Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-333

Proposal Title: Mitigating Diseases in Oilseed Crops for Clean Water

Project Manager Information

Name: Devanshi Khokhani

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

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Project Basic Information

Project Summary: We aim to mitigate diseases in soil and water-friendly oilseed crops, such as pennycress and camelina, by characterizing pathogens, assessing resistance, and improving management.

ENRTF Funds Requested: $403,000

Proposed Project Completion: June 30, 2029

LCCMR Funding Category: Water (B)

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.

Pennycress and Camelina are being developed as promising crops for biodiesel and sustainable aviation fuel production. Short season coupled with winter hardiness allows integration of winter camelina and pennycress into corn and soybean cropping systems, providing an additional cash crop for farmers to grow on land that would otherwise be fallow in winter. As such, pennycress and winter camelina have enormous potential to generate economic rewards for farmers and provide numerous ecosystem benefits, such as reducing soil erosion and nutrient runoff and providing food for pollinators in early spring. As cultivation grows, disease outbreaks affecting pennycress and camelina are becoming prevalent in the Midwest. In 2022-23 and 2024, Illinois, Wisconsin, and Minnesota fields reported significant disease impacts, affecting 30-50% of the pennycress plants. In 2020-21 in Montana, camelina fields also reported disease, which is now seen in Minnesota pennycress and camelina fields too. Initial work demonstrated that the bacterial pathogen Xanthomonas campestris and Aster Yellows Phytoplasma transmitted by aster leafhoppers are known to infect pennycress and camelina, respectively (1-3). These diseases can significantly affect their yields and oil production and reduce the environmental and economic benefits of these crops.

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.

Pennycress and camelina are excellent oilseed crops that provide soil cover, reduce nutrient run-off in drinking water, and support pollinators. To protect these environmentally beneficial crops from the threat of bacterial and phytoplasma pathogens, we propose three activities - 1. Characterize the population structure of these pathogens by collecting samples from pennycress and camelina fields in Minnesota and measuring the heterogeneity of the pathogens using robust molecular and bioinformatic tools. 2. Screen a collection of pennycress and camelina lines for genetic resistance against these pathogens. We have access to these lines from colleagues in the Department of Agronomy and Plant Genetics on the university campus. The disease resistance screening will guide the pennycress and camelina community in disease resistance breeding and studies in disease epidemiology and host-pathogen interactions. It will also recommend using resistant lines as cover crops and contributing to integrated crop management strategies. 3. We will also investigate how the pathogens spread and whether seed transmission is possible because many symptoms of these diseases are observed in the seed pods. Overall, these activities will support breeding for disease resistance, develop a comprehensive crop management strategy, and enhance production while limiting disease spread regionally.

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 project will advance the protection and sustainability of pennycress and camelina by identifying pathogens, analyzing their population structure, and understanding their epidemiology. Genomic and phylogenetic studies will reveal virulence mechanisms, while research on pathogen-host interactions will determine if pennycress pathogens use camelina as a reservoir. Disease resistance screening will guide breeding efforts, support integrated crop management, and promote the use of resistant lines as cover crops. Investigating seed transmission and environmental factors influencing pathogen spread will inform early detection tools, such as immunostrips, enabling proactive disease management to conserve soil health and enhance water resource sustainability.

Activities and Milestones

Activity 1: Characterize the pathogen population causing diseases in pennycress and camelina

Activity Budget: $146,021

Activity Description:
We will collect plant samples exhibiting disease symptoms by working with colleagues and stakeholders who grow pennycress and camelina at different locations in the upper Midwest, focusing on Minnesota. Depending on the symptoms observed, we will use bacterial or phytoplasma-specific primers to amplify 16S rDNA fragments, sequence the fragments, and look for the closest similar pathogen in the genomic database. From our initial isolation, we have isolated Xanthomonas campestris as the causative pathogen using 16S rDNA primers (Chiu et al., in press). We will reinfect the host plants with isolated bacterial pathogens to confirm the pathogenicity. Phytoplasma-infected plants collected from the fields will be transferred to growth chambers, then using aster leafhoppers, the pathogen will be transferred to the propagative host Catharanthus roseus. The aster yellows phytoplasma strains infecting camelina and pennycress will be characterized initially through multilocus sequence analysis (MLSA), subsequently distinct strains will be submitted to full genome sequencing using a combination of PacBio and Illumina sequencing. Pathogen identity, population structure, and genomic and phylogenetic analysis will reveal potential virulence mechanisms and help us understand the epidemiology of the disease.

