

# **Environment and Natural Resources Trust Fund**

# M.L. 2020 Approved Work Plan

#### **General Information**

ID Number: 2020-012 Staff Lead: Corrie Layfield Date this document submitted to LCCMR: August 13, 2021 Project Title: Developing Cover Crop Systems For Sugarbeet Production Project Budget: \$300,000

## **Project Manager Information**

Name: Anna Cates Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences Office Telephone: (612) 625-3135 Email: catesa@umn.edu Web Address: https://cfans.umn.edu/

# **Project Reporting**

Date Work Plan Approved by LCCMR: August 13, 2021

**Reporting Schedule:** April 1 / October 1 of each year.

Project Completion: June 30, 2024

Final Report Due Date: August 14, 2024

# Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 08e

**Appropriation Language:** \$300,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to develop agronomic guidelines to support growers adopting cover-crop practices in sugar beet production in west-central and northwest Minnesota.

Appropriation End Date: June 30, 2024

# Narrative

**Project Summary:** Evaluate effective ways to protect soil from erosion in sugarbeet production, with the long-term goal of slowing soil degradation, nutrient loss, and water quality.

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

Wind erosion in western MN averages 3-8 tons/acre per year. A cover crop planted the fall before sugarbeets should protect the soil as well as protect sugarbeet seedlings. No research has been done to evaluate erosion protection due to fall vs spring-seeded cover crops before sugarbeets. It is critical to quantify nutrient losses from sugarbeet fields in this region in order to meet Minnesota's Nutrient Reduction Strategy targets for the Red River Valley (10% in phosphorous and 13% in nitrogen by 2025). Researchers have noted that a high-residue fall cover crop suppressed weeds, which is of critical importance as growers struggle with increasing herbicide resistance in weed populations. In addition, fall-planted cereal rye reduces soil nitrate, which increases sugarbeet quality and reduces potential for nitrate leaching to ground and surface water.

Erosion is an even more difficult problem following sugarbeets in rotation. Sugarbeets are destructively harvested late in the fall, leaving soil exposed to fall, winter, and spring erosion. However, seeding cover crops which survive sugarbeet harvest has the potential to increase fall residue cover of the soil which would slow wind and water speeds, reducing erosion, potentially suppressing weeds.

# 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.

•In West-Central Minnesota, interseeding cover crops with strip-tilled corn prior to sugarbeets could reduce spring soil loss and save farmers time and money.

•In Northwest Minnesota, late-summer harvest of winter wheat provides an excellent window for establishment of prebeet cover crops.

•In both regions, interseeding cover crops into standing beets will reduce fall erosion.

Successful fall cover crops reduce soil, phosphorous and nitrogen losses during the fallow period, an opportunity for savings on fertilizer costs while improving water quality. In addition, a robust pre-beet cover crop could suppress competitive herbicide-resistant weeds, which are spreading throughout the state. In order to mitigate risk for farmers adopting these new practices, our research will evaluate different planting and termination timings and methods and develop initial recommendations. We will establish large-scale on-farm trials and plot-scale trials to evaluate regionally-specific systems for sugarbeet yield and quality, troubleshoot agronomic best practices, and measure soil health metrics, wind erosion, surface runoff, and associated nutrient loss. Growers are duly wary of adopting new practices without a clear understanding of the benefits and risks, so this groundwork is necessary for workshops, technical assistance, and promotion of sustainable sugarbeet production in Minnesota.

# 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 data will be used to promote adoption of cover cropping in sugarbeets to reduce erosion by wind and water, which enhance nutrient delivery to Minnesota's surface water. As sugarbeets are grown in rotation with other crops, other relevant agricultural conservation practices will be discussed at field days and in publications, using this research as leverage to promote soil and water conservation in the West-central and NW regions of Minnesota.

