Environment and Natural Resources Trust Fund
2018 Request for Proposals (RFP)

Project Title: **ENRTF ID: 046-B**

Improving Agricultural Sustainability on Irrigated Sandy Soils

Category: B. Water Resources

Total Project Budget: $ 470,000

Proposed Project Time Period for the Funding Requested: 3 years, July 2018 to June 2021

Summary:

This project will explore the use of innovative planting configurations and new nitrogen fertilizer technology to sustain potato productivity and reduce nitrate leaching to groundwater under irrigated conditions.

Name: Carl Rosen

Sponsoring Organization: U of MN

Address: Department of Soil, Water, and Climate; 1991 Upper Buford Circle
St. Paul MN 55108

Telephone Number: (612) 625-8114

Email rosen006@umn.edu

Web Address

Location

Region: Central

County Name: Anoka, Becker, Benton, Cass, Dakota, Douglas, Hubbard, Isanti, Morrison, Otter Tail, Pope, Sherburne, Todd, Wadena

City / Township: Staples/Staples Township

Alternate Text for Visual:

Conventional wide row planting configuration vs. narrow row bed configuration showing reduced nitrate leaching to groundwater with improved planting configuration and fertilizer technology.

_____ Funding Priorities _____ Multiple Benefits _____ Outcomes _____ Knowledge Base

_____ Extent of Impact _____ Innovation _____ Scientific/Tech Basis _____ Urgency

_____ Capacity Readiness _____ Leverage _____ TOTAL _____%

PROJECT TITLE: Improving Agricultural Sustainability on Irrigated Sandy Soils

I. PROJECT STATEMENT

Approximately one million acres of sandy soils are farmed in Minnesota with half of that acreage irrigated to improve productivity of crops such as potato, corn, and edible beans. While crop production in these areas contributes greatly to the economy in rural Minnesota, the use of nitrogen fertilizer on these vulnerable soils is highly susceptible to leaching, which may result in nitrate contamination of groundwater.

This project will explore innovative planting configurations to allow potato roots to intercept more water and nutrients than typical row crop configurations. Rather than high density single rows planted with wide spacing between rows, the potential for using lower density plantings within narrow rows will be investigated. In addition to planting configurations, advances in nitrogen fertilizer technology will also be evaluated. We will develop modified urea compounds (ureides) as well as evaluate new-generation coated products that breakdown much more slowly, retaining more nitrogen in the soil for plants, and minimizing water and air contamination. Finally, we plan to model nitrogen release and leaching potential in this new system to help growers make decisions regarding nitrogen fertilizer applications well as predict effects on water quality.

Coupling planting configuration with improved fertilizer technology will provide a win for everyone. Farmers will be providing better nutrition for their crops with lower inputs. They will need to fertilize less frequently, saving time and energy. And it will be a big win for Minnesota's environment and rural economy. More nitrogen being taken up by crop plants means less nitrate in Minnesota groundwater. Less nitrate in Minnesota groundwater is better for our health; it will lower water treatment costs, and reduce environmental impacts to benefit all our natural resources.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Testing efficacy of new planting configurations and nitrogen compounds in the laboratory and under Minnesota field conditions. **Budget: $270,000**

In laboratory growth facilities, we will use different combinations of ureide compounds and determine their effectiveness with respect to the growth of common Minnesota crops such as potatoes and corn. In farm fields and research stations, Potatoes will be planted at lower density with narrower furrows and novel nitrogen compounds to minimize bare soil and leaching nitrates. Results will be extended to growers, agricultural professionals and state agency personnel.

Outcome	Completion Date
1. Optimum combinations will be determined to allow field-testing to proceed.	March 1, 2019
2. Demonstration of techniques that can be adopted by farmers to improve practices and reduce nitrate leaching	June 30, 2021
3. Disseminate information to stakeholders and move the best technology into practice in Minnesota	June 30, 2021

Activity 2: Determining the underlying basis for effectiveness of new nitrogen compounds. **Budget: $ 100,000**

The effectiveness of ureide fertilizers is based on microbes in the soil breaking down the compound and releasing nitrogen. The manner in which this is done is critical for a long-lasting effect and for mitigating against unwanted discharge of chemicals like nitrate into groundwater. Soil microbes will be sampled, and their DNA sequenced to develop a better understanding of factors that influence effectiveness of ureide fertilizers.

