



Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-282

Proposal Title: Optimizing Biostimulant Use for Minnesota Grain Production Sustainability

Project Manager Information

Name: Paulo Pagliari

Organization: U of MN - Southwest Research and Outreach Center

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Project Basic Information

Project Summary: This proposal investigates biostimulants to reduce nitrogen fertilizer use in multiple grain crops and potatoes grown in Minnesota, supporting HF2683 water quality incentives while sustaining crop yields and farm profitability.

ENRTF Funds Requested: \$890,000

Proposed Project Completion: March 31, 2031

LCCMR Funding Category: Land (F)

Project Location

What is the best scale for describing where your work will take place?

Statewide

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

The proposal addresses Minnesota's urgent water quality crisis from agricultural nitrate pollution, threatening groundwater, rivers, and lakes statewide, especially in southeastern karst and central/southwestern areas. Where over 10% of wells exceed 10 mg/L safety limits, risking public health issues like "blue baby syndrome", cancers, and water pollution. Farming accounts for over 50% of nitrogen losses to waters.

Minnesota's HF2683 (Biofertilizer Innovation and Efficiency Program, 2025) directly incentivizes farmers to cut commercial nitrogen use by at least 15% or 30 lbs/acre via biofertilizers/biostimulants, offering ≥\$5/acre payments to improve nitrogen management and safeguard water quality. Similar policies in neighboring states highlight the regional priority.

However, reliable evidence is lacking on whether biostimulants enable these N reductions statewide without yield losses. Preliminary replicated field trials have shown that the use of biostimulants in certain crops can cause a significant loss in yield. The understanding of how biostimulants can manipulate the hormonal system of plants remain unclear in Minnesota's soils and climate.

This University of Minnesota study tests biostimulants on major crops (corn, wheat, potato, edible bean) at three research and outreach centers, delivering data-driven support for HF2683, curbing pollution, restoring waters, safeguarding health, and fostering sustainable farming.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

The proposed solution is a rigorous, multi-year field research project led by the University of Minnesota to evaluate biostimulants as practical tools to reduce commercial nitrogen fertilizer use while maintaining or enhancing crop yields.

Key elements include:

- Conducting replicated field trials over three years (2028–2030) at three Research and Outreach Centers (Lamberton/SWROC, Becker/Sand Plains, Crookston/NWROC) representing Minnesota's diverse soils and climates.
- Testing on major crops: corn, edible bean (black bean), wheat (rainfed sites), and potato (irrigated sandy site).
- Applying nitrogen at 0%, 50%, and 100% of recommended rates, plus biostimulant treatments at 75% N to assess reductions.
- Measuring comprehensive outcomes: soil nutrient status, plant uptake, plant hormone profiles, physiological responses (chlorophyll index, CO₂-assimilation, water use efficiency), microbial communities (16S rRNA sequencing), oxidative stress markers, and final yield.

This generates evidence-based data on when and how biostimulants enable reliable 15% or 30 lbs/acre N cuts without yield penalties, clarify mechanisms (e.g., hormonal shifts for stress tolerance), and identify risks (as seen in preliminary bean trials). Results will directly support HF2683 implementation by guiding farmers, MDA, and policymakers on effective, low-risk adoption. Which will protect Minnesota's waters and public health, and advance sustainable, resilient agriculture statewide.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

This research will identify biostimulants that enable Minnesota farmers to reduce synthetic nitrogen fertilizer use by 15–30% in corn, wheat, potato, and edible beans while maintaining yields. Specific outcomes include substantially lower nitrate pollution in lakes, rivers, and groundwater, directly protecting and enhancing water quality. The project will also improve soil health through enhanced microbial communities, increase nutrient use efficiency, and strengthen crop resilience to abiotic stresses. These results support the conservation and preservation of Minnesota's natural resources and provide critical scientific backing for HF2683 incentives.

Activities and Milestones

Activity 1: Multi-Location Field Research Trials

Activity Budget: \$875,000

Activity Description:

Objective: Quantify biostimulant effects on nitrogen use, plant hormones, stress tolerance, and yields for corn, wheat, potato, and edible beans to support 15–30% N fertilizer reductions.