# **Project Location**

What is the best scale for describing where your work will take place? Region(s): NW, Central,

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

Region(s): NW, Central,

#### When will the work impact occur?

During the Project and In the Future

# Activities and Milestones

## Activity 1: Central Minnesota: Integrating cover crops in strip-till corn-sugarbeet crop rorations

#### Activity Budget: \$100,000

#### **Activity Description:**

We will evaluate four treatments for soil protection and agronomic best practices: (1) pre-beet cover (rye and Austrian winter pea) interseeded between strip-tilled corn rows, (2) post-beet cover sewn after beet harvest, (3) nurse crops sewn at beet planting, and (4) no cover crops. Growers with the Southern Minnesota Beet Sugar Cooperative have agreed to host large on-farm trial plots, and SMBSC has agreed to support the logistics of research including beet yield and quality sampling. We will use dust collectors and/or erosion mats to quantify soil and nutrients lost to wind erosion and will measure soil health metrics (biologically active soil C and N). Yields of beets and corn will be evaluated using farmers' combine or weigh wagon data, and a subsample of beets and wheat will be taken from each plot to evaluate quality. Cover crop success will be quantified by harvesting biomass and photographing ground cover; weeds by estimating emergence. Field days and grower meetings will be held each year to address grower concerns and share best management practices developed.

#### **Activity Milestones:**

| Description  | Completion Date   |
|--|-------------------|
| Interseed pre-beet covers, evaluate fall ground cover and soil erosion (2022 and 2023) | December 31, 2023 |
| Evaluate sugarbeet yield and quality (2022 and 2023)                                   | December 31, 2023 |
| Evaluate spring cover, spring erosion, and plant sugarbeets (2022-2024)                | June 30, 2024     |
| Field days and winter meetings to disseminate results                                  | June 30, 2024     |

#### Activity 2: Northwest Minnesota: Integrating cover crops in wheat-sugarbeet rotations

#### Activity Budget: \$200,000

#### **Activity Description:**

We will evaluate four treatments for soil protection and agronomic best practices: 1) pre-beet cover sewn after wheat; 2) post-beet cover intereseeded before beet harvest; 3) no cover beets. Growers with American Crystal Sugar have agreed to host large on-farm trial plots, and ACS has agreed to support the logistics of research including beet yield and quality sampling. We will use dust collectors and/or erosion mats to quantify soil and nutrients lost to wind erosion and will measure soil health metrics (biologically active soil C and N). Yields of beets and wheat will be evaluated using farmers' combine or weigh wagon data, and a subsample of beets and wheat will be taken from each plot to evaluate quality. Cover crop success will be quantified by harvesting biomass and photographing ground cover; weeds by estimating emergence. Field days and grower meetings will be held each year to address grower concerns and share best management practices developed.

In addition, a small-plot study at Crookston NWROC will evaluate the same treatments, and be split to evaluate 2-5 different cover crop species for pre-beet and post-beet windows. Evaluation of soil and environmental indicators will proceed as in on-farm plots.

#### **Activity Milestones:**

| Description  | Completion Date   |
|--|-------------------|
| Establish pre-beet covers, evaluate fall ground cover and soil erosion (2022 and 2023) | December 31, 2023 |
| Evaluate sugarbeet yield and quality (2022 and 2023)                                   | December 31, 2023 |
| Evaluate spring cover, spring erosion, and plant sugarbeets (2022-24)                  | June 30, 2024     |
| Field days and winter meetings to disseminate results                                  | June 30, 2024     |

# **Project Partners and Collaborators**

| Name                              | Organization  | Role  | Receiving<br>Funds |
|-----------------------------------|---|---|--------------------|
| Dr. Lindsay<br>Pease              | NW Research<br>and Outreach<br>Center                                 | Assistant Professor and Extension Specialist of Nutrient and Water Management,<br>Department of Soil, Water, and Climate, UMN, Crookston, MN. Lead on<br>Crookston site management, surface runoff measurements, graduate student co-<br>advisor. | Yes                |
| Jodi DeJong-<br>Hughes            | University of<br>Minnesota<br>Extension                               | Regional Extension Educator in Crops and Soils, lead on Central MN work.  | Yes                |
| Dorian<br>Gatchell                | MN Ag<br>Services   | Farmer contact and field work support in central MN work.   | Yes                |
| Dr. Thomas<br>Peters              | North Dakota<br>State<br>University and<br>University of<br>Minnesota | Extension Sugarbeet Agronomist, will lead weed pressure evaluation.   | No                 |
| Todd<br>Cymbalak                  | American<br>Crystal Sugar   | Cymbalak identified NW MN growers, and will coordinate plot data collection including sugarbeet yield and quality metrics.  | No                 |
| David Mettler                     | Southern<br>Minnesota<br>Beet Sugar<br>Cooperative                    | Mettler helped identify cooperators and will coordinate harvest data collection including yield and beet quality.   | No                 |
| Leah Grim                         | UMN   | Help to collect and analyze samples for soil health indicators.   | Yes                |
| Graduate<br>research<br>assistant | UMN   | Collect and analyze field data including water quality and soil health metrics.   | Yes                |
| Heidi<br>Reitmeier                | UMN, NW<br>Research and<br>Outreach<br>Center                         | Technician to collect field data and analyze water quality samples.   | 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.** Farmers have been active participants in the design of this research. Meetings were first held with growers and beet sugar coop owners in 2018 to discuss proposed research goals and protocols. This ensures that beet growers have buy-in and capacity for the research goals, and the acres in beet rotation are more likely to adopt innovations generated by this research.

