



Environment and Natural Resources Trust Fund

2023 Request for Proposal

General Information

Proposal ID: 2023-182

Proposal Title: Cover Crops: Rooting for Sustainable Cropping in Minnesota

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

Email: axel@umn.edu

Project Basic Information

Project Summary: Synthesis of existing and new research coupled to modeling, will be used to develop decision-making information on cover crop carbon sequestration, nitrogen and water use, and environmental benefits in MN.

Funds Requested: \$365,000

Proposed Project Completion: June 30, 2025

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): SE, 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 success of current crop production practices is shadowed for its association with loss of diversity and environmental degradation. Cover cropping is a diversification practice recognized by its capacity to enhance yield and quality of the environment. Its adoption, however, is still low in the state due to long, cold winters that result on short growing seasons. Cover cropping has been the focus of a range of field studies, and results represent a variety of subjects, including cover crop species, locations, soils, and cropping systems, among others. Basic information, including timing for planting and termination, C, and N use and credit, biomass contribution of roots, and water use at multiple locations are still not comprehensively approached and synthesized. We proposed to do generate much-needed information on cover crop scope in southern MN. Our approach targets corn-soybean and the corn-soybean-wheat rotations as major crops and brassica-, grass-, and legume-type cover crops. Specific objectives are to 1) synthesize the potential of cover crops (above- and below-ground biomass) to sequester C, credit N, and use water, 2) multiply findings to multiple locations with crop modeling, and 3) develop a synthesis of research results to reduce a knowledge gap for stakeholders and policymakers use.

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 develop a decision-making of cover crop use in corn-soybean and corn-soybean-wheat rotation practices for conditions in southern MN. Our approach consist on conducting applied research with field trials throughout the state to complement existing research results, using ancillary data, and coupling results to dynamic crop simulation models to synthesize current knowledge and extend findings beyond research sites. We expect our study 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 and 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?

Specific outcomes include synthesis of cover crop research and site-specific performance through modeling to advance sustainability efforts in major cropping systems in MN. Beyond the time frame of the project, society, especially rural communities and future generations, will benefit from sustainable crop production practices. Cover cropping will a) increase C sequestration and reduce greenhouse gas emissions and global warming; b) provide N credit to cash crops, reduce synthetic N fertilizer use, loss, and water impairment; and 3) reduce excess water from agricultural fields, facilitate field activities in spring, and help in the decision-making for optimum productivity of main crops.

Activities and Milestones

Activity 1: C 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. Cereal rye, red clover, and winter camelina will be planted in corn-soybean and corn-soybean-wheat rotations to represent some of the most important cash crops and cropping systems in the state. The UMN Long-term Agricultural Research Network will be used as the platform to conduct the experiments.

Activity Milestones:

Description	Completion Date
Quantify C and N contribution of cover crop rooting system	May 31, 2025
Quantify C and N contribution of cover crop aboveground growth	May 31, 2025

Activity 2: Water use of cover crops

Activity Budget: \$60,000

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	Completion Date
Determine the water use of cover crops under multiple conditions of growth	May 31, 2025
Determine the effect of cover crops water use on productivity of major crops	June 30, 2025

Activity 3: A. 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), 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 produce integrated knowledge on above- and below-ground biomass of high-efficiency cropping system crops.

Activity Milestones:

Description	Completion Date
Model C and N contribution of whole cover crop plant (above- and below-ground growth)	June 30, 2025
Model water use and quality of cover crops	June 30, 2025

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, Waseca, respectively, and the UMN Extension. Our extension activities will target stakeholders (farmers, NGOs, private sector, researchers, and consumers) as well 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 (e.g., Forever Green Initiative). 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 been studying sustainable cropping in the state since 2014. His major 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 (MN) cropping systems for productivity and profitability while delivering ecosystem services. D. Garcia y Garcia has experience on both irrigated and rainfed cropping systems and on the application of crop models. He is member of the American Society of Agricultural and Biological Engineers, American Society of Agronomy, Crop Science Society of America, and the 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
Personnel								
Researcher 3 - Lamberton		Support field research			32%	1		\$55,000
Summer help - Lamberton		Field research assistant			8.3%	1		\$20,000
Researcher 5 - Waseca		Support field research			32%	1		\$60,000
Summer help - Waseca		Support field research			8.3%	1		\$20,000
Researcher		Manager, summer salary			36.8%	4		\$75,000
Research Assistant		To oversee field trials			24.1%	2		\$110,000
							Sub Total	\$340,000
Contracts and Services								
TBD	Internal services or fees (uncommon)	Fees for lab analysis of plant and soil samples				6		\$5,000
							Sub Total	\$5,000
Equipment, Tools, and Supplies								
	Equipment	Pr2/6 probe and accessories	Probe to monitor soil moisture					\$4,700
							Sub Total	\$4,700
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-

Travel In Minnesota								
	Miles/ Meals/ Lodging	Trip 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
							Sub Total	\$7,500
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Printing	Bulletins summarizing findings	Pro extension and outreach purposes					\$2,500
	Publication	A scientific paper	Cost of publication of scientific findings					\$3,500
							Sub Total	\$6,000
Other Expenses								
		Land use	Research plot fees					\$1,800
							Sub Total	\$1,800
							Grand Total	\$365,000

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: [36ba1fe0-0d5.pdf](#)

Alternate Text for Visual Component

Authorization to submit the proposal...

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?

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