Tasks: Establish replicated field trials at three UMN ROCs (Lamberton, Becker, Crookston) during the 2028–2030 growing season; apply varying N rates plus biostimulants to be tested including (nitrogen fixing bacteria, sea weed extract, and humic substances); collect soil samples for nutrient assessment and microbial community assessment, plant tissue for nutrient concentration, plant physiological changes (chlorophyll, gas exchange, oxidative stress status), changes in hormone production, and yield data.

This objective will be accomplished via standardized protocols, best management practices, and certified lab analyses (LC-MS/MS, 16S sequencing) to generate the highest resolution data possible.

Outputs: Comprehensive performance and mechanistic datasets that will allow our team to develop best management practices for the use of biostimulants in MN farms.

Impact/Use: Scientific basis for HF2683 incentives, protecting MN water quality while sustaining farm profitability.

Evaluation: We will evaluate the success of this project during extension events when we meet with farmers to show results of the project.

Activity Milestones:

Description	Approximate Completion Date
Tasks	November 30, 2030
Outputs	December 31, 2030
Impact	March 31, 2031
Evaluation	March 31, 2031

Activity 2: Extension and Knowledge Dissemination

Activity Budget: \$15,000

Activity Description:

Objective: translate research findings on biostimulants into recommendations that enable Minnesota farmers and crop consultants to confidently reduce synthetic nitrogen fertilizer use by 15–30% in the state while maintaining yields and directly supporting water quality improvements under HF2683 and similar state legislation.

Tasks: Synthesize all field, physiological, hormone, and microbial data; create four crop-specific fact sheets; prepare presentations; and deliver results through multiple Extension channels.

How tasks will be accomplished: Leveraging the project team’s combined 3 FTE Extension capacity, fact sheets will be professionally designed and posted on the UMN Extension website and shared through MN Department of Agriculture networks. Results will be presented at established, high-attendance events: Nitrogen Management Conference (250 farmers), Nutrient Management Conference (250), Crop & Pest Management Shortcourse (500+), and five Ag Update meetings (350 total).

Outputs: Four practical, crop-specific fact sheets and targeted presentations reaching thousands of Minnesota farmers and consultants annually, plus peer-reviewed publications.

Impact and Use: Farmers will receive science-based guidance on which biostimulants reliably reduce nitrogen needs under Minnesota conditions, accelerating adoption while protecting farm profitability.

Evaluation: Track success via event attendance, pre/post-participant surveys measuring knowledge gain and intended adoption rates, and long-term monitoring of nitrogen fertilizer use trends in MN.

Activity Milestones:

Description	Approximate Completion Date
field days to educate farmers	March 31, 2031
factsheets publication	March 31, 2031
peer-reviewed publication	March 31, 2031

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Fabian Fernandez	University of Minnesota	Adviser	No
Carl Rosen	University of Minnesota	Co-PI	Yes
Lindsay Pease	University of Minnesota	Co-PI	Yes
Satoshi Ishii	University of Minnesota	Co-PI	Yes

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.

Leveraging the project team's combined 3 FTE Extension capacity, fact sheets will be professionally designed and posted on the UMN Extension website and shared through MN Department of Agriculture networks. Results will be presented at established, high-attendance events: Nitrogen Management Conference (250 farmers), Nutrient Management Conference (250), Crop & Pest Management Shortcourse (500+), and five Ag Update meetings (350 total), as well as other extension events throughout the state.

Peer reviewed publications will also be developed with results from this study.

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?

Findings will be implemented through University of Minnesota Extension's well-established programs. We will produce and distribute four crop-specific fact sheets and present results at field days, the Nitrogen Management Conference, and other grower events reaching over 1,000 Minnesota farmers each year. This will promote practical adoption of effective biostimulants to lower nitrogen fertilizer use and protect water resources. Ongoing Extension activities will be funded through standard UMN Extension budgets. Any additional research needed beyond 2031 will be supported by securing new competitive grants from state and federal sources.

Project Manager and Organization Qualifications

Project Manager Name: Paulo Pagliari

Job Title: Professor

Provide description of the project manager's qualifications to manage the proposed project.