UMN Extension and our collaborator with NDSU Extension have established networks for field days and publication dissemination, so ongoing and final results can be easily shared with agricultural stakeholders around the state. Given the importance of agricultural lands for water quality across Minnesota, this is the critical audience fort his work. We understand the ENTRF Acknowledgement Guidelines, and will include language, logo, and social media tags as appropriate for each outreach activity.

# 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 project addresses basic questions of cover crop management for sugarbeets; however, we expect to refine these systems. All personnel will disseminate these results through field days on farms, at the NWROC Crop and Soils Field Day, UMN-Extension website, two peer-reviewed research publications, at winter beet Grower's Seminars and ACS's "Way to Grow" series. Federal, cost-share is available to individual growers for cover cropping. Commodity crop organizations including the Sugarbeet Research and Education Board, MN Wheat, MN Soybean Growers Association, and MN Corn Growers Association fund cover crop research which may be used to address questions raised here.

# Budget Summary

| Category /<br>Name                   | Subcategory<br>or Type | Description  | Purpose | Gen.<br>Ineli<br>gible | %<br>Bene<br>fits | #<br>FTE | Class<br>ified<br>Staff? | \$ Amount       |
|--------------------------------------|------------------------|--|---------|------------------------|-------------------|----------|--------------------------|-----------------|
| Personnel                            |                        |  |         | givic                  | 1105              |          | Starr                    |                 |
| Professiona                          |                        | PI   |         |                        | 26.7%             | 0.03     |                          | \$2,796         |
| and Admin                            |                        |  |         |                        |                   |          |                          |                 |
| Professional                         |                        | Scientific Leadership  |         |                        | 26.7%             | 0.13     |                          | \$14,438        |
| and Admin                            |                        |  |         |                        |                   |          |                          |                 |
| Professional                         |                        | Scientific and Field Leadership  |         |                        | 32.6%             | 0.07     |                          | \$8,485         |
| and Admin                            |                        |  |         |                        |                   |          |                          |                 |
| Graduate                             |                        | Data collection and analysis   |         |                        | 46.6%             | 1        |                          | \$100,787       |
| Student                              |                        |  |         |                        | 24.49/            | 0.75     |                          | 605 <b>7</b> 00 |
| Researcher                           |                        | Lab and field technical support  |         |                        | 24.1%             | 0.75     |                          | \$35,799        |
| Researcher                           |                        | Lab and field technical support  |         |                        | 24.1%             | 0.38     |                          | \$20,248        |
| Undergraduate                        |                        | Lab and field work   |         |                        | 0%                | 1.05     |                          | \$31,980        |
| researcher                           |                        |  |         |                        |                   |          | Cub                      | 6214 522        |
|                                      |                        |  |         |                        |                   |          | Total                    | \$214,535       |
| Contracts and                        |                        |  |         |                        |                   |          |                          |                 |
| Services                             |                        |  |         |                        |                   |          |                          | 4               |
| MN                                   | Professional           | Soil sampling, erosion monitoring, yield sampling at   |         | х                      |                   | 0.05     |                          | \$3,000         |
| Agricultural                         | or Technical           | \$25/nour for 60 nours/year for 2 years. Gatchell  |         |                        |                   |          |                          |                 |
| Services,                            | Contract               | nas wis in Agronomy, owns son sampling   |         |                        |                   |          |                          |                 |
| Gatchell                             | Contract               | vears of experience with research protocols  |         |                        |                   |          |                          |                 |
| Soil sample                          | Professional           | \$20/sample *101 plots * 2 years for analysis of   |         |                        |                   | -        |                          | \$4 040         |
| analysis                             | or Technical           | standard nutrients or soil biological activity.  |         |                        |                   |          |                          | <i>\(\)</i>     |
| /                                    | Service                |  |         |                        |                   |          |                          |                 |
|                                      | Contract               |  |         |                        |                   |          |                          |                 |
| Water sample                         | Professional           | At Crookston NWROC plots only, collect runoff  |         |                        |                   | -        |                          | \$1,800         |
| analysis                             | or Technical           | samples approximately monthly to represent key   |         |                        |                   |          |                          |                 |
|                                      | Service                | points during the growing season (e.g. pre/post  |         |                        |                   |          |                          |                 |
|                                      | Contract               | planting, pre/post cover crop interseeding). 9<br>samples/year * \$5/sample * 20 plots * 2 years |         |                        |                   |          |                          |                 |
|                                      |                        |  |         |                        |                   |          | Sub                      | \$8,840         |
|                                      |                        |  |         |                        |                   |          | lotal                    |                 |
| Equipment,<br>Tools, and<br>Supplies |                        |  |         |                        |                   |          |                          |                 |

