

**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 tis 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 the 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-feet 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. Ineli gible** | **% Bene fits** | **# FTE** | **Class ified 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** |

### **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](https://lccmrprojectmgmt.leg.mn/media/map/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