

# MDA SUSTAINABLE AGRICULTURE GRANT PROGRAM

## COVER CROP EFFECTS ON SOIL TEMPERATURE AND SOIL MOISTURE

Measuring soil temperature and soil moisture to analyze the impacts on  
farm management

2018 Annual Report

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## **Cover Crop Effects on Soil Temperature and Soil Moisture**

### **SECTION I. NARRATIVE**

#### **A. PROJECT SUMMARY**

Previous research has shown that cover crops reduce erosion, decrease soil compaction, increase water infiltration to prevent runoff, bring leached nitrogen back to the root zone for the following year's crop, and can increase organic matter. However, project partners are unaware of any first-hand data about cover crop effects on soil temperature and soil moisture for southwest Minnesota. Soil temperatures and soil moisture are very important for nutrient uptake for plants and plant growth. It is common for farmers to see flooding and drought conditions in the same growing season. This project will help determine if cover crops can improve infiltration during wet conditions and water holding capacity during drought conditions. Soil and tissue samples will also be collected to observe if cover crops can be a tool to help cash crops become more effective at nutrient uptake. With the cost of inputs increasing and water quality declining, this type of project will help southwest Minnesota farmers in their farming operations and also help improve water quality in local streams.

Over the duration of this project, soil temperatures and soil moisture will be measured using soil probes. Weather stations will be placed on each plot to measure rainfall, humidity, and air temperatures. Infiltration tests, tissue samples, and soil samples will also be collected. The data collected will be used to provide a dataset with which to analyze the impact of cover crops on current farm management. In addition, project partners will work together to host a field day at the end of the grant period. This field day and project will create an educational opportunity for farmers interested in implementing cover crops in to their farming operations and provide first hand, measureable results in Southwest Minnesota.

#### **B. PROJECT DESCRIPTION**

Jerry and Nancy Ackermann have been farming for 45 years and both are extremely active in on-the-farm research and test plots. The farm is a 1,050 acre crop rotation of corn, soybeans, and alfalfa. For the past fifteen years, the landowners have incorporated 350 acres of no-till soybeans and 350 acres of strip-till corn in the crop rotation. The alfalfa crop is a cash crop and is used in nutrient management for alfalfa-corn rotations.

Jerry and Nancy have partnered with multiple landowners, Jan Voit, Heron Lake Watershed District (HLWD) Administrator and Catherine Wegehaupt, HLWD Technician, Andy Nesseth, Extended Ag Services, Inc., and University of Minnesota on research efforts and have hosted numerous field days in the past five years. Project partners will continue to work together on this grant effort.

Kevin and Dana Schmid are fourth generation farmers and are currently in their 23rd year of farming. They have a corn and soybean rotation on 1,680 acres of cropland. Historically, they have used conventional tillage and have no-tilled soybeans from time to time. They also have a wean-to-finish swine operation consisting of three 1,100 head tunnel barns. These were built in

2005 and have allowed them to utilize manure as a fertilizer source in their operation. They are in their third year of studying cover crops on 20 acres at home and have added 54 more acres in the last two years.

Bruce Leinen started farming with his father in 1987 and he now farms with his sons. One son farms with him full time and the oldest son part time. He currently farms 1,600 acres and he grows corn, soybeans, and has started to incorporate some wheat. He has 150 head of cattle and nearly 400 ewes. He also sells feeder lambs and finished lambs.

All project cooperators and partners are looking for research data that shows how cover crops can effect soil moisture and soil temperature. Project partners are not aware of research regarding soil moisture and soil temperature in southwest Minnesota. The farmers in this area are looking for a way to better utilize their costly nutrient inputs and also protect our water resource. Weather variations are becoming more intense and southwest Minnesota farmers are looking for a way to protect their crops during flooding and drought conditions within the same growing season. The project will provide hands on data for southwest Minnesota. It will also provide away to reach other farmers and share data with them through a field day.