Activity Milestones:

Description	Approximate Completion Date
Collect symptomatic plants from pennycress and camelina growing areas in Minnesota	December 31, 2026
Isolate and identify disease-causing bacterial and phytoplasma pathogens	March 31, 2027
Perform whole genome and phylogenetic analyses to understand potential virulence mechanisms	August 31, 2027

Activity 2: Screening pennycress and camelina lines to identify disease-resistant genotypes

Activity Budget: $152,259

Activity Description:
Using disease-resistant plant genotypes is an effective way to manage disease. After confirming the pathogens, we will evaluate the disease resistance level of wild pennycress and camelina germplasm collections and UMN elite breeding lines. For this proposal, we will screen 40 accessions of each crop, representing major gene pools from the Caucasus, Europe, the U.S., and Canada. Additionally, the top 10 elite breeding lines will be tested as varietal candidates. We will infect the bacterial pathogen, Xanthomonas campestris, into the pathogen's leaves, five technical replicates per accession, and score disease for all the growth chamber screening. Disease scores of 75 % (highly susceptible), 50 and 75% (moderately susceptible), 25 and 50% (moderately resistant), and below 25% (highly resistant) will be applied. Similarly, disease resistance for aster yellows phytoplasma will be evaluated under controlled environment conditions using the same germplasm accessions. Virulifeorus colonies of aster leafhoppers will be reared on an infected phytoplasma propagative host. Disease resistance will be evaluated by transferring 10 viruliferous leafhoppers per plant and allowing a latent period of one week, we will use five technical replicates per accession. Symptoms will be evaluated using an arbitrary scale from 1 (resistant, no symptoms) - 5 (highly susceptible).

Activity Milestones:

Description	Approximate Completion Date
creen pennycress and camelina lines against bacterial pathogens	December 31, 2027
Screen pennycress and camelina lines against aster yellows phytoplasma using viruliferous leafhoppers	August 31, 2028

Pennycress and camelina accessions evaluated for both pathogens: Xanthomonas campestris and Aster yellows phytoplasma	March 31, 2029

Activity 3: Determine the transmission routes of bacterial and phytoplasma pathogens in pennycress and camelina

Activity Budget: $104,720

Activity Description:

To determine if seeds could be a source of disease transmission, seeds harvested from infected plants will be planted again to test if seeds carry sufficient inoculum to trigger disease onset in the next generation of plants. We will perform disease progression assays under 18, 22, and 28°C and low (30%) and high humidity (70%) levels. We will perform dilution plating to estimate colony-forming units/g of seeds. Similarly, we will collect three plants from each humidity condition, with 12 samples after the onset of the first disease symptoms.

Aster yellows phytoplasma is mainly transmitted by aster leafhopper. We will monitor the leafhopper species population monthly during the growing season using sweep nets and insect traps on our experimental plots. Collected leafhopper species will be identified by DNA barcoding and qPCR tested for aster yellows to determine their infectious status. At the same time, potted and healthy Catharanthus roseus plants will be used as bait for aster yellows phytoplasma, these plants will be placed in the fields, replaced monthly, and transported to the laboratory for phytoplasma testing. With this information, we will identify peaks of the vector population and the aster yellows incidence, along with spread patterns through the field.

Activity Milestones:

Description	Approximate Completion Date
Collect seeds from infected plants	December 31, 2026
Perform virulence assays using seeds from infected plants	March 31, 2027
Establishment of field plots, begin vector monitoring, collect samples for pathogen testing	August 31, 2027
Aster yellows phytoplasma vectors are identified	December 31, 2027
Finalize data analysis, and propose disease recommendations	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Julia Zhang	Agronomy and Plant Genetics, University of Minnesota-Twin Cities	CO-PI	Yes
Robert Alvarez-Quinto	Department of Plant Pathology, University of Minnesota-Twin Cities	CO-PI	Yes
Brett Arenz	Department of Plant Pathology, University of Minnesota-Twin Cities	CO-PI	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?
We will seek further funding through additional state and federal funding sources including the United States Department of Agriculture, the United States Environmental Protection Agency, and the National Science Foundation.

Project Manager and Organization Qualifications

Project Manager Name: Devanshi Khokhani

Job Title: Assistant Professor

Provide description of the project manager's qualifications to manage the proposed project.
Dr. Devanshi Khokhani (Project Manager) received her PhD in 2014. Following her PhD, she spent six years as a postdoctoral fellow and project manager. She has been a professor with the Department of Plant Pathology and a graduate faculty member of the Plant and Microbial Biology Department at the University of Minnesota since 2020. The Department of Plant Pathology conducts cutting-edge research on plant-microbe interactions, disease diagnostics, and sustainable disease management to improve plant health and agricultural productivity. 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. Khokhani's laboratory space.

