


# Minnesota Wheat Research and Promotion Council

## RESEARCH PROPOSAL GRANT APPLICATION

<b>1. NAME AND ADDRESS OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE</b>  <b>Name:</b> Regents of the University of Minnesota <b>Address:</b> Sponsored Projects Administration 454 McNamara Alumni Center, 200 Oak Street SE Minneapolis, MN 55455-2070		
<b>2. TITLE OF PROPOSAL</b> Bacterial seed inoculation to improve nitrogen uptake and use efficiency in wheat		
<b>3. PRINCIPAL INVESTIGATOR(S)</b>  Paulo Pagliari  <hr/> PI# 2 Name: Lindsay Pease  <hr/> PI# 3 Name:	<b>4. PI #1 BUSINESS ADDRESS</b>  Southwest Research and Outreach Center 23669 130th St. Lamberton, MN 56152 Tel. 507-752-5065 FAX 507-752-5097 email: pagli005@umn.	
<b>5. PROPOSED PROJECT DATES (calendar years)</b> 01/01/2021 to 12/31/2021  Note: Research Reports are Due November 15th of Each Year	<b>6. TOTAL PROJECT COST</b>	<b>7. PI #1 PHONE NO.</b> Tel. 507-752-5065
<b>8. RESEARCH OBJECTIVES:</b> (List objectives to be accomplished by research grant)  Determine if inoculation of wheat with plant growth promoting bacteria has a positive impact on wheat growth and yield.  Assess nitrogen uptake in plots inoculated with plant growth promoting bacteria.   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).		
<b>Signature Of Principal Investigator</b> 	<b>Date</b> 01/13/2021	<b>Phone Number</b> 507-752-5065
<b>Signature Of Authorized Representative</b>	<b>Title</b>	<b>Date</b>
<b>Address Of Authorized Representative</b>  April Coon, Sr. Associate Director, Office of Sponsored Projects Administration McNamara Alumni Center, 200 Oak Street SE, Minneapolis, MN 55455-2070		<b>Phone Number</b>  450

# Minnesota Wheat Research and Promotion Council

## RESEARCH PROJECT PROPOSAL

### (2-pages maximum)

**Project Title:** Bacterial seed inoculation to improve nitrogen uptake and use efficiency in wheat

#### **Importance of this project to the profitability of wheat producers:**

Nitrogen (N) fertilization is one of the highest costs in the production process of non-leguminous crops such as wheat (*Triticum aestivum*). Developing management practices which minimize the reliance on chemical N inputs are critical for global food security and environmental sustainability. Recent research has shown the potential for utilization of plant growth promoting bacteria (PGPB) to enhance nutrient use efficiency in non-leguminous cropping systems. This has the potential to reduce both costs associated with fertilizer purchases and N loss to the environment. Microorganisms such as *Azospirillum brasilense* and *Bacillus subtilis*, are PGPB known to have a significant effect on the nutrient balance in the soil-plant ecosystem. The mutualism relationship between PGPB, soil microflora, and plants could lead to better plant nutrition and development and increased productivity, while minimizing the needs for external inputs. The PGPB are nonpathogenic residents of plants or/and soil who act directly to promote growth or indirectly as biological control agents of plant diseases (Mariano et al., 2004). The use of inoculation in non-leguminous crops with non-symbiotic PGPB is increasing in Latin America, in particular for wheat and corn crops (Marks et al., 2015; Salvo et al., 2018). The use of PGPB can reduce significantly the amount of chemical N needed for optimum wheat productivity. Therefore, the overall hypothesis of this study is that *A. brasilense* and *B. subtilis* have the ability to promote plant growth by increasing biological N fixation (BNF), N use efficiency, overall nutrient uptake, and reduce biotic and abiotic stress.

#### **Procedures:**

Replicated field studies will be conducted at two of the University of Minnesota research and outreach center at Lamberton (SWROC) and Crookston (NWROC). To test the effects of seed inoculation on wheat grain yield, wheat will be planted after soybean and corn, at Lamberton, and soybean and sugarbeets, at Crookston. Treatments will be inoculation and nitrogen rates. For the inoculation rate portion of the study a fixed N rate will be used (likely a limiting rate such as 50 lbs N ac<sup>-1</sup>) and the levels of inoculation will be 0x, 0.5x, 1x, 2x, and 3x, with x being the recommended inoculation rate. For the N rate portion of the study, we will have plots which will be inoculated at the 1x levels and also plots which will not be inoculated; nitrogen rates will be 0, 30, 60, 90, and 120 lbs of N / acre. Each study will be replicated four times for a total of 100 plots in each location. Having equivalent N rates with and without inoculation will allow us to determine the true potential for N fixation from the seed treatments and if a reduction in N fertilization is possible with this seed treatment. Wheat will be harvested using plot combine and wheat grain samples will be saved for N uptake analysis to be performed at Lamberton in Dr. Pagliari labs.

#### **Regional linkage to other research activities:**

N/A

#### **List current or potential other funding sources for this project:**

There are current no other funding sources for this project.

#### **Research Group:**

The research group for Dr. Pagliari is:

Lee Klossner – Researcher 6

Emily Evans – Researcher 3

The research group for Dr. Pease is:

Heidi Reitmeier

#### **Relationship to past projects:**

The proposed research has not link to previous research funded by the wheat growers. However, the Dr. Pagliari has worked with PGPBs with collaborators from Brazil.

#### **Estimate the budget requirements:**

Budget needed is \$15,000 per location in addition to \$9,240 for total nutrient uptake and protein analysis and

supplies needed for field trials. The total budget is \$39,240. The \$15,000 per location will cover plot fees, supplies needed for plots set up, harvest, and sample collection, as well as technical support salaries.

#### References:

- Mariano RLR, Silveira EB, Assis SMP, Gomes AMA, Nascimento ARP, Donato VMTS. 2004. Importance of plant growth-promoting rhizobacteria for a sustainable agriculture. (In Portuguese, with English abstract). *Anais Acad. Pernamb. Ci. Agron.* 1:89-111.
- Marks BB, Megías M, Ollero FJ, Nogueira MA, Araujo RS, Hungria M. 2015. Maize growth promotion by inoculation with *Azospirillum brasilense* and metabolites of *Rhizobium tropici* enriched on lipo-chitooligosaccharides (LCOs). *Amb Express* 5:71-82. doi: 10.1186/s13568-015-0154-z.
- Salvo LP, Ferrando L, Fernández-Scavino A, Salamone IEG. 2018. Microorganisms reveal what plants do not: wheat growth and rhizosphere microbial communities after *Azospirillum brasilense* inoculation and nitrogen fertilization under field conditions. *Plant Soil* 424:405-417. doi: 10.1007/s11104-017-3548-7.