Environment and Natural Resources Trust Fund

2022 Request for Proposal

General Information

Proposal ID: 2022-211

Proposal Title: Climate Resilient Lawns for Minnesota

Project Manager Information

Name: Eric Watkins

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

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Project Basic Information

Project Summary: There is a need to develop turfgrasses for Minnesota greenspaces that are more resilient to warming winters, hotter summers, and increased flooding rains.

Funds Requested: $479,000

Proposed Project Completion: June 30 2024

LCCMR Funding Category: Air Quality, Climate Change, and Renewable Energy (E)

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 and In the Future

Narrative

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

Lawns are an important part of urban greenspace, providing functional and aesthetic benefits, along with environmental benefits such as soil stabilization and cooling effects. Climate change poses challenges for turfgrass lawns. There are three primary ways in which these changes could result in poor performance of turf and the resultant loss of important ecosystem services. First, warming winters are likely to result in less insulating snow, exposing turfgrass to lower temperatures; in addition, highly fluctuating temperatures in winter bring periods of deacclimation and ice melt, followed by severe cold and potentially lethal ice formation. Second, higher temperatures in the summer will stress common Minnesota lawn grasses (Kentucky bluegrass, fine fescues, perennial ryegrasses) to a point where death can occur. Finally, the increasing risk of high rainfall events brings greater risk of flooding--this is a major problem for some of the turfgrasses that have lower-input characteristics that are usually very important components of a sustainable landscape.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

We will initiate a targeted plant breeding effort specifically to develop climate-resilient turfgrasses for use in lawns across Minnesota. We will use protocols and methodologies developed by the UMN turfgrass research group over the past decade to optimize selection approaches to identify the most climate-resilient turfgrass germplasm for use in our breeding program. We will also develop new methodology, especially in the areas of selection for ice cover tolerance and flood tolerance, using advanced plant physiological approaches. Finally, building off of work in our lab and with collaborators, we will initiate a new effort in genomics-assisted plant breeding targeting important traits related to climate resilience. To date, use of genomic tools has been limited in turfgrasses, due to their complex genomes; however, new approaches are allowing for the use of new approaches (Della Coletta et al., 2021; Qiu et al., 2021).

Della Coletta, R., Qiu, Y., Ou, S. et al. How the pan-genome is changing crop genomics and improvement. Genome Biol 22, 3 (2021). https://doi.org/10.1186/s13059-020-02224-8

Qiu, Y., Yang, Y., Hirsch, C.D. and Watkins, E. (2021), Building a reference transcriptome for the hexaploid hard fescue turfgrass….. Crop Sci.. https://doi.org/10.1002/csc2.20489

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?

Plant breeding programs take many years to bring a cultivar to market. The ultimate outcome of this work will be climate resilient cultivars for use on home lawns, sports fields, parks, roadsides, and other green spaces throughout the state. In the short term, we will build a solid foundation upon which the selection of these turfgrasses can be accelerated so that Minnesotans are provided with the best possible lawn grasses that provide important ecosystem services.

Activities and Milestones

Activity 1: Accelerate phenotyping for climate-resiliency traits in low-input turfgrasses

Activity Budget: $252,420

Activity Description:

We will develop and optimize high throughput methods to screen turfgrasses for traits important in a changing climate: (1) ice cover tolerance; (2) resistance to deacclimation effects; (3) tolerance to high summer temperatures (Breuillin-Sessoms and Watkins, 2020); (4) tolerance of flooded conditions. As new approaches are developed, they will be combined with current methodologies developed by our lab for selection for shaded environments (Petrella and Watkins, 2020) to ensure the development of well-adapted climate-resilient cultivars.