Outcome	Completion Date
1. Basic understanding of how new nitrogen compounds are affected by soil biological processes	June 30, 2021

Activity 3: Modify an existing soil-crop-water-fertilizer model to help predict the efficacy of the new system for reducing nitrate leaching. **Budget: $ 100,000**

The model will be calibrated and validated using field data. It will describe the impacts of lower density narrower furrow potato plantings on crop growth and leaching of water and nitrates, as well as impacts of slower release coated and ureide fertilizer formulations that better synchronize N release with plant uptake.

Outcome	Completion Date
1. This new model will be used as a decision tool by growers and stakeholders to make decisions regarding nitrogen and water applications using new fertilizer formulations and improved potato bed planting techniques.	June 30, 2021
2. Predict reductions in water and nitrate leaching due to improved practices	June 30, 2021

III. PROJECT STRATEGY

The overall strategy in this project is to conduct field experiments at the Irrigation Facility operated by Central Lakes College in Staples MN. Replicated plots will be established to evaluate planting configurations and fertilizer formulations. Suction tube lysimeters will be used to estimated nitrate concentrations in each plot below the root zone. Concurrently, field demonstrations will also be established to show that the innovative approaches will work on a commercial scale. Laboratory studies will be conducted to determine underlying mechanisms involved and modeling of the new systems will be done to extend the results obtained. This is a collaborative project between the University of Minnesota, Central Lakes College, and the Area II Potato Growers Association.

A. Project Team/Partners

University of Minnesota, Carl Rosen, Larry Wackett, Co-PI, David Mulla, Co-PI: [$430,000] receiving funds
Central Lakes College, Keith Olander, Dean of Agricultural Studies, cooperator: [$40,000] receiving funds
Area II Potato Growers, Paul Gray, Executive Secretary: contributing funds ($40,000 - pending)

B. Project Impact and Long-Term Strategy

This project will explore the use of innovative planting configurations and new nitrogen fertilizer technology to sustain potato productivity and reduce nitrate leaching. While nitrogen is an essential nutrient needed for crop production, its use on sandy soils can lead to leaching and nitrate contamination of groundwater. Use of new planting configurations and new nitrogen fertilizers will improve nitrogen use efficiency and sustainability of agriculture on soil vulnerable to nitrate losses. Because of the high value of the crop being produced, the project will have important impacts on the rural economy. In addition, we will employ students and interns from the Central Lakes College area to assist with the research at the irrigation facility in Staples, which will give them valuable experience in research in linking agriculture with natural resources. The long-term strategy will be to promote new practices that potato growers can adopt to improve water quality based on the research and modeling results obtained during the project period.

C. Timeline Requirements

In order to test practices over two growing seasons, this project will require 36 months to carry out as described above.

2018 Detailed Project Budget

Project Title: Improving Agricultural Sustainability on Irrigated Sandy Soils

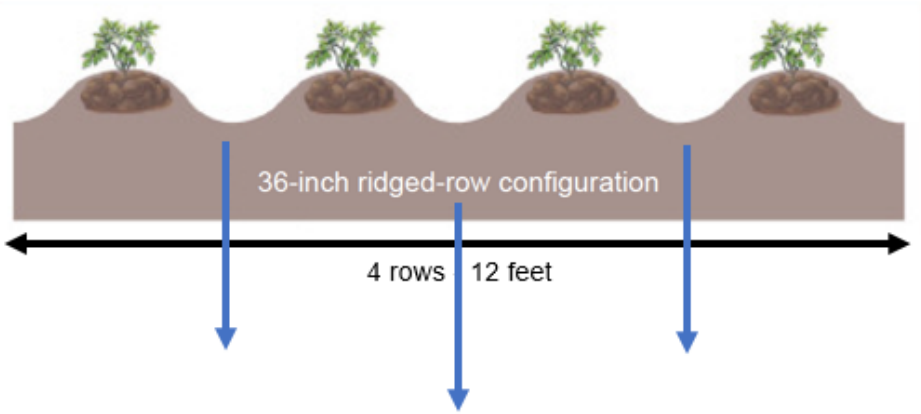
IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel:	
Post Doc ($24,712 Salary + $5288 Fringe * 3 years .52 FTE) Mohamend Tahir	$ 90,000
Reseach technicians Matt McNearney - .50 FTE time for two years; Jim Crants .25 FTE time for two years; + 1.00 FTE post-doc or research fellow for Larry Wackett for 1 year, Anthony Dodge	$ 170,000
Graduate student - Brian Bohman for 2 years at .50 FTE.	$87,895
1.5 Undergraduate Research Assistants; Assist with all aspects of the project. $12/hr salary, 0% fringe. 1.00 FTE in summer, .25 FTE in school year, two years.	$ 32,400
Professional/Technical/Service Contracts: Central Lakes College: Plots fees for experimental set up. Technical support to maintain plots at remote sites.	$ 40,000
Professional/Technical/Service Contracts: Fees for growth chamber use, lab services for soil and tissue analysis	5000
Equipment/Tools/Supplies: Supplies needed for analysis of water samples for nitrate and DNA analysis for soil microbes. Field supplies such as flags, sample bags, etc.	$ 34,705
Acquisition (Fee Title or Permanent Easements)	N/A
Travel: Travel will be to maintain experimental plots and collect water samples; participate in meetings with stakeholders to present results of the project activities. Roundtrip to Staples/surrounding area from St. Paul 350 miles x 40 trips x $0.535/mile per year = $7490 + miscellanous trips to stakholder meetings - estimated at 2510 = $10,000.	$ 10,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 470,000

