



Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-129

Proposal Title: Assessing Risk of Neonicotinoid Seed Treatment on Insects

Project Manager Information

Name: Susan Balenger

Organization: U of MN - College of Biological Sciences

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Project Basic Information

Project Summary: This project aims to provide risk assessment data on non-targeted insects when exposed to neonicotinoid seed treatment (NST hereafter), assisting evidence-based policy-making for NST regulation and integrative pest management.

ENRTF Funds Requested: \$632,000

Proposed Project Completion: June 30, 2031

LCCMR Funding Category: Resiliency (A)

Project Location

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

Region(s): Metro

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

Statewide

When will the work impact occur?

In the Future

Narrative

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

Preemptive NST is widespread nationwide, evident by use in ~100% and >40% of corn and soy acres respectively. This has serious environmental impacts. >90% of NSTs leach into natural habitat, threatening wildlife communities.

The US has no federal regulation for NST in agriculture and only two states have laws regulating NST. Minnesota is among few leading states having active legislative proposals to restrict NST. Recently, a settlement was reached requiring MDA to address environmental impacts of NST. Risk assessment is critical for maintaining Minnesota's lead in moving towards evidence-based legislation.

However, data are limited. First, we lack understanding about exposure risk from NST on and off application sites. Second, current risk assessment data almost exclusively come from bees. Yet, data from bees cannot be easily generalized. E.g., sublethal neonicotinoid exposure differentially affects male and female crickets; such a finding cannot be made from bees where workers are exclusively females. Third, prior risk assessment focuses primarily on mortality, yet NST also causes sublethal effects in wildlife, especially via reduced immunity. As parasites and pathogens impair health of wild insects and honey bees, data on NST impacts on insect immunity is crucial but scant. These limitations greatly impede data-informed policy making.

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.

The proposed solution aims to provide data to help inform MDA, other government agencies and the scientific community regarding: (1) what is the risk of exposure through NST on and off application sites and how does the risk compare to other application methods, and (2) what is the effect of sublethal exposure to NST on insect immune functions.

To assess exposure risk through NST, we will first track seed-coated neonicotinoids in soil and vegetation at research facilities where we follow common farm practices. We will then compare the contamination level from NST with that from foliage application.

To assess sublethal effects of NST on insect immunity, we will use lab and field experiments to understand how exposure to realistic levels of seed-coated neonicotinoids affects cellular and humoral immune functions using local *Gryllus* crickets as a model organism. Additionally, under pesticide-induced stress, immunity and reproduction are two major physiological systems competing for limited resources. Understanding how insects strategize resource allocation between maintaining health and reproduction can inform strategies for conservation intervention in addition to pesticide use regulation.

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?

Focusing on NST, this project will provide assessment for (1) exposure risk through soil and vegetation on and off agricultural sites, (2) impacts on immune functions, and (3) resource allocation between immunity and reproduction under pesticide-induced stress. These data will be shared with MDA and other Minnesotan agricultural agencies in reports to assist evidence-based policy-making, inform the public about exposure risk in publicly available datasets, and offer scientific insights about NST's effect on insect immunity. As Minnesota is one of few states moving towards NST regulation, data from this project will help the state maintain the lead.

Activities and Milestones

Activity 1: Assess and benchmark exposure risk of NST

Activity Budget: \$354,000

Activity Description:

This activity will (a) assess where and how much neonicotinoid residue is deposited in soil and vegetation using NST and (b) benchmark NST residue deposition by comparing it to that from foliar spray. For Activity 1a, we will sample topsoil and vegetation from fields of a major Minnesota crop (e.g., corn, soybean) grown from seeds with and without NST. Planting and growing will follow common farming practices, and soil and vegetation samples will be collected on a weekly basis for up to two months. The USDA Agricultural Marketing Service National Science Laboratories will analyze neonicotinoid residues to assess the exposure risk of NST.

For Activity 1b, we will compare neonicotinoid concentrations from topsoil and vegetation from fields grown with and without foliar spray. This activity will benchmark exposure risk to neonicotinoids via NST relative to foliar spray. Foliar application of neonicotinoids is tightly regulated at state and national levels, while NST is exempt from this regulation.

Detailed knowledge about neonicotinoid contamination in the environment from NST will fill a major data gap about exposure risk for non-targeted animals and humans and benefit data-informed policy and management decisions.

Activity Milestones:

Description	Approximate Completion Date
Select focal neonicotinoid, crop, and design plot locations for growing crops	December 31, 2027
Pilot methods for growing crop and neonicotinoid applications	April 30, 2028
Complete residue analysis on pilot samples	August 31, 2028
Collect soil, seeds and vegetation samples	October 31, 2029
Complete residue analysis	February 28, 2030
Report and publication preparation, meet with state officials to share findings	December 31, 2030

Activity 2: Assess and benchmark sublethal effects of NST on immunity of non-targeted insects

Activity Budget: \$176,000

Activity Description:

This activity will (a) assess effects of sublethal exposure to NST on insect immunity and (b) benchmark the effect by comparing to that from foliar spray. For Activity 2a, we will introduce local field crickets in cages to crops grown from seed with and without neonicotinoid treatment in plots or agricultural fields at research facilities. Planting and growing will follow common farming practices. We will compare insect immunity, including humoral and cellular immune responses, using standardized lab assays to assess NST's impact on insect immunity.