### C. RESULTS

Tell us what happened this year and how it affects your farm's environment, management, and costs, and profitability. Data that show the size of the effect are more useful than just a statement that there was a positive or negative effect. For example, it is more useful to know that a new practice increased yield by 3 bushels over the old practice, than to just say that it increased the yield.

- Provide the data, measurements and evaluations (such as yield, animal weights, input costs, dates) you recorded. If you have tables or charts, please attach to your report.

***This is where charts and graphs are really valuable – they help the reader “see” the results.***

#### **Some questions to answer:**

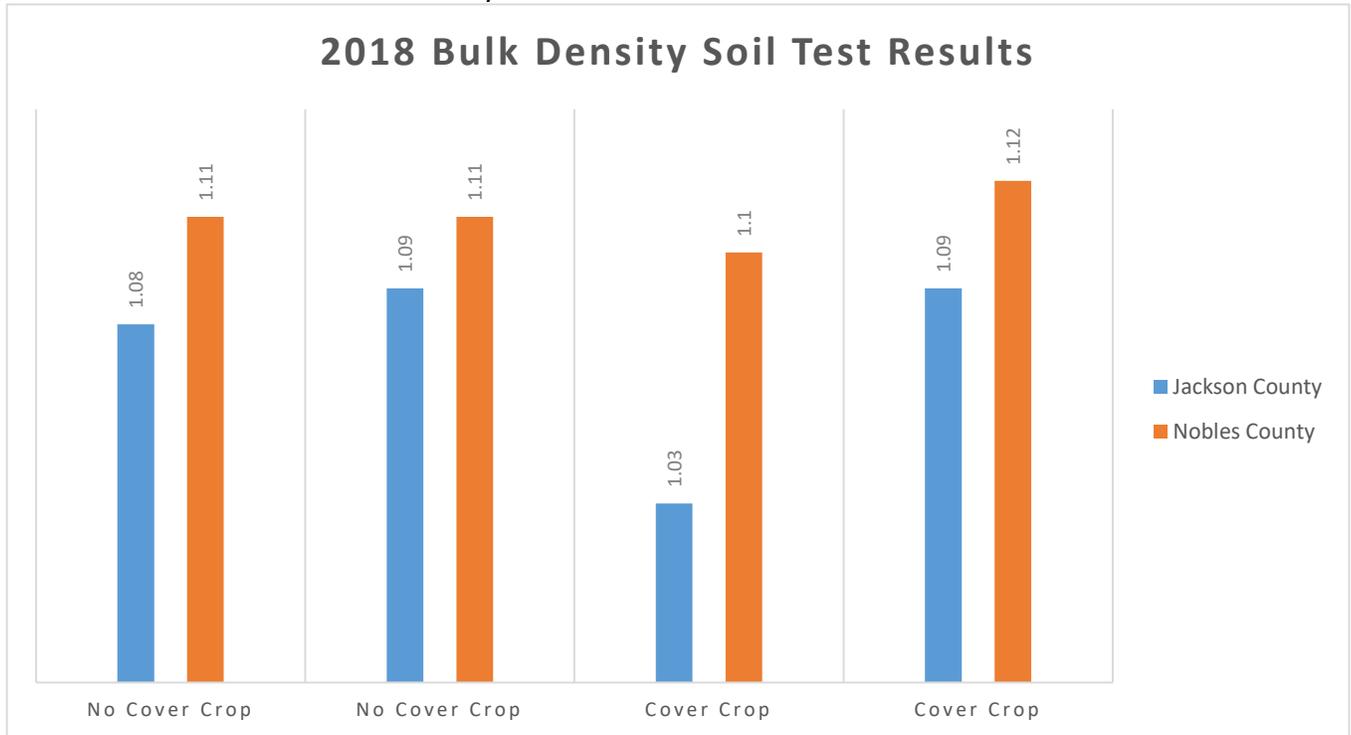
- What happened this year?
- What do you think affected your project results this year? Weather, market, etc.?
- Have there been any environmental benefits for your farm, community, watershed, etc.?
- Has this project reduced or made better use of non-renewable resources? How?
- Has this project reduced input costs, improved markets or increased income? How?
- How are these changes affecting your quality of life and that of your family?
- What did not work that you expected to work? Why do you think it didn't work? How will you change what you were doing?
- For marketing projects: What was your market research? How was it done? Who were your customers for your products? How did they react to your project, products, etc.?

