



Environment and Natural Resources Trust Fund

2024 Request for Proposal

General Information

Proposal ID: 2024-157

Proposal Title: Lowering Nitrogen Fertilizer Application to Restore Water Quality

Project Manager Information

Name: Brett Barney

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

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Project Basic Information

Project Summary: Our project will identify native microbes that provide nitrogen to plants through natural biological processes, and apply these to replace current industrial fertilizers while lowering fertilizer costs for farmers.

Funds Requested: \$292,000

Proposed Project Completion: June 30, 2026

LCCMR Funding Category: Methods to Protect, Restore, and Enhance Land, Water, and Habitat (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?

During the Project

Narrative

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

Modern agricultural practices require large quantities of fertilizer to feed a growing population. These costs have been amplified in recent years as a result of global shortages and conflicts, contributing to inflation and hurting farmers and rural communities. In addition, much of the fertilizer that is applied to crops and soil never reaches the plant it is intended for, instead being converted into compounds that escape to the atmosphere or work their way into various water systems, resulting in detrimental environmental effects to groundwater, lakes and streams. In some cases, this further affects landowners by contaminating drinking and well water. Prior to the addition of these fertilizers, many natural plant ecosystems in Minnesota thrived using only nitrogen provided by beneficial microbes that grow in association with plants. The introduction of farming and various agricultural and industrial chemicals can disrupt these beneficial associations. It is essential that our state takes steps to catalog and characterize these natural associations that exist in our native prairies as well as with important agricultural crops to identify microbes with a potential to lower the needs for fertilizers in Minnesota, and maintain microbial culture stocks to meet potential future needs.

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.

We will collect and catalog important microbes that form beneficial associations with important plants and crops from various ecosystems across the state of Minnesota. This effort will be aimed at developing a catalog of these microbial associations and maintaining a collection of these microbes that are important to both our native prairies, grasslands and forest, and to the agricultural community. Recent evidence has shown that specific microbes form strong and specific associations with different plants that can be highly beneficial to the plant, providing nitrogen to these plants in a manner that dramatically decreases the amounts of industrial nitrogen (fertilizers) that need to be applied to agricultural crops and helps to sustain important plants that make up our native prairies. Once identified, we will also sequence the microbes so that we can better understand the underlying principles behind the benefits. These results will be shared with the broader scientific community in support of future research projects to gain a better understanding of the microbes that form an integral part of a healthy plant microbiome.

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?

We will generate a strain catalog of beneficial microbes from Minnesota that benefit plant health and deposit these in various strain collections in addition to maintaining our own strain collection. We will also study and characterize the nature of the beneficial association between the microbes and various plant species to develop a clearer picture of why these are beneficial and investigate the potential to further improve plant growth by providing microbes as part of the initial seed inoculate.

Activities and Milestones

Activity 1: Collection of Important Microbes from Natural Plant Microbiomes (Prairies, Grasslands and Forests) across Minnesota

Activity Budget: \$160,000

Activity Description:

Project participants will work with various private and public land stakeholders to identify and sample native plants from undisturbed (no industrial fertilizer application) sites across the state of Minnesota. From selected plant species, we will sample microbes that form strong associations with the plant in an effort to culture and identify the different microbes that are beneficial to specific plants. Our goal will be to investigate the plant microbiomes of approximately thirty different plant species from each of the specific plant microbiomes (prairies, grasslands and forests) across Minnesota as an initial pilot study, and then select about ten different associations for each microbiome for further characterization.

Activity Milestones:

Description	Approximate Completion Date
Identify and obtain permission to sample specific sites across Minnesota	August 31, 2025
Culture and identify important nitrogen-fixing and plant growth promoting microbes	December 31, 2025
Select various microbial strains for genomic sequencing to better understand the nature of specific traits.	March 31, 2026
Characterize key strains and prepare for long-term storage and submission to additional strain libraries.	June 30, 2026

Activity 2: Collection of Important Microbes from Important Agricultural Crops across Minnesota

Activity Budget: \$132,000

Activity Description:

In addition to sampling native plant species, we will also work with specific stakeholders to identify key agricultural crops with high nitrogen requirements that represent ideal targets for improved nitrogen delivery through natural microbes. Microbes that are common to approximately ten specific crops grown in Minnesota will be collected and tested to identify strains that could provide additional nitrogen to these plants. Strains with ideal characteristics will be further sequenced to better understand the nature of the associations with these plants, and will be cataloged and preserved in various culture collections so that they can be easily accessed in the future as part of a strategy to lower requisite nitrogen application to these crops and provide an additional financial incentive in terms of higher crop yields.