Breuillin-Sessoms, F, Watkins, E. Performance of multiple turfgrass species during prolonged heat stress and recovery in a controlled environment. Crop Science. 2020; 60: 3344– 3361. https://doi.org/10.1002/csc2.20262

Petrella, DP, Watkins, E. Variation in fine fescue taxa response to simulated foliar shade. Crop Science. 2020; 60: 3377– 3394. https://doi.org/10.1002/csc2.20279

Activity Milestones:

Description	Completion Date
Implement selection protocol for heat stress tolerance	February 28 2023
Implement selection protocol for flooding tolerance	February 28 2023
Implement selection protocol for ice cover tolerance	June 30 2023
Implement selection protocol for deacclimation	June 30 2023

Activity 2: Implement new genomic tools for turfgrass cultivar development to hasten climate resilient cultivar development

Activity Budget: $191,225

Activity Description:

Turfgrasses have complex genomes, often having multiple sets of chromosomes (polyploidy) and are usually out-crossing. These factors have slowed the progress of implementing molecular approaches in a turfgrass breeding program. Fortunately, recent advances in genomics and molecular biology now allow for more robust approaches to molecular breeding in these complex species. In this activity, we will hire a new Plant Genomics lead for our breeding program. This person will be responsible for rapidly establishing pipelines for plant improvement targeting climate resiliency traits in multiple turfgrass species.

Activity Milestones:

Description	Completion Date
Hire plant genomics lead	September 30 2022
Build lab and data management resources	June 30 2023
Initiate molecular breeding program	December 31 2023

Activity 3: Implement (Extension etc) to inform the public about climate resilient turfgrasses for Minnesota

Activity Budget: $35,355

Activity Description:

Using climate resilient turfgrasses is essential for Minnesota to maintain healthy greenspace and ensure a sustainable future for urban ecosystems. A major implementation gap that needs to be addressed is consumers' lack of understanding about how turfgrass cultivar selection plays a role in environmental stress tolerance. People are not using the best turfgrass available to them today. To address this need, we will establish a focused outreach effort to inform Minnesotans of low-input turfgrass species and recent advances in turfgrass improvement. We will reach consumers at events hosted by the University of Minnesota and the Minnesota Landscape Arboretum. We will use digital tools like the University of Minnesota Extension website to house instructional materials. Lastly, we will work with current partners to deploy an easy-to-use online turfgrass seed selection application that is currently under development at the University of Minnesota (https://z.umn.edu/ffd1).

Activity Milestones:

Description	Completion Date
Outreach to Minnesota stakeholders at public events (MN State Fair etc.)	September 30 2022
Update cultivar selection Extension web resources	June 30 2023
Train key stakeholders on use of seed selection web application	September 30 2023
Write Extension focused articles about seed selection outreach	June 30 2024

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Maggie Reiter	University of Minnesota Extension	Maggie Reiter, assistant Extension professor for turfgrass, leads an outreach program to connect Minnesota turfgrass managers and users with research-based information. She will coordinate delivery of outreach to pilot ambassadors and collaborate on all parts of the project.	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 be funded?

This work will build a solid foundation for a long-term cultivar development program that can generate self-sustaining funding and deliver numerous new cultivars to the market . These new cultivars can be grown by seed producers in Roseau and Lake of the Woods counties, marketed by seed sellers throughout all of the state, and used to provide functional green spaces in rural and urban landscapes.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Bee Pollinator Habitat Enhancement - Phase II	M.L. 2016, Chp. 186, Sec. 2, Subd. 08a	$387,000

Project Manager and Organization Qualifications

Project Manager Name: Eric Watkins

Job Title: Professor

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

Eric Watkins leads the turfgrass science program where his research interests are focused on the development and utilization of low-input turfgrasses for cold climates. His group conducts wide-ranging research that includes plant adaptation to shade, plant-microbe interactions, germplasm improvement, plant genomics, lawn water conservation education, and species recommendations for Minnesota roadsides. He has worked with the Met Council for several years on strategies to reduce lawn water use in the Twin Cities Metropolitan Area, with strategies ranging from irrigation controller technologies to low-water-use turfgrass species. He has led multiple successful multidisciplinary grant proposals, and is active in outreach to Minnesota stakeholders through blog posts, professional trade magazine articles, in-person seminars, and site visits.

