



# Environment and Natural Resources Trust Fund

## 2024 Request for Proposal

### General Information

**Proposal ID:** 2024-247

**Proposal Title:** Harnessing Cover Crops and Roots for Sustainable Cropping

### Project Manager Information

**Name:** Axel Garcia y Garcia

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

**Office Telephone:** (507) 752-5080

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### Project Basic Information

**Project Summary:** This project proposes to increase the adoption of cover cropping in southern Minnesota to address issues of loss of diversity and environmental degradation. By generating important information on cover crops,

**Funds Requested:** \$375,000

**Proposed Project Completion:** June 30, 2026

**LCCMR Funding Category:** Foundational Natural Resource Data and Information (A)

### 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?**

Region(s): SW

**When will the work impact occur?**

During the Project and In the Future

## Narrative

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

The proposed project aims to promote sustainable crop production practices in southern Minnesota by increasing the adoption of cover cropping. Current crop production practices have led to a loss of diversity and environmental degradation. Cover cropping is a diversification practice that has been shown to enhance yield and quality of the environment. However, its adoption is low in the state due to short growing seasons. There is still a knowledge gap in basic information such as timing for planting and termination, C and N use and credit, biomass contribution of roots, and water use at multiple locations. This project aims to fill this knowledge gap by generating much-needed information on cover cropping in southern MN, targeting major crops and cover crop types. The objectives of the project are to synthesize the potential of cover crops to sequester C, credit N, and use water, multiply findings to locations with limited research information, and develop a synthesis of research results for stakeholders and policymakers. Investing in this research can create sustainable practices that promote crop diversity, improve soil health, and benefit the environment while maintaining high crop yields.

### **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 propose to conduct applied research with field trials throughout the state to complement existing research results, using ancillary data and coupling results to crop simulation models to synthesize current knowledge and extend findings beyond research sites. The project aims to develop a decision-making tool for cover crop use in corn-soybean and corn-soybean-wheat rotation practices for conditions in MN. The project aims to provide applied ready-to-use information that will advance cover crop adoption in major crops and cropping systems in MN while providing agroecological benefits, including C sequestration, N credit potential, and water use.

### **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?**

The project aims to synthesize cover crop research and site-specific performance through modeling to advance sustainability efforts in major cropping systems in MN. The outcomes of the project include increasing C sequestration, reducing greenhouse gas emissions and global warming, providing N credit to cash crops, reducing synthetic N fertilizer use, loss, and water impairment, as well as reducing excess water from agricultural fields, facilitating field activities in spring, and helping in the decision-making for optimum productivity of main crops. These outcomes will benefit society, especially rural communities, and future generations, by promoting sustainable crop production practices.

## Activities and Milestones

### Activity 1: Carbon sequestration and N credit potential of cover crops

**Activity Budget:** \$180,000

**Activity Description:**

Field trials will be conducted at different locations throughout the state to represent different gradients of precipitation and soil conditions. The UMN Long-term Agricultural Research Network will be used as the platform to conduct the experiments. Cereal rye, red clover or equivalent legume, and winter camelina will be planted in the corn-soybean and corn-soybean-wheat rotations. Soil samples will be collected at the beginning, before seeding cover crops, and end of the study. Cover crops will be seeded immediately after harvest of main crops. Samples for above- and below-ground biomass will be collected at frost establishment in the fall and at termination in the spring. Biomass samples will be processed for dry biomass and then prepared for carbon and nitrogen concentration.

**Activity Milestones:**

Description	Approximate Completion Date
Determine carbon, nitrogen, and C:N ratio in root biomass of cover crops	May 31, 2026
Determine carbon, nitrogen, and C:N ratio of aboveground biomass of cover crops	May 31, 2026

### Activity 2: Water use of cover crops

**Activity Budget:** \$70,000

**Activity Description:**

Activity Description:

Field trials established for C and N will be used for this purpose. Soil moisture under cover cropping will be monitored to a 4-foot depth at each location. Weather data from automated weather stations will be collected at each experimental site. Soil moisture and weather information will be used to run a field water balance and quantify the amount of water used by cover crops, from planting to termination. In turn, that information will be used to determine the effect of cover crop water use on major crops.