Activity Milestones:

Description	Approximate Completion Date
Identify and obtain permission to sample specific crops across Minnesota	August 31, 2025
Identify specific microbes that are beneficial to selected crop targets.	January 31, 2026
Catalog and sequence specific strains of microbes that are beneficial to specific crops in Minnesota.	June 30, 2026
Publish results of studies as a potential tool and education component for Minnesota farmers.	June 30, 2026

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?

We are seeking further funding through federal funding sources including the United States Department of Agriculture and the National Science Foundation.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Transformation of Plastic Waste into Valued Resource	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 04j	\$225,000

Project Manager and Organization Qualifications

Project Manager Name: Brett Barney

Job Title: Professor

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

Dr. Brett Barney (Project Manager) received his PhD in 2003. Prior to his PhD work, he spent six years in the medical device manufacturing sector. Following his PhD, he spent six years as a postdoctoral fellow and project manager. He has been a professor with the Department of Bioproducts and Biosystems Engineering and a member of the Biotechnology Institute at the University of Minnesota since 2009. He was the Director of the Microbial and Plant Genomics Institute from 2020 to 2022. The Bioproducts and Biosystems Engineering Department serves as a core department combining Agricultural Engineering, Biological Engineering and Environmental and Ecological Engineering. The University of Minnesota provides a range of facilities and sufficient laboratory space to perform each of the activities described in this proposal. Additionally, controlled environments including greenhouse space sufficient for this work is conveniently located in close proximity to Dr. Barney's laboratory space.

Dr. Barney's laboratory is focused on minimizing the environmental impacts associated with biofuels and agriculture, and finding innovative methods to remove contaminants from water and wastewater. Dr. Barney has 30 years of experience in both basic and applied research in both academia and industry, including experience managing projects and laboratories in a range of settings. Previous research funding has come from the National Science Foundation (NSF), the United States Department of Agriculture (USDA), the United States Department of Energy (DOE), the Defense Advanced Research Projects Agency (DARPA), the Legislative-Citizen Commission on Minnesota Resources (LCCMR), Minnesota's Discover, Research and Innovation Economy (MnDRIVE) and the Initiative for Renewable Energy and the Environment (IREE).

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Organization Description:

In the College of Food, Agricultural and Natural Resources Sciences (CFANS) at the University of Minnesota, we look at the bigger picture. When we envision a better tomorrow, it includes disease-resistant crops, products that protect our health, lakes free from invasive species, and so much more. We use science to find answers to Minnesota and the world's grand challenges and solve tomorrow's problems. Almost 93 percent of students who earn CFANS undergraduate degrees find jobs in their career field or enter graduate school within six months of graduation.

The Department of Bioproducts and Biosystems Engineering, in CFANS, discovers and teaches solutions for the sustainable use of renewable resources and the enhancement of the environment. We discover innovative solutions to address challenges in the sustainable production and consumption of food, feed, fiber, materials, and chemicals by integrating engineering, science, technology, and management into all degree programs.

We have a public impact through community engagement and extension efforts. We develop and deliver high quality, regionally and nationally-recognized research-based programs to meet current and emerging needs of industry and communities. We also have a long-standing tradition of close partnerships with alumni, industry professionals, organizations, government agencies, donors, and community members.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Lead Principal Investigator		Oversee all aspects of project, supervise students			36.8%	0.12		\$23,954
Graduate Student/ Research Assistant		Conduct research and analysis, education			45.8%	3		\$163,993
Undergraduate students (3-4)		Collect data and learn about research			0%	2.01		\$68,182
							Sub Total	\$256,129
Contracts and Services								
							Sub Total	-
Equipment, Tools, and Supplies								
	Tools and Supplies	Lab Supplies	Laboratory Supplies: General Laboratory Chemicals, Media, Reagents and Safety Materials for students, including gloves (\$200 per month) and Kits for Performing Routine Molecular Biology (\$200 per kit), Analytical Reagents (\$300 per month), Liquid Nitrogen for Strain Storage (\$400 per year).					\$35,871
							Sub Total	\$35,871
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								

							Sub Total	-
Travel In Minnesota								
							Sub Total	-
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
							Sub Total	-
							Grand Total	\$292,000

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	-

Attachments

Required Attachments

Visual Component

File: [5d3dde33-a4c.pdf](#)

Alternate Text for Visual Component

Graphic of Prairie Grass and associated beneficial microbes....

Optional Attachments

Support Letter, Photos, Media, Other

Title	File
2022 Audit	742b2acb-acf.pdf
Authorization	141ff587-e6b.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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

Yes

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

Yes

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

No

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 design, construction, or renovation of a building, trail, campground, or other capital asset costing \$10,000 or more?

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?

No