For activity 2b, we will provide data about sublethal effects on insect immunity from the regulated foliar application as a context to benchmark the severity of NST's effects. Data will be collected from crickets enclosed in cages with crops that will receive foliar spray but no NST.

Data-informed management and policymaking relies on a comprehensive picture of NST's risk for non-targeted organisms. A major gap in the current picture is lack of data on NST's effect on immunity, a primary player in insect health. Data from this activity will not only help fill this gap but also provide a context for data interpretation from an application method that is under regulation.

Activity Milestones:

Description	Approximate Completion Date
Pilot methods for experiment using control crickets	October 31, 2028
Complete cricket exposure experiment	October 31, 2029
Complete immunity assays	December 31, 2030
Data analysis	April 30, 2031
Report and publication preparation, meet with state officials to share findings	June 30, 2031

Activity 3: Assess and benchmark sublethal effects of NST on allocation across domains of health of non-targeted insects

Activity Budget: \$102,000

Activity Description:

This activity will (a) assess effects of sublethal exposure to NST across two domains of insect health and (b) benchmark the effect by comparing to that from foliar spray. For Activity 3a, we will collect data on a second major domain of insect health: reproduction using measurements including ovary and testis mass. We will then compare NST's effects on reproduction to that on immunity to answer the question whether both domains take equal hit or one domain takes a heavier impact.

For activity 2b, we will provide data about sublethal effects on insect reproduction from the regulated foliar application as a context to benchmark the severity of NST's effects. Data will be collected from crickets enclosed in cages with crops that will receive foliar spray but no NST.

Minnesota has been strongly promoting integrative pest management. Data produced from this activity can help devise more targeted and efficient management plans by offering novel insights into how insects under NST-induced stress allocate between two major domains of health.

Activity Milestones:

Description	Approximate Completion Date
Complete data collection for reproductive investment	December 31, 2030
Data analysis	April 30, 2031
Report and publication preparation, meet with state officials to share findings	June 30, 2031

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Mingzi Xu	UMN - College of Biological Sciences	Dr. Xu will assist with data collection, advise analytical approaches and publication preparation, and supervise the graduate research assistant.	Yes

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.

The neonicotinoid residue data (NST and foliar spray) as well as immunity and reproduction measures generated from these activities will be shared with the Minnesota Department of Agriculture, the Minnesota Department of Natural Resources, the Minneapolis-St. Paul Metropolitan Area Long Term Ecological Research Program, and appropriate municipalities. Findings will also be communicated through peer-reviewed publications and presentations at conferences and symposiums. All data will be available to other organizations and the public when requested. Environment and Natural Resources Trust Fund will be acknowledged in the trust fund logo or attribution language in all publications, conference posters, presentations slides, or material for public outreach.

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?

Findings from these activities will be published in peer-reviewed journals and disseminated through conference presentation and seminars. I will directly share data with the Minnesota Department of Agriculture, the Minnesota Department of Natural Resources, the Nature Conservancy in Minnesota, and municipalities. Information will also be disseminated to the public through outreach programs such as public talks and educational booths at farmer's markets.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Sublethal Effects of Pesticides on the Invertebrate Community	M.L. 2024, , Chp. 83, Art. , Sec. 2, Subd. 03p	\$387,000

Project Manager and Organization Qualifications

Project Manager Name: Susan Balenger

Job Title: Researcher 2

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

Project manager Balenger has been studying the impacts of environmental stressors, including pesticides and parasites, on immunity and reproduction of wildlife for over 20 years. She led her own lab at the University of Mississippi for 6 years (2016-2022), and now holds a position as a researcher in Mingzi Xu's lab at the University of Minnesota-Twin Cities (2022-present). Throughout her career she has designed and conducted field and lab studies that involve handling insects and wild birds, assessing their health and behavior, and collecting blood and other tissues for physiological measurement. She is highly skilled in conducting immune assays and wildlife dissection, as evidenced through many of her 30 peer-reviewed publications (Google scholar profile -

<https://scholar.google.com/citations?user=YE73bs8AAAAJ&hl=en>).

In her current position, Balenger leads soil and vegetation sampling efforts across MN for neonicotinoid residue analysis, and she works directly with the USDA National National Science Laboratories to coordinate testing and evaluate results. She has developed protocols for rearing crickets, experimentally exposing crickets to neonicotinoids via injection, ingestion, and surface contact, and assessing cricket behavior, immune, and reproductive responses to neonicotinoids in the laboratory. She currently supervises 1 graduate student, 3 undergraduate students, and 1 research technician. She communicates sampling efforts, research directions, and study findings with the MDA, MN DNR, and university field/research stations. She is currently a co-PI on an unrelated National Science Foundation grant (Polyploidization, gene dosage, and the evolution of hormonal phenotypes) which expires in 2027.