Dr. Khokhani's laboratory is focused on minimizing the environmental impacts associated with agriculture and finding innovative methods to prevent agricultural runoff of contaminants like nitrate and chemical compounds present in pesticides from entering water resources. Dr. Khokhani has 15 years of experience in both basic and applied research in academia, including experience managing projects and laboratories in various settings. Previous research funding has come from the National Science Foundation (NSF), the United States Department of Agriculture – Agriculture and Food Research Initiative (USDA-AFRI), and the Minnesota Invasive Terrestrial Plants and Pests Center (MITPPC).

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, lakes free from agricultural runoff water containing agrochemicals and 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.

Since 1907, the Department of Plant Pathology at the University of Minnesota has significantly influenced plant health, agricultural development, and ecosystem vitality at all levels. The department's mission focuses on solving contemporary plant health challenges through innovative research, offering sound advice to stakeholders, and educating future plant health professionals with a comprehensive curriculum. Research areas include plant disease biology and management, genetics, and genomics of disease resistance and microbial biology. Additionally, the department provides research-based information and education on a broad range of crops and disease management strategies through extension activities.

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 researchers, plan monthly meeting with entire research group and quarterly meetings with broader group of stakeholders. These funds represent partial summer support for the lead Principal Investigator.			36.6%	0.12		$21,646
Researcher 2		Conduct laboratory and field experiments, train and educate undergraduate students in field and laboratory research. Write research papers related to project finding and share results with the broader research community through presentations. These funds represent support throughout the duration of the grant period of one research staff for 50% of the time.			32.3%	1.5		$124,079
Co-Principal Investigator		Oversee experiments and analysis associated with phytoplasma work in growth chamber and field experiments. Supervise researcher 3 in their lab. These funds represent partial summer support for the Co-Principal Investigator.			36.6%	0.12		$21,280
Researcher 3		Design and supervise experiments, work with stakeholders and act as point person to manage experiments and assure that routine phytoplasma experimental procedures are properly performed. Assist with completion of project reports and lead efforts to complete peer-reviewed research papers related to the project. These funds representpartial support for researcher 3 for two years of the grant period.			32.3%	1		$98,028
Researcher 2		Researcher 2 in CO-PI Julia Zhang's group will grow pennycress and camelina plants in growth chambers throughout the grant duration.			32.3%	0.75		$57,916
							Sub Total	**$322,949**
Contracts and Services								

							Sub Total	**-**
Equipment, Tools, and Supplies								
	Tools and Supplies	lab supplies	Petri dishes, tips, media, 1.5 ml, 50 ml tubes, glasswares, gloves for safety ($200/month), germplasm to screen genotypes, Molecular biology reagents ($200/kit): DNA extraction reagents for bacteria and phytoplasma, PCR reagents, gallon bags for sample collection, analytical reagents.					$33,530
	Tools and Supplies	Sequencing costs, growth chamber cost	External costs to contract laboratories to perform whole genome sequencing runs to identify pathogenic bacteria and phytoplasmas. Anticipating two runs per year, $3000 per run, for all three years. Projections are based on historical costs for similar projects. The cost for 3-4 growth chambers is included to perform disease and screening assays throughout the grant duration ($200/month/chamber).					$34,774
							Sub Total	**$68,304**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Other	Travel to various sampling sites to meet with stakeholders and collect symptomatic pennycress and camelina samples. Approximately three day trips per year, with a combined travel of under 200 miles per trip, including two or more persons.	Collect pennycress and camelina disease samples during the duration of the grant					$4,998

							Sub Total	**$4,998**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	research articles published in peer reviewed journals like phytopathology, plant disease etc.	2-3 Peer-reviewed journal articles is an effective way to communicate research findings to researchers and stakeholders.					$6,749
							Sub Total	**$6,749**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$403,000**

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	**-**

Total Project Cost: $403,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 4f504efe-ef1.pdf

Alternate Text for Visual Component

The graphic summarizes proposed activities to characterize the pathogen populations, screen disease-resistant genotypes of oilseed crops pennycress and camelina, and to understand the mode of transmission of these pathogens....

Supplemental Attachments

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

Title	File
References	258d5e7c-6fa.pdf
Support Letter from Cargill	0ab3f576-8eb.pdf
Support letter from organization	3e3653d8-def.pdf

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?

No

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:

Robert Alvarez Quinto, Julia Zhang, Brett Arenz, Sue Kilber, Hannah Haley

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

N/A