**Activity Milestones:**

Description	Approximate Completion Date
Determine the water use of cover crops under at multiple environments	May 31, 2025
Determine the effect of cover crops water use on productivity of major crops	June 30, 2026

### Activity 3: Extend cover cropping performance to multiple locations in southern Minnesota

**Activity Budget:** \$125,000

**Activity Description:**

In this project, field and existing research results will be used to synthesize cover crop performance in southern MN. The platform of the Decision Support System for Agrotechnology Transfer (DSSAT; [www.dssat.net](http://www.dssat.net)), including the Crop Environment Resource Synthesis maize and wheat (CERES-Maize and -Wheat) and CROPGROW-Canola and -soybean models, will be used. DSSAT encompasses several process-based crop models that predict growth, development, and yield as a function of local weather, soil conditions, crop management scenarios, and genetic information. Input data to run DSSAT include daily weather, soil properties, specific-crop information, and agronomic management. This project will integrate knowledge of above- and below-ground biomass of crops for high-efficiency cropping systems.

**Activity Milestones:**

<b>Description</b>	<b>Approximate Completion Date</b>
Model C and N contribution of whole cover crop plant (above- and below-ground growth)	June 30, 2026
Model water use and quality of cover crops	June 30, 2026

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Gregg Johnson	University of Minnesota	Research collaborator	Yes
Liz Stahl	University of Minnesota	Extension collaborator	Yes

## 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?**

Results from this proposal will be highlighted in extension programs organized by the UMN Southwest and Southern Research and Outreach Centers located near Lamberton and Waseca, respectively, and the UMN Extension. Our extension activities will target stakeholders (farmers, NGOs, the private sector, researchers), and policymakers. Ongoing efforts are and have been supported by the industry (corn and soybean growers), federal and state agencies (e.g., NSF, MDA), and the UMN. Results will be implemented in our extension programs. Federal and state agencies are our main targets for funding if additional work is needed.

## Project Manager and Organization Qualifications

**Project Manager Name:** Axel Garcia y Garcia

**Job Title:** Associate Professor / Sustainable Cropping Systems Specialist

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

Dr. Garcia y Garcia, Associate Professor at the University of Minnesota (UMN) College of Food, Agricultural, and Natural Resource Sciences, has studied sustainable cropping in the state since 2014. His primary research areas of interest include sustainable cropping systems, primarily in the corn-soybean rotation, management practices on emerging crops and cover crops, water and nitrogen use and efficiencies, and environmental assessment (climate change and climate variability) in the context of sustainable intensification. The overall objective of his research is to improve Minnesota's (MN) cropping systems for productivity and profitability while delivering ecosystem services. D. Garcia y Garcia has experience in both irrigated and rainfed cropping systems and on the application of crop models. He is a member of the American Society of Agricultural and Biological Engineers, American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America.

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

**Organization Description:**

Higher education institution

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Two research technicians		Support field data collection at two locations			32%	2		\$120,000
Summer helpers		Support research technicians with data collection			8.3%	2		\$40,000
Research Assistant		Oversee field trials and synthesize results			24.1%	4		\$110,000
Researcher		Oversee the completion of the project, summer salary			36.8%	8		\$75,000
							<b>Sub Total</b>	<b>\$345,000</b>
<b>Contracts and Services</b>								
Minnesota Valley Testing Laboratories, Inc. (MVTL)	Professional or Technical Service Contract	Fees for lab analysis of plant and soil samples				-		\$10,000
							<b>Sub Total</b>	<b>\$10,000</b>
<b>Equipment, Tools, and Supplies</b>								
	Equipment	1 Pr2/6 probe and accessories	Probe to monitor soil moisture					\$4,700
							<b>Sub Total</b>	<b>\$4,700</b>
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	-
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-

<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	Trips from and to research sites located in Grand Rapids, Lamberton, and Waseca	Establish field experiments, data collection, and present results as required by LCCMR					\$7,500
							<b>Sub Total</b>	<b>\$7,500</b>
<b>Travel Outside Minnesota</b>								
							<b>Sub Total</b>	-
<b>Printing and Publication</b>								
	Printing	Bulletins summarizing findings	For extension and outreach purposes					\$2,500
	Publication	A scientific paper	Cost of publication of scientific findings					\$3,500
							<b>Sub Total</b>	<b>\$6,000</b>
<b>Other Expenses</b>								
		Land use	Research plot fees					\$1,800
							<b>Sub Total</b>	<b>\$1,800</b>
							<b>Grand Total</b>	<b>\$375,000</b>

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: [aa409f93-db6.pdf](#)

#### *Alternate Text for Visual Component*

Letter authorizing proposal submission...

### Optional Attachments

#### *Support Letter, Photos, Media, Other*

Title	File
UMN letter of endorsement	<a href="#">92f19711-a6e.pdf</a>

## 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?**

N/A

**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