Dr. Pagliari has been a professor at the University of Minnesota since August 2012 and has been involved with multiple experiments in agricultural production in MN, other US states, and also internationally. Dr. Pagliari has over 20 peer-reviewed publications on the use of biostimulants on grain crops. The MN wheat growers and corn growers (research and promotion councils), as well as the MDA-AFREC program, have financed some of the preliminary work done by Dr. Pagliari research team. In these preliminary field trials, diverging results have been observed where the use of biostimulants can be beneficial to crop yield; but, it can also be detrimental and lead to significant yield losses. All of the experience Dr. Pagliari has gained over the last decade working on and collaborating with international scientists makes

him the most suited researcher to develop management practices that makes best of plant biostimulants in MN cropping systems.

Organization: U of MN - Southwest Research and Outreach Center

Organization Description:

U of MN, southwest research and outreach center

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Project Director		Manage all aspects of this project			36.6%	0.56		\$85,724
Co-PI Ishii		Will manage all aspects of the microbial analysis			36.6%	0.2		\$33,272
Co-PI Pease		Will manage all aspects of this project at Crookston			36.6%	0.2		\$31,068
Research-6 SWROC		This person will oversee all field activities of this project at Lamberton			36.6%	0.56		\$63,574
Research-6 NWROC		Will assist with field trials and sample collection at NWROC			36.6%	0.14		\$13,865
Graduate Student		Will help with data analysis and interpretation, writing of documents, presentation at field days, and data collection			24.2%	3		\$303,851
Undergraduate students all sites		undergraduate students will be hired to help with all activities for this project.			0%	8		\$35,525
Civil Service Ishii		Will assist with microbial analysis of soil samples from all sites			32.3%	0.46		\$40,285
Civil Service Pagliari		Will manage plant tissue collection for hormone analysis for SWROC			32.3%	0.38		\$26,857
Civil Service Pease		Will manage plant tissue collection for hormone analysis for NWROC			32.3%	0.36		\$26,857
Researcher 6 Rosen		Will assist with field set up and sample collection at Becker			32.3%	0.32		\$34,914
Researcher 3 Becker		Will assist with planting, soil and tissue collection, and harvest at Becker			32.3%	0.36		\$26,857
Researcher 1 Becker		Will assist with tissue collection for hormone analysis Becker			36.6%	0.36		\$27,730
							Sub Total	\$750,379
Contracts and Services								
TBD	Service Contract	This will cover soil analysis for microbiome and also hormone analysis in plant tissue				2		\$94,522
							Sub Total	\$94,522

Equipment, Tools, and Supplies								
	Tools and Supplies	General operating supplies including, fertilizer, seeds, flags, chemical reagents for tests, test tubes, bags, trays, and other lab equipment needed for analysis.	Those items are needed to conduct the field trials and also for sample preparation and analysis in our laboratories.					\$24,924
							Sub Total	\$24,924
Capital Equipment								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel from SWROC to St Paul for sample delivery and project meeting, 4 trips per season (300 miles round trip) total 1,200 miles for 2028 and 1,200 miles for 2029, two trips in 2030 for final meetings 600 miles; total milage for SWROC 3000 miles at \$0.725 totals \$2,175. Travel from NWROC to St Paul for sample delivery and project meeting, 1 trip per season (690 miles round trip) for a total of 1,380 miles and total \$1,000. Trips from St Paul to Becker for field work, sample collection, plot maintenance, and harvest (100 miles round trip) 35 trips per season 3,500 miles per season and total of \$5,075 for the two seasons. In addition, a total of \$6,000 for travel is being requested to allow the researchers in this project to travel across the state to participate in Extension events to share the results from this project.	Travel is needed to maintain plots, collect sample, deliver samples, and also for project meetings.					\$14,175
							Sub Total	\$14,175
Travel Outside Minnesota								

							Sub Total	-
Printing and Publication								
	Publication	Peer review publication rate	Pay for publishing fees					\$4,000
	Printing	Printing extension materials	This fund will be used to print Extension materials developed with results form this research porject					\$2,000
							Sub Total	\$6,000
Other Expenses								
							Sub Total	-
							Grand Total	\$890,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
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Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
			Non State Sub Total	-
			Funds Total	-

Total Project Cost: \$890,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [ba94c567-47a.pdf](#)

Alternate Text for Visual Component

The visual component shows how the project was developed, who provided input, and how the project will be managed to deliver the results needed....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
Letters of support	25ab4486-48b.pdf
University of Minnesota SPA authorization to submit proposal letter	185a9a37-4f6.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the UMN Policy on travel applies.

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

No

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care,

treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

Sue Kilber at University of Minnesota

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

Yes, I understand