Extended Ag collected spring soil samples on May 30, 2018. The samples were sent to Minnesota Valley Testing Labs to be analyzed for pH, Organic Matter, Phosphorus, Zinc, and Potassium. Multiple soil samples were collected in each field plot to accurately demonstrate soil characteristics in each plot. These samples will be used to show any significant changes in the soil over the grant duration between a cover crop versus a non-cover crop management.

The HLWD conducted infiltration tests following harvest. The Nobles County field was frozen following harvest, so an infiltration test was only done on the Jackson County field plots. The cover crop field had three inches per hour and the non-cover crop field had less than one inch per hour. The

results determine that infiltration is better in the cover crop/strip till management than in the non-cover crop/conventional tillage management system.

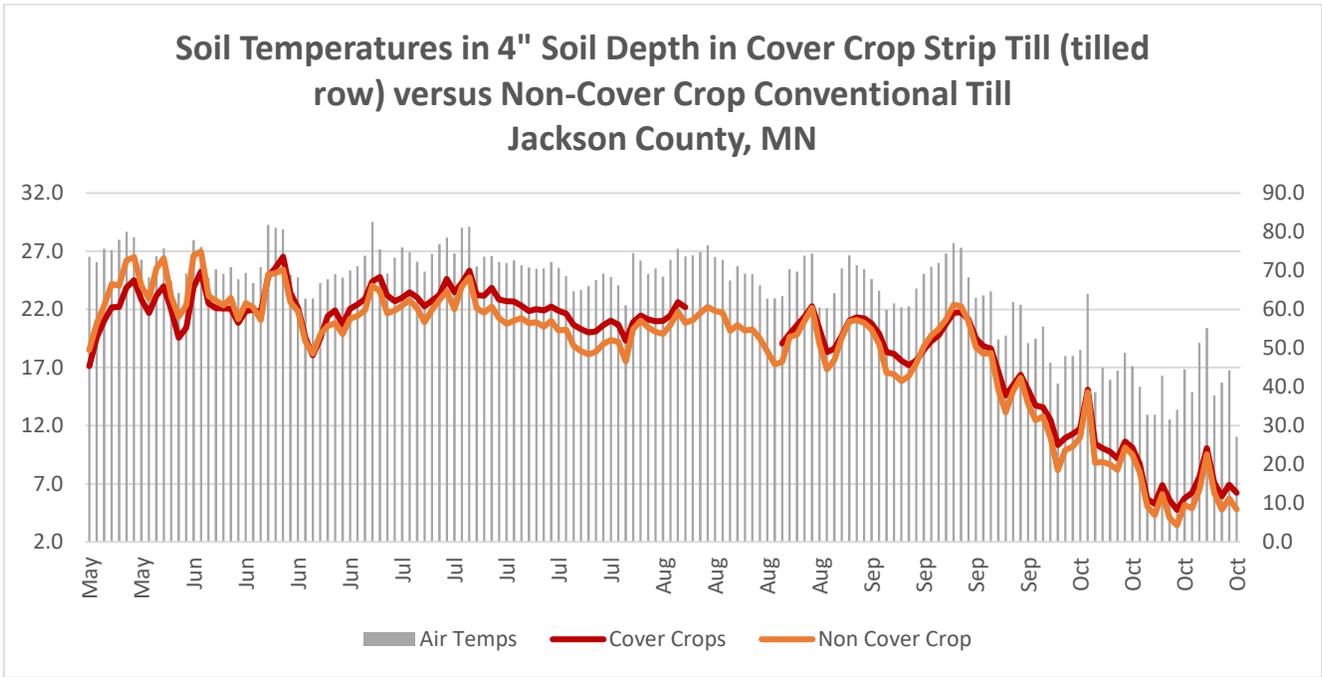
Bulk density soil samples were collected December 3 and December 7, 2018. The data didn't show any correlation between cover crop and non-cover crop managements. Bulk density will continue to be collected over the grant duration to determine if any changes are record. The 2018 bulk density results for Jackson and Nobles County are as follows:



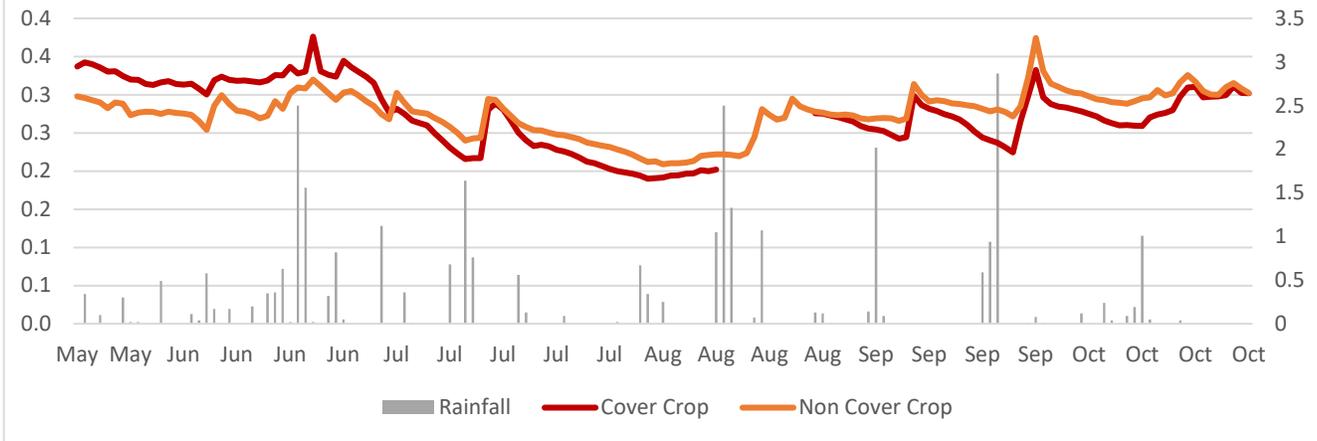
Soil temperatures and soil moisture were collected at all four test plots starting in late May 2018, following planting. Soil probes were placed in the ground at 4" and 8" depths. All soil readings were collected at 15 minute intervals. Rainfall and air temperature was also recorded at each test plot. Below are the Jackson County results:

2018 Jackson County Soil Moisture Monthly Averages			
		Non-Cover Crop/Tillage	Cover Crop/Strip Till
4" Soil Probe Depth	May	0.28	0.32
	June	0.29	0.32
	July	0.26	0.24
	Aug	0.25	0.23
	Sept	0.29	0.27
	Oct	0.30	0.28
	Nov	0.30	0.26
	Average	0.28	0.27
8" Soil Probe Depth	May	0.35	0.33
	June	0.34	0.35
	July	0.32	0.31
	Aug	0.31	0.31
	Sept	0.34	0.33
	Oct	0.33	0.25
	Nov	0.27	0.25
	Average	0.32	0.30

2018 Jackson County Soil Temperatures Monthly Averages (°C)			
		Non-Cover Crop/Tillage	Cover Crop/Strip Till
4" Soil Probe Depth	May	21.57	20.18
	June	22.52	22.35
	July	21.19	22.46
	Aug	20.00	20.68
	Sept	17.10	17.74
	Oct	7.22	8.12
	Nov	3.78	3.38
	<b>Average</b>	<b>16.20</b>	<b>16.42</b>
8" Soil Probe Depth	May	19.52	18.68
	June	21.41	21.56
	July	20.55	22.49
	Aug	19.49	20.77
	Sept	17.20	18.02
	Oct	8.19	8.83
	Nov	4.93	4.56
	<b>Average</b>	<b>15.90</b>	<b>16.41</b>



### Soil Moisture in 4" Soil Depth in Cover Crop Strip Till (tilled row) versus Non-Cover Crop Conventional Till Management Jackson County, MN