V. OTHER FUNDS

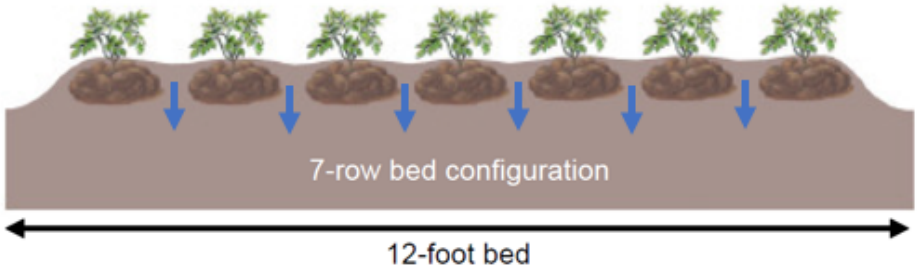
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period: Area II Potato Growers	$ 40,000	*Pending*
Other State $ To Be Applied To Project During Project Period	N/A	
In-kind Services To Be Applied To Project During Project Period: Unrecovered Indirect Costs (54% MTDC in FY19 and FY20) associated with this proposal. Office, lab, and meeting space, accounting and secretarial services, phone & office equipment, security, and library access, for all project personnel.	$234,055	*secured*
Past and Current ENRTF Appropriation: This proposed project extends the activities of an LCMR project funded in 2005 entitled "Improving Water Quality on the Central Sands." Based on that project, changes to production practices have been made to reduce nitrate leaching, but equipment and fertilizer technology suggested to be used in this proposal were not available at that time.	$587,000	*completed*
Other Funding History:	N/A	
Remaining $ From Current ENRTF Appropriation	N/A	

Conventional potato planting with urea



More nitrate leaching to groundwater

Bed potato planting with ureides or coated urea



Less nitrate leaching to groundwater

Improving Agricultural Sustainability on Irrigated Sandy Soils

Project Manager Qualifications:

Carl Rosen, Ph.D. - Soil Science

Education and Training

Degree	Major	Institution	Year
Ph.D.	Soil Science	Univ. of California, Davis	1983
M.S.	Horticulture	Penn. State University	1978
B.S.	Horticulture	Penn. State University	1976

Research and Professional Experience

2010-present	Head, Department of Soil, Water & Climate
1995-present	Professor, Univ. of Minn., Dept. of Soil Water, and Climate
1989-95	Associate Professor, Univ. of Minn., Soil Science Dept.
1983-89	Assistant Professor, Univ. of Minn., Soil Science Dept.

Dr. Rosen's current position is Head of the Department of Soil, Water and Climate. As Department Head, he continues to direct an active research program related to nutrient management for crop production. The responsibilities of his research and extension activities include identifying needs and establishing priorities in plant nutrition and improving fertilizer use efficiency for crop production in Minnesota. Primary emphasis is on irrigated crops commercially grown in Minnesota. However, efforts in recent years have also focused water quality issues related to fertilizer use and agricultural use of municipal and industrial by-products as soil amendments. He is an author or co-author on 110 peer-reviewed publications and over 50 extension publications related to nutrient management and crop production.

Organization Description – University of Minnesota

The University of Minnesota (UMN) is Minnesota's research university. UMN changes lives through research, education, and outreach. Faculty and staff at UMN seek new knowledge that can change how we all work and live. At UMN, students do research alongside top professors in all majors. UMN prepares students to meet the great challenges facing our state, our nation, and our world. UMN faculty and staff utilize their expertise to meet the needs of Minnesota, our nation, and the world. UMN partners with communities across Minnesota to engage our students, faculty, and staff in addressing society's most pressing issues.