|               | Tools and     | Field supplies for 101 plots, \$900/year 1 and         | Field flags to mark plots, soil sampling |       | \$1,550           |
|---------------|---------------|--|--|-------|-------------------|
|               | Supplies      | \$650/year 2   | bags, maintenence and repair of soil     |       |                   |
|               |               |  | samplers,                                |       |                   |
|               | Tools and     | Dust collectors, 40 too be manufactured at             | To measure wind erosion on selected      |       | \$10,000          |
|               | Supplies      | \$250/each, 20 in West-central MN and 20 in NW         | on-farm plots, collecting sediment for   |       |                   |
|               |               | MN.  | analysis of total organic matter, pest   |       |                   |
|               |               |  | presence, and nutrients.                 |       |                   |
|               | Tools and     | Cover crop seed, Pre-beet cover: Winter rye (.24/lb    | This seed should be sufficient to        |       | \$9,912           |
|               | Supplies      | * 60 lb/ac) and peas (.65/lb * 10 lb/ac) *20 ac/farm,  | supply all farmers with uniform seed     |       |                   |
|               |               | * 6 farms * 2 years Post-beet cover: Winter rye        | supplies to apply treatments.            |       |                   |
|               |               | (.24/lb * 60 lb/ac) and rapeseed (1.2/lb * 5 lb/ac)    |  |       |                   |
|               |               | *20 ac/farm, * 6 farms * 2 years                       |  |       | 4                 |
|               | Tools and     | 2 sprinkle infiltrometers, \$1450 apiece, plus \$150   | To measure infiltration and runoff at    |       | \$3,050           |
|               | Supplies      | golf hole cutter for installation                      | all plots, allowing collection of water  |       |                   |
|               |               |  | samples for nutrient analysis, and       |       |                   |
|               |               |  | showing the resiliency of soil structure |       |                   |
|               |               |  | to rainfall.                             |       | <u> </u>          |
|               | Tools and     | Lab supplies for in-house soil analysis, \$30/sample   | Samples will be analyzed for biological  |       | \$6,060           |
|               | Supplies      | * 101 plots * 2 year                                   | activity, structure and organic matter   |       | ¢2 500            |
|               | Tools and     | Field day supplies (5 total in 2nd 2 years of project) | Porta-potty rental (\$200/day),          |       | \$2,500           |
|               | Supplies      |  | share prostings with UNAN Extension's    |       |                   |
|               |               |  | share practices with UNIN Extension's    |       |                   |
|               |               |  |  | Cub   | 622.072           |
|               |               |  |  | Jub   | \$ <b>55,</b> 072 |
| Capital       |               |  |  | Total |                   |
| Evnenditures  |               |  |  |       |                   |
| Experiantales |               |  |  | Sub   |                   |
|               |               |  |  | Total |                   |
| Acquisitions  |               |  |  | Total |                   |
| and           |               |  |  |       |                   |
| Stewardship   |               |  |  |       |                   |
|               |               |  |  | Sub   | -                 |
|               |               |  |  | Total |                   |
| Travel In     |               |  |  |       |                   |
| Minnesota     |               |  |  |       |                   |
|               | Miles/ Meals/ | Approximately 65 trips/year of varying lengths,        | Travel sampling, project team            |       | \$20,544          |
|               | Lodging       | \$0.575/mile, plus lodging (\$1000) and meals (\$700)  | meetings, and field days will mostly     |       |                   |
|               |               |  | consist of day trips, except for St.     |       |                   |
|               |               |  | Paul-based personnel to spend nights     |       |                   |
|               |               |  | in Crookston for harvest and field       |       |                   |