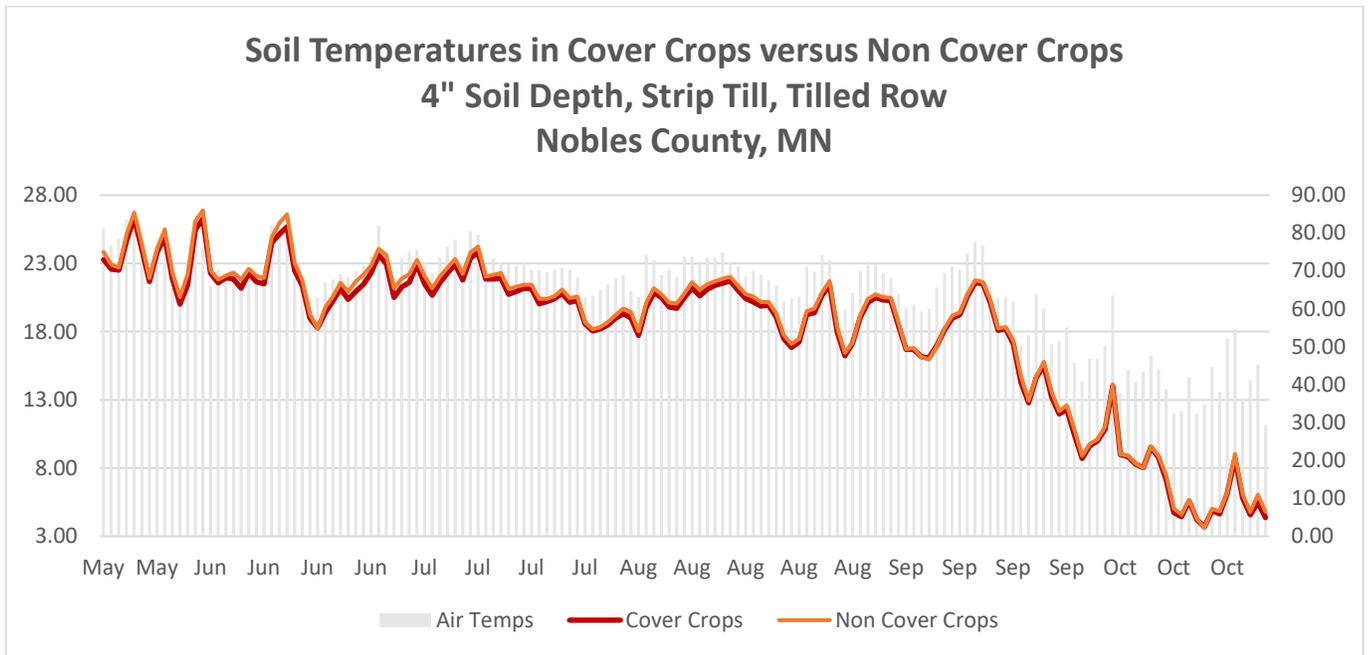
The 2018 Jackson County soil temperatures, on average, were cooler in the non-cover crop conventional tilled field versus the cover crop/strip till field throughout the entire growing season. Over the entire growing season, there was more soil moisture in the conventional till/non-cover crop field versus the cover crop/strip-till field. 2018 was a very wet year for southwest Minnesota and having a cover crop with strip till management showed to be a benefit throughout the wet growing season.

In the Nobles County test plots, tillage management is exactly the same. The only difference is cover crops versus non cover crop. The 2018 data showed the same amount of moisture early in the growing season and slightly more moisture in the cover crop field throughout the entire season. Temperatures were very similar in May and June but the cover crop field showed a slightly cooler reading early in the growing season. Throughout the whole growing season, the non-cover crop field had warmer temperatures on average.

