FOR ADMINISTRATIVE USE

Minnesota Wheat Research and Promotion Council
RESEARCH PROPOSAL GRANT APPLICATION

Program Area Code Proposal Code

1. NAME AND ADDRESS OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

Name: SMSU Agronomy (Contract signer is Deb Kerkaert though if that is important/needed)
Address: 1501 State Street, Marshall MN, 56258

2. TITLE OF PROPOSAL Resubmission: Utilization of wheat fertility trials to enhance educational opportunities for future ag professionals

3. PRINCIPAL INVESTIGATOR(S) Adam M Alford Ph.D.

PI# 2 Name: Elliot Vaughan Ph.D.

PI# 3 Name:

4. PI #1 BUSINESS ADDRESS
Southwest Minnesota State University
1501 State Street
Agriculture, Culinology, and Hospitality Management Department
Marshall, MN, 56258

5. PROPOSED PROJECT DATES (calendar years)
Jan 1-Dec 31st 2024

Note: Research Reports are Due November 15th of Each Year

6. TOTAL PROJECT COST
$13,000

7. PI #1 PHONE NO.
479-879-2736

8. RESEARCH OBJECTIVES: (List objectives to be accomplished by research grant)

Objective 1: Demonstrate how varying rates of N fertilizer (soil and foliar) impact wheat growth rates, canopy development (quantified via drone photography), final yield, and the overall protein content of the grain for educational purposes.

Objective 2: Familiarize SMSU agriculture students (along with the intern hired to conduct this work) with wheat production practices and provide hands-on learning opportunities and data for the SMSU agriculture curriculum using the wheat plots this project funds.

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).

Signature Of Principal Investigator Adam Alford	**Date** 1/1/24	**Phone Number** 479-879-2736
Signature Of Authorized Representative Deb Kerkaert	**Title** Vice President for Finance and Administration	**Date** 1/2/2024
Address Of Authorized Representative 1501 State Street Marshall, MN 56258		**Phone Number** 507-537-6093

Minnesota Wheat Research and Promotion Council
RESEARCH PROPOSAL GRANT APPLICATION
(2-pages maximum)

Project Title: Resubmission: Utilization of wheat fertility trials to enhance educational opportunities for future ag professionals

Importance of this project to the profitability of wheat producers:

The primary manner in which this project will positively impact MN wheat farmers is via education and demonstration. Agriculture students at Southwest Minnesota State University are the future crop scouts, consultants, and product sales service that our MN wheat farmers rely on, and as such, training investments made in today's agriculture students, will pay major dividends once these students hit the job market.

Along these lines, the main purpose of this grant is to provide experiential hands-on and visual learning opportunities for the agriculture, biology, and environmental science students at SMSU. The proposed research methods are heavy on visual and hands-on learning opportunities, and while somewhat obtuse and hard to quantify, one of the main objectives of this project is to help students put their own words to management practices either performed or observed. I have found that even for my farming students, most cannot communicate the **why** of whatever ag practice they are conducting in their field. Said another way, they often know how to operate the machinery, and at the very least drive the grain cart, but they often aren't brought into the decision making process on why they perform one management practice over another.

To help students put their own words to management practices, we will **target student labor** to carry out the projects experimental objectives. Additionally, data generated from the field plots, as well as the research plots themselves, will be used to provide hands-on learning experiences and data sets. An abbreviated list of how the data will enhance coursework is provided below for at least 6 different courses:

AGRO 132 Crop Production + Lab (Where the effect of fertility on yield will be used for a lab)
AGRO 212 Grain and Forage Crop Management (Weed suppressive ability & soil quality aspects will be demonstrated)
AGRO 332 Crop Quality and Traits (Where wheat protein content will be demonstrated with samples and chem analysis)
AGRO 341 Principles of Pest Management + Lab (Where various wheat pests will be shown, IDed, and collected)
AGRO 454 Experimental Design in Agriculture + Lab (Where statistical data collected from this project will be analyzed)
ENVS 107 Introduction to ArcGIS (Spring 2025) soil quality parameters collected from the wheat field with different fertility regimens, will be paired with GPS data to demonstrate how field soil data can be mapped into a digital model.

For this project, the summer plot work will focus on demonstrating how N rates can be managed to reduce lodging risk, increase yields, and improve wheat protein quality. Additionally, these plots will also be used to demonstrate various other aspects of wheat production, such as wheat's ability to suppress weeds (which will be assessed with drone imagery and ImageJ photo analysis), and how a wheat rotation can improve soil health, in particular effects on soil organic matter, soil respiration, and soil moisture.

Farming **is** becoming more technologically advanced and as an ag educator, it is my responsibility to introduce all types of students to farming, especially as ag **is becoming more interdisciplinary**. I have been relatively successful in doing this with last years funded projects (MNWR&PC and others) and was able to get 157 unique visitors to the SMSU research plots in the 2023 growing season. While this number includes agriculture majors fulfilling coursework, it also includes business, biology, Culinology, environmental science, education, and graphic design majors. This number also includes international students and members of the public just curious to see whats going on. After their visits, all of these individuals now have a better understanding of wheat production and where their food comes from.

