



## Environment and Natural Resources Trust Fund

### 2026 Request for Proposal

#### General Information

**Proposal ID:** 2026-511

**Proposal Title:** Optimizing Oilseed Production for Sustainable Aviation Fuel

#### 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:** This proposal aims to establish best production and environmental practices for incorporating winter camelina into the corn-soybean rotation in Minnesota. This work will benefit Minnesota farmers and residents of Minnesota.

**ENRTF Funds Requested:** \$507,000

**Proposed Project Completion:** June 30, 2029

**LCCMR Funding Category:** Resiliency (A)

#### Project Location

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

Region(s): Metro, SW, NE,

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

Statewide

**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.**

Minnesota agriculture is highly productive with corn (*Zea mays* L.), soybean [*Glycine max* (L.) Merr.], and small grains rotations covering over 17 million acres and generating over \$7 billion in revenue. This results in a fallow period of more than 6 months which leads to degradation of water and soil resources and is a missed opportunity to produce an additional crop. In shorter growing season and colder winters like Minnesota, adding a winter crop in a rotation is a challenge.

Concurrently, private companies such as Delta Airlines, Inc. and Cargill are interested in producing sustainable aviation fuel (SAF) in Minnesota, but production is still minimal due to a lack of foundational research needed to develop best management practices. Winter camelina [*Camelina sativa* (L.) Crantz] is a promising short-season, cold hardy oilseed crop that could be incorporated in rotations in Minnesota and used for SAF production. To develop best practices and build a strong case for farmer adoption, critical research is needed on optimal planting dates per region, the effects on water quality and other environmental outcomes, and strategies to maximize farmer profitability.

**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.**

A winter crop in the corn-soybean rotation has the potential to enhance environmental outcomes while providing additional income for Minnesota farmers. Sustainable aviation fuel is gaining interest in the United States and can be produced in Minnesota using oilseed crops like winter camelina. This three-year proposal builds on existing knowledge of winter camelina to help farmers generate additional revenue while improving environmental quality— without disrupting current production systems. Field studies will be conducted at the University of Minnesota Research and Outreach Centers in Grand Rapids, Rosemount, and Lamberton. These locations were chosen to represent diverse climates and soil types across key agricultural regions. Treatments include three winter camelina planting dates: (1) late August, (2) early September, and (3) late September, followed by spring plantings of corn and soybean and a control treatment of conventional corn-soybean with no winter camelina. While research on winter camelina in Minnesota is increasing, few studies have included detailed root measurements, which are critical for understanding carbon sequestration, nitrogen cycling, and overall plant productivity. This project will measure both above- and below-ground biomass to assess productivity, while environmental data will be used to evaluate the effects of winter camelina on water resources and greenhouse gases.

**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 generate environmental and economic insights to support the protection, conservation, and enhancement of natural resources in Minnesota. By advancing efficient and sustainable agricultural intensification, it aims to increase production per unit of land while preserving and improving natural ecosystems. The project focuses on two specific environmental factors: greenhouse gas emissions and water resources. Monitoring greenhouse gas emissions will inform climate-smart practices while water quality assessment will help preserve human, animal, and ecosystem health. Given the critical role of water quality, this research has implications beyond agricultural regions, contributing to broader environmental sustainability efforts across Minnesota.

## Activities and Milestones

### Activity 1: Evaluating the agronomic and environmental effects (water resources, and greenhouse gases) of winter camelina

**Activity Budget:** \$396,941

#### Activity Description:

This activity includes the establishment of a randomized complete block design field experiment at three Minnesota locations to assess the agronomic and environmental effects of winter camelina in the corn-soy rotation. Field data collection, including biomass, soil and GHG measurements will be conducted consistently across all years. Each growing season will start with winter camelina planting and end with its harvest. The work will be done by technicians and researchers and be completed by October 30th, 2029. The outcomes from this activity will serve as the foundation for subsequent analysis and research activities. Results will be analyzed using ANOVA in R with appropriate statistical packages.

Planting date, winter camelina biomass, winter camelina yield, yield quality, water use, soil solution nitrogen, and GHGs will be analyzed with separate ANOVAs using a linear mixed effects model to test the significance of main and interaction effects. Normality and constant variance will be checked and data transformations will occur as needed. Post-hoc analysis will be conducted at  $\alpha = 0.05$ .

#### Activity Milestones:

Description	Approximate Completion Date
Falls: Establish three planting dates for winter camelina following a small grain	September 30, 2026
Collect above- and below-ground biomass and process for C and N content	June 30, 2029
Monitor greenhouse gas emissions	June 30, 2029
Collect and analyze soil, soil moisture, and soil solution samples throughout the season	June 30, 2029
Process yield samples for oil and protein content	June 30, 2029

### Activity 2: Modeling winter camelina performance in the corn-soybean rotation at multiple locations in southern Minnesota

**Activity Budget:** \$55,029

#### Activity Description:

This activity focuses on using crop models to extend the insights gained from field research. We will simulate winter camelina performance in multiple locations in southern Minnesota, improving prediction of agronomic and environmental outcomes. Model calibration and validation will be performed using field data collected. The outputs will be made accessible to Minnesota farmers through UMN Extension resources. This activity will be completed by the third year of the project.

Crop models will be calibrated using root mean square error (RMSE) normalized RMSE, index of agreement d, and Pearson's correlation coefficient: r. Models evaluation will be conducted using normalized RMSE (nRMSE).