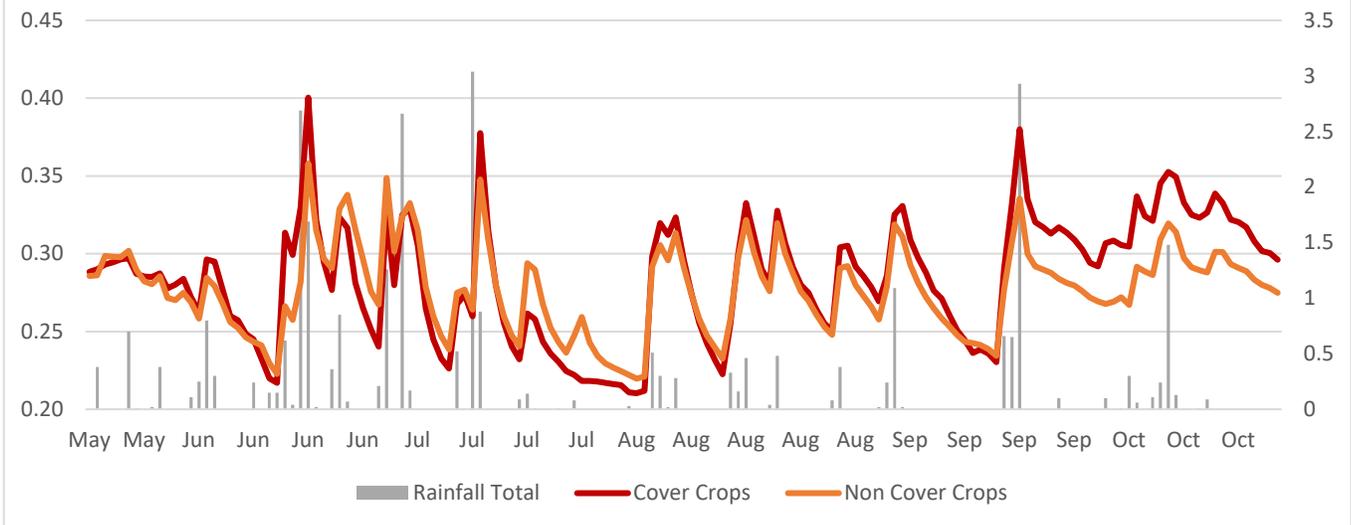
**2018 Nobles County Soil Moisture Monthly Averages**

		Non-Cover Crop/Strip Till	Cover Crop/Strip Till
<b>4" Soil Probe Depth</b>	<b>May</b>	0.29	0.29
	<b>June</b>	0.28	0.28
	<b>July</b>	0.27	0.26
	<b>Aug</b>	0.27	0.28
	<b>Sept</b>	0.28	0.29
	<b>Oct</b>	0.29	0.32
	<b>Average</b>	<b>0.28</b>	<b>0.29</b>
<b>8" Soil Probe Depth</b>	<b>May</b>	0.31	0.32
	<b>June</b>	0.32	0.32
	<b>July</b>	0.34	0.31
	<b>Aug</b>	0.29	0.30
	<b>Sept</b>	0.30	0.31
	<b>Oct</b>	0.31	0.32
	<b>Average</b>	<b>0.31</b>	<b>0.31</b>

2018 Nobles County Soil Temperatures Monthly Averages			
		Non-Cover Crop/Strip Till	Cover Crop/Strip Till
4" Soil Probe Depth	May	23.99	23.63
	June	22.59	22.10
	July	21.23	20.88
	Aug	19.93	19.63
	Sept	16.82	16.64
	Oct	7.09	6.93
	<b>Average</b>	<b>18.61</b>	<b>18.30</b>
8" Soil Probe Depth	May	21.52	21.89
	June	21.48	21.43
	July	20.73	20.62
	Aug	19.53	19.44
	Sept	16.91	16.79
	Oct	7.93	7.52
	<b>Average</b>	<b>18.02</b>	<b>17.95</b>



### Soil Moisture in Cover Crops versus Non Cover Crops 4" Soil Depth, Strip Till, Tilled Row Nobles County, MN



To conclude the first year, the data showed there was bigger difference in tillage practices when it came to soil moisture and soil temperatures than in cover crops versus non cover crop same tillage management. In the early growing season, readings showed that conventional tilled soils were warmer and drier. 2018 was a very wet year and this year's project showed that cover crops had less moisture, due to better infiltration throughout the entire growing season. The non-cover crop/conventional tilled field held on to rainfall and moisture longer and kept soil temperatures cooler than in the cover crop/strip till fields. All data will be used to compare the coming years. More data will show a clearer picture of what is happening in the soil profile.

