**FOR ADMINISTRATIVE USE Minnesota Wheat Research and Promotion Council**

**Program Area Code Proposal Code**

 **RESEARCH PROPOSAL GRANT APPLICATION**

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| **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**Bacterial seed inoculation to improve nitrogen uptake and use efficiency in wheat |
| **3. PRINCIPAL INVESTIGATOR(S)**Paulo Pagliari PI# 2 Name: Lindsay Pease PI# 3 Name: Satoshi Ishii | **4. PI #1 BUSINESS ADDRESS** Southwest Research and Outreach Center 23669 130th St. Lamberton, MN 56152 Tel. 507-752-5065 FAX 507-752-5097email: pagli005@umn. |
| **5. PROPOSED PROJECT DATES (calendar years)** 01/01/2022 to 12/31/2022 Note: Research Reports are Due November 15th of Each Year | **6. TOTAL PROJECT COST**$39,240 | **7. PI #1 PHONE NO.**Tel. 507-752-5065  |
| **8. RESEARCH OBJECTIVES:**  (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.Measure soil available nitrogen after inoculation with plant growth promoting bacteria.Assess nitrogen uptake in plots inoculated with plant growth promoting bacteria.Text, letter  Description automatically generatedAttach 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**  | **Date** **12/15/2021** | **Phone Number**507-752-5065  |
| **Signature Of Authorized Representative** | **Title****Associate Director** | **Date****12/21/2021** |
| Address Of Authorized RepresentativeAmy Rollinger, Associate Director, Office of Sponsored Projects Administration 450 McNamara Alumni Center, 200 Oak Street SE, Minneapolis, MN 55455-2070 | **Phone Number** |

**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 (Galindo et al., 2021a). 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; Galindo et al., 2021b). The use of PGPB can significantly reduce the amount of chemical N needed for optimum wheat productivity (Galindo et al., 2021a,b). Therefore, the overall hypothesis of this study is that *A. brasilense* and *B. subtilis* could 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-1) 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

In addition Dr. Satoshi Ishii from the department of soil water and climate will collaborate in this research

**Relationship to past projects**:

The proposed research was funded by the MN wheat growers in 2021 and showed very positive results from the first trial.

**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.

Budget justification

Salary ($30,000): We are asking for funding to cover salary for Lee Klossner (0.19FTE) and Heidi Reitmeier (0.21FTE). Lee and Heidi will oversee all aspects of the field trial including sample collection.

Supplies ($8,940): Supplies will cover plot fees, supplies needed for plots set up, harvest, sample collection, and supplies needed for N uptake analysis.

Shipping ($300): will cover shipping of inoculant from Brasil and grain and soil samples from Crookston to Lamberton.

**References:**

Galindo, F.S., Pagliari, P.H., Buzetti, S., Rodrigues, W.L., Fernandes, G.C., Biagini, A.L.C., Tavanti, R.F.R. and Teixeira Filho, M.C.M., 2021a. Nutrient availability affected by silicate and Azospirillum brasilense application in corn–wheat rotation. *Agronomy Journal*.

Galindo, F.S., da Silva, E.C., Pagliari, P.H., Fernandes, G.C., Rodrigues, W.L., Biagini, A.L.C., Baratella, E.B., da Silva Junior, C.A., Neto, M.J.M., Silva, V.M. and Muraoka, T., 2021b. Nitrogen recovery from fertilizer and use efficiency response to Bradyrhizobium sp. and Azospirillum brasilense combined with N rates in cowpea-wheat crop sequence. *Applied Soil Ecology*, *157*, p.103764.

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, Fernandéz-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.

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 **RESEARCH PROJECT PROPOSAL BUDGET**

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|  **Project Title:**  |
|  **Principal Investigator(s) / Project Director(s)**    |   Funds Requested For  Year 1 Year 2 Year 3 (2022) (2023) (2024) |
| 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 |  |  |  |
|  7. Secretarial - Clerical |  |  |  |
|  8. Technical, Shop and Other | $23,046  |  |  |
| B. Fringe Benefits | $6,954  |  |  |
| C. Consulting and Professional Services |   |  |  |
| D. Supplies and Services   | $8,940  |  |  |
| E. Travel |   |  |  |
| F. Sub-Contracts |   |  |  |
| G. Repairs & Maintenance |   |  |  |
| H. Rentals & Lease  |   |  |  |
| I. Other Expenses (shipping of inoculant from Brazil and samples from Crookston to Lamberton) | $300  |  |  |
| **TOTAL AMOUNT OF THIS REQUEST (per year)** | **$ 39,240** | **$**  | **$**  |