#### Activity Milestones:

Description	Approximate Completion Date
Calibrate the model using part of the field data	June 30, 2029
Validate the model using the remainder of the field data	June 30, 2029
Present the findings at a UMN Extension Field Day to engage with farmers	June 30, 2029

Run the crop model to generate production and environmental outcomes for additional locations within Minnesota	June 30, 2029
Prepare fact sheets for farmers	June 30, 2029

### Activity 3: Establish an enterprise budget to evaluate the economic feasibility for farmers

**Activity Budget:** \$55,030

#### Activity Description:

This activity includes the establishment of an enterprise budget using the field data from this project which will help farmers to maximize their profits including winter camelina in their cropping rotations. This budget will include basic costs for the cropping system and profits likely to be generated from the yield of the crops. The outcomes for this activity are the enterprise budgets per location and sharing this information with farmers through UMN Extension bulletins and activities.

#### Activity Milestones:

Description	Approximate Completion Date
Record input costs for equipment, labor, fertilizer, fuel, herbicide and pesticide	June 30, 2029
Use yields of crops within the rotation to determine profits for the cropping system	June 30, 2029
Create enterprise budget per location using three years data	June 30, 2029
Share enterprise budget with Minnesota Farmers at UMN Extension and through bulletins	June 30, 2029

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Stephen Gregg	University of Minnesota	Postdoctoral researcher	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?**

After the project is completed, data will continue to be published in peer-reviewed journals and shared at UMN Extension events and in bulletins. Data from the project will be shared with relevant partners like Forever Green researchers to help producers understand the risks and benefits of incorporating winter camelina into cropping systems. Models will continue to be modified for changing weather patterns or additional locations within Minnesota and data will be shared with researchers and farmers.

## Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Harnessing Cover Crops and Roots for Sustainable Cropping	M.L. 2024, , Chp. 83, Art. , Sec. 2, Subd. 03y	\$375,000

## 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 winter oilseed crops in the state since 2015. 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) of crop production practices. 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 in 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:**

The Department of Agronomy and Plant Genetics in the CFANS program at the University of Minnesota focuses on plant science, sustainable agriculture, and food systems, employing diverse research methods to improve crop production, with faculty expertise in areas like breeding, genetics, and agronomy.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Researcher		Oversee the completion of the project			36.6%	0.45		\$51,225
Postdoctoral Researcher		Oversee field trials and synthesize results, conduct data analysis and write journal articles			25.9%	3		\$249,053
Technician		Support permanent technicians with field operations and data collection at three locations			32.3%	1.5		\$134,946
Summer helper		Support research technicians with data collection			7.4%	3		\$19,917
							<b>Sub Total</b>	<b>\$455,141</b>
<b>Contracts and Services</b>								
Minnesota Valley Testing Laboratories, Inc. (MVTI)	Service Contract	Analyzing soil samples for fertility and initial characterization (108 camelina plots * 2 depths * 2 dates @\$15.50/ sample)				0		\$8,928
Oregon State University Seed Laboratory (OSUSL)	Service Contract	Fees for carbon and nitrogen biomass measurements [(108 winter camelina samples * 2 dates for abv bio) + (108 root samples * 1 date) + (108 yield samples) @ \$12/sample = \$5184]. OSUSL fees for oil and protein NMR analysis (108 winter camelina yield samples @ \$50/sample = \$5400)				0		\$10,584
UMN Extension Services	Service Contract	UMN extension educator for material production and organization				0		\$5,000
							<b>Sub Total</b>	<b>\$24,512</b>
<b>Equipment, Tools, and Supplies</b>								
	Tools and Supplies	Reactant and distilled water	For soil solution sample analysis					\$3,000
	Equipment	48 x 2 inch pvc caps @\$1.5 = \$72, 48 x 3 ft 5 inch pvc pipe @ \$1/foot for piezometers = \$165, 1000x 50 ml polypropylene tubes = \$250	For soil solution sample collection					\$487

							<b>Sub Total</b>	<b>\$3,487</b>
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	<b>-</b>
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	<b>-</b>
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	1-2 people for roughly 7 trips per each of 3 locations. 2 nights overnight per location with per diems. 4844 miles @ \$0.70 per mile.	These trips are for collecting data and also for any UMN Extension events.					\$13,735
							<b>Sub Total</b>	<b>\$13,735</b>
<b>Travel Outside Minnesota</b>								
							<b>Sub Total</b>	<b>-</b>
<b>Printing and Publication</b>								
	Printing	Printing bulletins	Printing extension and outreach bulletins containing research findings					\$2,500
	Publication	Publication of peer-reviewed journal article	Journal publication fee					\$3,500
							<b>Sub Total</b>	<b>\$6,000</b>
<b>Other Expenses</b>								
		Land use	rental for research field plots (5 acres per location @ \$275/acre = \$1375 per year)					\$4,125
							<b>Sub Total</b>	<b>\$4,125</b>
							<b>Grand Total</b>	<b>\$507,000</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	-

Total Project Cost: \$507,000

This amount accurately reflects total project cost?

Yes

## Attachments

### Required Attachments

#### *Visual Component*

File: [a43c5599-061.pdf](#)

#### *Alternate Text for Visual Component*

Root research has shown meaningful correlations to crop yield, crop resilience, as well as ecosystem services. Despite this, root research is limited, especially for crops beyond corn and soybean...

### Supplemental Attachments

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

Title	File
Board_of_Regents_UMN_letter	<a href="#">0e4b1660-e27.pdf</a>

## 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?**

Yes, Sponsored Projects Administration

**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:**

Stephen Gregg, 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