#### D. MANAGEMENT TIPS

- List three management tips or pieces of advice that you would share with other farmers. 2018 will be a year for comparison in our area with late spring snows to continuous moisture throughout the year (20 inches of rain in June) and much more the rest of the summer and fall. Since we are studying moisture and temperature with the use of cover crops, a few items were noticeable early in the season. Our soils were warmer in early spring compared to the soils with tillage. The second item was that after a 1 3/4 in rain, our moisture levels at four inch and eight inch depths were the same. The comparison on the tilled field was the same at the four inch level, but at eight inches it was significantly higher. This would indicate a hard pan just below tillage depth. Our soils from previous one-hour water infiltration tests had shown we could handle 11 inches of rain in an hour without water standing on the surface. The cover crops have appeared to break up any hard pan from previous tillage. In retrospect, it would have been nice to have a third moisture probe, at approximately the 24 inch level, to compare how much moisture is getting into deeper levels to be stored when conditions turn dry for the following crop to use.

#### E. COOPERATORS

- Jerry and Nancy Ackermann own the property in Jackson County on which the cover crop research will be conducted. Address: 39750 820<sup>th</sup> Street, Lakefield, MN 56150. Phone: 507-662-5584.
- Kevin Schmid owns the property in Jackson County on which the non-cover crop research will be conducted. Address: 32804 780<sup>th</sup> Street, Worthington, MN 56187. Phone: 507-360-2851.
- Bruce Leinen owns the property in Nobles County on which the cover crop and non-cover crop research will be conducted. Address: 14213 Palm Avenue, Fulda, MN 56131. Phone: 507-360-5997.
- Andy Nesseth, Extended Ag Services, Inc. will collect soil and tissue samples and assist with data interpretation. Address: 507 Milwaukee Street, Lakefield, MN 56150. Phone: 507-662-5005.
- Jan Voit, HLWD, will assist with grant administration and the field day. Address: PO Box 345, Heron Lake, MN 56137. Phone: 507-793-2462.
- Catherine Wegehaupt, HLWD, will assist with data collection, infiltration testing, data interpretation, and the field day. Address: 1567 McMillan Street, Worthington, MN 56187. Phone: 507-376-9150, extension 111.

#### F. PROJECT LOCATION

- Ackermann: 5 ¼ miles west of Lakefield, Minnesota on Jackson County Highway 14 (820<sup>th</sup> Street) and ¼ mile north on the west side of the road.
- Schmid: 5 ¼ miles west of Lakefield, Minnesota on Jackson County Highway 14 (820<sup>th</sup> Street) and ¼ mile south on the west side of the road.
- Leinen: 3 miles south of Fulda, Minnesota on Highway 59, 1 ¼ miles west on Nobles County Highway 18 (120<sup>th</sup> Street), south side of road.

#### G. OTHER RESOURCES

List any information resources you think are useful and would recommend.

- Resources we have used heavily are “Managing Cover Crops Profitably” through SARE, No-Till Farmer magazine, Farm Journal magazine, and many more farm publications.

Name: \_\_\_\_\_

## SECTION II. 2018 – SUMMARY OF PUBLIC INFORMATION ACTIVITIES

Year of Project: (Indicate which number of years)       1      2      3

Final year?    Yes or  No

Did you solicit any radio, newspaper, or television reporting on your project? If yes, please elaborate.

Number of: Newspaper articles: \_\_\_\_\_ TV Reports: \_\_\_\_\_ Radio Reports: \_\_\_\_\_ about your project.

***If this is the final year of your project:***

Date of Your Field day: \_\_\_\_\_

What did visitors see/learn?

