |
| H. All Other Direct Costs (Attach supporting data) See Attached   | 6,488.00            | 6,614.00            |                  |
| <b>I. TOTAL AMOUNT OF THIS REQUEST (per year)</b>   | <b>\$ 13,839.00</b> | <b>\$ 14,115.00</b> | <b>\$</b>        |

**Other Direct Costs**

|          |  |
|----------|--|
| \$200.00 | Covers cost of printing poster board enlargements used for field days held at the nitrogen rate trial locations                                    |
| \$485.00 | Covers cost of soil sample analysis for baseline samples taken at the nitrogen rate studies and soil samples taken at the variety trial locations. |
| \$12,217 | Sample analysis charges to analyze plant samples both years of the study from the flag leaf sampling.  |