Organization: U of MN - College of Biological Sciences

Organization Description:

The mission of the (UMN) College of Biological Sciences is to deliver cutting-edge, internationally recognized research and teaching at all levels of biological organization from molecules to ecosystems. While preparing today's students to create the biology of tomorrow, CBS promotes collaborative research within and beyond the University to advance knowledge and find solutions that improve human health and the environment locally, nationally, and globally. (taken from <https://cbs.umn.edu/about/about-college/overview>)

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Susan Balenger		Dr. Balenger will lead all experimental design, sampling, data analysis, and report preparation. She will be the Project Manager, and therefore is the primary point person for the project with LCCMR.			32.3%	4		\$364,513
Dr. Mingzi Xu		Dr. Xu will participate in experimental design and data collection, provide data analysis and report preparation support. She will be the primary mentor to the graduate student.			36.6%	0.3		\$46,701
Graduate Student		participate in sample collection, lab experiments, and report preparation			50%	0.13		\$27,121
Undergraduate Summer Field Technician		assist in maintaining agricultural field crops, collect data, process soil and vegetation samples in field and lab			0%	0.75		\$23,974
2 animal care technicians (undergraduates)		rear and maintain lab cricket colony, collect wild crickets to breed with colony			0%	1.2		\$36,543
Undergraduate research technician		grow and maintain greenhouse and lab crops, collect physiological samples and conduct physiological assays in lab			0%	1.14		\$26,957
							Sub Total	\$525,809
Contracts and Services								
USDA Agricultural Marketing Service National Science Laboratories	Service Contract	Pesticide residue analysis for 32 samples at \$468/sample (full insecticide panel) and 384 samples at \$157/sample (neonicotinoid only panel).				0		\$75,264
Rosemount Research and Outreach Center	Internal services or fees (uncommon)	Rosemount ROC can provide research space, operational coordination, and logistical support for agricultural field work. Amount includes funding to pay fees for conventional seeds, experimental acreage, tillage, planting, and				0		\$4,800

		administration of pesticides over the course of the activities.						
University of Minnesota Plant Growth Facilities	Internal services or fees (uncommon)	UMN PGF provides greenhouse supplies and services for conducting research. The estimated rate is \$0.05/sq ft per day. We estimate we will use 120 sq ft of space over the course of 1.5 years.				-		\$3,000
University of Minnesota Imaging Center	Internal services or fees (uncommon)	The UMN UIC provides training and access to microscopes and imaging software.				-		\$1,000
							Sub Total	\$84,064
Equipment, Tools, and Supplies								
	Tools and Supplies	1) Insect cages for the field and greenhouse; 2) rearing supplies (plastic bins, cricket food, egg cartons, cotton); 3) pesticide application related supplies (large tank for spraying and NST bag of seeds); 4) general lab supplies (tips, tubes, gloves, glassware, petri dishes); and 5) chemical reagents.	1) Cages will be used to conduct experimental insect exposures to insecticide; 2) rearing supplies will be used to rear crickets in the lab for physiological experiments; 3) NST seeds are required to conduct the experiments and a large tank is required to conduct foliar spray applications; 4) lab supplies are for general lab maintenance and activities; and 5) chemical reagents will be used in processing and cleaning up field samples, as well as conducting immune assays.					\$13,087
							Sub Total	\$13,087
Capital Equipment								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								

	Miles/ Meals/ Lodging	This includes mileage cost for 120 round trips between the University of Minnesota and experimental agricultural fields. At a rate of \$0.70/miles, it is \$42 per roundtrip between UMN and Rosemount ROC (60 miles total).	Trips between UMN and experimental agricultural fields will be used to pilot and perform insecticide applications, housing and monitoring of crickets in an agricultural setting, monitor plant growth, collect climatic data, and collect soil and vegetation samples.					\$5,040
							Sub Total	\$5,040
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Publication	Publication costs	Fees associated with publication of peer-reviewed papers from this project					\$4,000
							Sub Total	\$4,000
Other Expenses								
							Sub Total	-
							Grand Total	\$632,000

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	-

Total Project Cost: \$632,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [5b306524-272.pdf](#)

Alternate Text for Visual Component

Research plan for the proposed project. 1) Evaluating exposure risk of NST in field collected soil and vegetation samples. 2) Evaluating the effects of NST on the immune response of non-targeted insects in the field and lab. 3) Evaluating the effects of NST across domains of health of non-targeted insects....

Supplemental Attachments

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

Title	File
Approval Letter Balenger	a8216bad-2b7.pdf
Balenger_LoS_UMNgreenhouse	c82ad5b3-cc0.pdf
Balenger_LoS_RosemountROC	4aa14291-545.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:

NA

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