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What was the weather like? \_\_\_\_\_

How many people attended? \_\_\_\_\_

Was this a good time of year for a field day on your project topic? Why/why not?

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Total number of people that visited your project this year: \_\_\_\_\_

What do you think would help reach more people with information about your project?

***Please include copies or citation of any news clippings, program bulletins, or information about any radio or coverage about your project.***

Name: \_\_\_\_\_

### SECTION III. 2018 BUDGET

How did you spend the grant money this year? List your actual expenses for this year. An accurate and complete accounting of all eligible project expenditures will benefit both you and us. We are not attempting to regain unspent funds at this time. We realize that you will incur unexpected or future expenses as the project continues and will work with you. **\*\*\*Please explain any major changes (greater than 10%) to your budget categories.** (EX: In original budget, you have \$750 in 2018 for Analysis, but you only spent \$75 on Analysis and moved \$675 to Personnel Salaries – why?) MAJOR BUDGET CHANGES need to be PRE-APPROVED by the Grant Coordinator.

Item	Funds Spent in 2018	Amount Budgeted for 2018 <sup>1</sup>
<b>1. Analysis</b> (soil, plant, water, manure, nutritional value, statistical, etc.)		
a.	\$ 1,340.00_____	\$ 1,840.00_____
b.	\$ _____	\$ _____
c.	\$ _____	\$ _____
<b>2. Consultant(s), Subcontractor(s), Bookkeeping</b> (administration, technical assistance, analysis, etc.)		
a.	\$ 800.00_____	\$ 800.00_____
b.	\$ _____	\$ _____
c.	\$ _____	\$ _____
<b>3. Personnel Salaries</b> (Time/labor - Only labor directly related to grant activities over and above time spent on normal farm operations.)		
a.	\$ 200.00_____	\$ 200.00_____
b.	\$ _____	\$ _____
c.	\$ _____	\$ _____
<b>4. Supplies and Materials</b>		
a.	\$ 7,346.18_____	\$ 7,308.00_____
b.	\$ _____	\$ _____
c.	\$ _____	\$ _____
<b>5. Use of Farm Equipment</b>		
a.	\$ 0.00_____	\$ 0.00_____
b.	\$ _____	\$ _____
c.	\$ _____	\$ _____
<b>6. Outreach</b>		
a.	\$ 0.00_____	\$ 0.00_____

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<sup>1</sup>List the amount you budgeted for 2018 in your original or amended grant agreement. Contact us if you need help finding these amounts).

b. \$ \_\_\_\_\_ \$ \_\_\_\_\_

(continued on next page)

**7. Communications** (telephone, faxes, mail)

a. \$ 0.00 \_\_\_\_\_ \$ 0.00 \_\_\_\_\_

b. \$ \_\_\_\_\_ \$ \_\_\_\_\_

c. \$ \_\_\_\_\_ \$ \_\_\_\_\_

**8. Travel**

a. \$ \_\_\_\_\_ \$ \_\_\_\_\_

b. \$ \_\_\_\_\_ \$ \_\_\_\_\_

c. \$ \_\_\_\_\_ \$ \_\_\_\_\_

**9. TOTALS (Add Items 1 thru 8)**

**\$ 9,686.18** \_\_\_\_\_ **\$ 10,148.00** \_\_\_\_\_

#### **SECTION IV. FINAL YEAR REPORT**

**Answer the following questions ONLY if this was the FINAL YEAR of your project.** Use as much space as you need to.

**a.) In your opinion, what should be done to follow up on the system you experimented with so that it could be adopted by Minnesota farmers?** What kind of additional research is needed? What kinds of modifications should be made to make the system more practical?

**b.) Do you intend to continue these practices on your farm now that the grant project has ended?** Why or why not?

**c.) Would you recommend this system to other farmers?** Why or why not?

**d.) What kind of impact has your project had on your others?** For example, do you know of other farmers who have adapted this system in their farm operations after seeing or hearing about your demonstration? Do you sense a shift in attitude of your neighbors/visitors about the system you worked on?