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

Organization Description:

The College of Food, Agricultural, and Natural Resources Sciences, at the University of Minnesota, aims to inspire minds, nourish people, and enhance the natural environment. The college's vision is to advance Minnesota as a global leader in food, agriculture, and natural resources through extraordinary education, science-based solutions, and dynamic public engagement that nourishes people and enhances the environment in which we live. The college has 13 academic departments, including Horticultural Science, home of the turfgrass science program. The turfgrass science program has the field, laboratory, growth chamber, and greenhouse facilities needed for innovative research to serve the needs of Minnesota stakeholders.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineli gible	% Bene fits	# FTE	Class ified Staff?	$ Amount
Personnel								
Faculty		Lead and coordinate project			36.5%	0.24		$30,722
Extension Faculty		Lead outreach component, communicate about climate resilient turfgrasses to the public			36.5%	0.2		$18,647
Project Coordinator		coordination, scheduling, editing, logistiics			31.8%	0.2		$16,709
undergraduate student researcher		assist with data collection, assist with lawn ambassador meetings,			0%	0.6		$18,000
Field Facility Manager		Maintain turf plots and breeding nurseries (mow, fertilize, weed, etc.)			31.8%	0.4		$28,254
Plant Physiology Researcher		Research on abiotic and biotic stresses, develop high throughput phenotyping			36.5%	0.8		$71,144
Plant Breeding Researcher		Coordinate all plant breeding activities (field, greenhouse) supervise undergraduate students			36.5%	1		$96,435
Plant Geneticist		Genomics/bioinformatics for molecular plant breeding efforts			36.5%	2		$179,225
							Sub Total	**$459,136**
Contracts and Services								
UMN Genomic Center	Internal services or fees (uncommon)	Sequencing costs associated with molecular breeding efforts.				0		$12,000
UMN Plant Growth Facilities	Internal services or fees (uncommon)	Space and use charges for greenhouses and growth chambers needed for plant breeding and plant physiology projects.				-		$4,000
							Sub Total	**$16,000**
Equipment, Tools, and Supplies								

							Sub Total	-
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel to Magnusson Research Farm in Roseau	The UMN research farm in Roseau is critical to ensure our new cultivars can be produced for seed in northern MN					$3,864
							Sub Total	$3,864
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
-							Sub Total	-
Other Expenses								
-							Sub Total	-
							Grand Total	**$479,000**

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: [08369b40-e9c.pdf](08369b40-e9c.pdf)

Alternate Text for Visual Component

(to be filled in before submission)In this figure, a gray box labeled "lawn stressors" at the top includes warmer winters, increased summer temperatures, increased rainfall events. Below the left side of the box an arrow leads to "traditional turf cultivars" that have medium to high impacts. Below this is a box showing that these cultivars have negative environmental impacts. Under the righthand side of the "stressors" box, an arrow points to a box that says "climate-resilient turf cultivars"...

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?

> Yes

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

> Yes

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF? If so, describe here:

> Yes, Plant breeding effort such as these take long-term financial commitment. Reinvesting royalties into the breeding program is a sustainable funding model. Funding from the LCCMR would allow for a 2 year head start on implementation of a climate resilient turfgrass breeding effort.

Does your project include original, hypothesis-driven research?

> Yes

Does the organization have a fiscal agent for this project?

> Yes, Sponsored Projects Administration

CLIMATE RESILIENT LAWNS
FOR MINNESOTA

LAWN STRESSORS
(warmer winters, increased summer temps., increased rainfall events)

Traditional Turf Cultivars
Impacts: Medium to High

Climate-Resilient Turf Cultivars
Impacts: Low to Medium

Negative Environmental Impacts

Sustainable Landscapes

Resilient low-input lawns help protect soil

Poor-performing lawns lead to negative environmental outcomes