R&D requires both software and mechanical engineers to write code, and develop the machinery for the agromachines and agro-sensors of the future, especially within the area of precision agriculture. Marketing professionals are needed to communicate the value of newly developed and developing technologies. Ag professionals/consultants are needed to bridge the research to grower gap that can sometimes occur when communicating the results of scientific research. Ag competent lawyers are needed to voice and pursue the interest of farmers. While this list of jobs is brief and certainly not conclusive of all shareholders within the ag-community, representatives from any ag-related job will be

better prepared to do their job, and do it well, if they are simply provided an opportunity **to go out to a farm**, get their boots muddy, and experience how the work is done. Even a basic experiment, like varying N fertilizer and demonstrating ther corresponding changes to plant yields and crop quality, can help elucidate some of the challenges/decisions growers have to make when investing in their crop. Funding this grant will help us achieve our educational goals.

Procedures: In order to investigate and provide data on the role of N-rates on canopy space and development in hard red spring wheat, varying rates of N (90, 120, and 150 lbs/ac) will be applied in relation to soil test values resultant from a composite soil test taken prior to planting. Two additional treatments will also be planted at 90 and 120 lbs N/ac rate, but will receive an additional 30 lbs N/ac via foliar application once anthesis has been reached. These foliar treatments will be used to demonstrate how foliar applications can be used to improve protein content and will be quantified in collaboration with the Agricultural Utilization Research Institute (AURI) at the Marshall location. We will also include a single higher yielding/lower protein variety to be fertilized at the 120 lbs/ac level. All other varieties will be higher protein/lower yielding. Variety selection will depend on seed availability and suggestions from our local seed dealer. All 6 experimental treatments will receive 23 lbs/ac of P and 30 lbs/ac of K. Fertilizers will be shallowly incorporated with a culti-tiller prior to planting to reduce any fertilizer injury to wheat seeds.

Each of these six experimental treatments will be planted, and analyzed with a plot size of at least 32 rows (7.5" row spacing), 60 feet long each, with a targeted planting population of ~2 million plants per acre. Plots will be replicated a minimum of four times in a randomized complete block design. Wheat will be combine harvested and weighed with a weigh wagon in late summer. Separate ANOVA models will be constructed for various dependent variables including but not limited to yield, leaf chlorophyll content (measured via chlorophyll meter), and canopy development (measured via drone photography + ImageJ software). Relevant predictors for each statistical model will include fertility treatment and block. Significant ANOVA results will be further analyzed with a Tukey posthoc to determine significant differences between treatments. SMSU owns all farm equipment needed to conduct this research.

Several soil health parameters will be collected before, during and after the growing season. Particular focus will be given to parameters related to soil organic matter, including loss on ignition, soil C, soil N, and soil respiration (a measure of plant root and microbial activity). Soil respiration and soil moisture will be measured using sensors constructed and already tested at these field plots. These measurements will be compared across the five wheat treatments as well as to other existing crop rotations on the property (primarily corn and soy).

Regional linkages to other research activities: None

List any other secured, pending, or planned submissions to outside funding sources for this work: We are applying for a grant from MNSR&PC to fund the purchase of an NDVI sensor. If the grant is funded, we will likely record NDVI values with wheat as well for preliminary data collection purposes.

Research Group: None

Relationship to past projects: This project is a resubmission w/ minor modifications of FY 2023's funded grant at SMSU. We are resubmitting this project due to the major influence of drought on last year's results. If the grant reviewers would like a new project I have one in mind looking at the impact of planting rates.

Estimate the budget requirements: Total of $13,000: $1,500 for PI salary to maintain the plot, oversee the student worker, and conduct statistical analyses, **$3,500** for herbicide, fertilizers, pesticides, high quality wheat seed, incidentals (fuel, in-field equipment repair, plot stakes, sensor repair, etc.), **$5,000** for student intern for 300 hours of work @ $17/hour, **$500** for student intern overhead/insurance @ 10% of pay rate, **$500** for occasional adjunct labor, **$1500** for soil testing to target fert rates pre plant and throughout the season, **$500** for wheat quality (protein) testing

References: None

Minnesota Wheat Research and Promotion Council

RESEARCH PROJECT PROPOSAL BUDGET

Project Title:			
Principal Investigator(s) / Project Director(s)	Funds Requested For		
	Year 1 (2023)	Year 2 (2024)	Year 3 (2025)
A. Salaries and Wages	$	$7,000	$
1. Co-principal Investigator(s)		1,500	
2. Senior Associates		500	
3. Research Associates – Post Doctorate			
4. Other Professionals			
5. Graduate Students			
6. Prebaccalaureate Students		5,000	
7. Secretarial - Clerical			
8. Technical, Shop and Other			
B. Fringe Benefits		500	
C. Consulting and Professional Services		2,000	
D. Supplies and Services		3,500	
E. Travel			
F. Sub-Contracts			
G. Repairs & Maintenance			
H. Rentals & Lease			

I. Other Expenses			
TOTAL AMOUNT OF THIS REQUEST (per year)	**$**	**$ 13,000**	**$**