|                             |  |  | days, and Crookston-based personnel<br>to spend nights in St. Paul for<br>meetings.  |   |                |           |
|-----------------------------|--|--|--|---|----------------|-----------|
|                             |  |  |  |   | Sub<br>Total   | \$20,544  |
| Travel Outside<br>Minnesota |  |  |  |   |                |           |
|                             | Conference<br>Registration<br>Miles/ Meals/<br>Lodging | 2 trips at \$1500/trip   | PI or graduate student will present<br>results and national or regional<br>meetings devoted to soil health,<br>agronomy, and/or water quality                | х |                | \$3,000   |
|                             |  |  |  |   | Sub<br>Total   | \$3,000   |
| Printing and<br>Publication |  |  |  |   |                |           |
|                             | Printing   | Research reports and field day handouts, ~\$205/year   | Growers still appreciate paper copies<br>of research results, which will be<br>mailed to participating growers, and<br>summarized for the field day audience |   |                | \$411     |
|                             |  |  |  |   | Sub<br>Total   | \$411     |
| Other<br>Expenses           |  |  |  |   |                |           |
|                             |  | Farmer stipend, \$1100/site * 6 sites * 2 years  | To compensate farmers for use of<br>their land and their participation in<br>the project.  |   |                | \$13,200  |
|                             |  | Equipment rental: To strip-till plots, \$800/site/year<br>@ 2 sites/year and interessed covers, \$800/year at<br>2 sites/year (not all farmers require this) | Farmers who are experimenting with<br>these practices must hire proper<br>equipment to apply field treatments.   |   |                | \$6,400   |
|                             |  |  |  |   | Sub<br>Total   | \$19,600  |
|                             |  |  |  |   | Grand<br>Total | \$300,000 |

# Classified Staff or Generally Ineligible Expenses

| Category/Name    | Subcategory or Type | Description                          | Justification Ineligible Expense or Classified Staff Request                                |
|------------------|---------------------|--------------------------------------|---|
| Contracts and    | Professional or     | Soil sampling, erosion monitoring,   | Gatchell's specific experience with growers and research in central MN makes him a          |
| Services - MN    | Technical Service   | yield sampling at \$25/hour for 60   | critical asset to the project. The price is competitive for his level of experience and     |
| Agricultural     | Contract            | hours/year for 2 years. Gatchell has | education, as soil sampling alone could cost \$25/hour for some one with the appropriate    |
| Services, Dorian |                     | MS in Agronomy, owns soil sampling   | equipment and expertise.  |
| Gatchell         |                     | equipment, works closely with        | This is a single source contract.   |
|                  |                     | farmers, and has years of            |   |
|                  |                     | experience with research protocols.  |   |
| Travel Outside   | Conference          | 2 trips at \$1500/trip               | Minnesota is a major player in the beet-growing industry, which holds regional meetings     |
| Minnesota        | Registration        |                                      | to share best practices. In order to reach all top Minnesota personnel as well as a         |
|                  | Miles/Meals/Lodging |                                      | relevant wider audience, project personnel should be prepared to present their results      |
|                  |                     |                                      | at these national and regional meetings. This legitimizes the project in the wider industry |
|                  |                     |                                      | and amplifies our impact on water quality and soil conservation.                            |
|                  |                     |                                      |   |

# 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: <u>87560803-874.pdf</u>

#### Alternate Text for Visual Component

Cover crops provide ground protection and take up nutrients when summer cash crops are not growing. Without cover crops, erosion transports N and P to waterways and leaves degraded soil....

#### **Optional Attachments**

#### Support Letter or Other

| Title                  | File                    |
|------------------------|-------------------------|
| Cates background check | <u>82e50573-35b.pdf</u> |

## Difference between Proposal and Work Plan

#### Describe changes from Proposal to Work Plan Stage

Adjusted budget to reflect recommended funding of \$300,000. Responded to comments and revisions.

# Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes? N/A

Do you agree travel expenses must 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 agree to the UMN Policy.

- Does your project have potential for royalties, copyrights, patents, or sale of products and assets? No
- Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?  $$\rm N/A$$
- 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

# Cover crops hold soil in place, retain N and P, and add organic matter to the soil.



Without cover crops, erosion transports N and P to waterways and leaves degraded soil.

WATER RESOURCES CENTER