NCR-SARE Farmer Rancher Grant Program
Final Report Form

Please fill out the final report form and return it to the North Central Region (NCR) Sustainable Agriculture Research and Education (SARE) Office by your project end date. For 2009 projects, the end date is March 31, 2012. The report may be prepared on a computer or handwritten (please write or print clearly). The final payment of your grant will be awarded when the final report and final budget are received and approved.

I. PROJECT IDENTIFICATION

- Name: DAVID BRANDT
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- Project Title: **Using Oilseed Radish as Biological Plow to Reduce Soil Compaction and Recycle Nutrients.**
- Project Number: FNC08- **FNC09-708**
- Project Duration: 1 year
- Date of Report:

II. PROJECT BACKGROUND

1. Briefly describe your operation (i.e. how many acres, what crops, types of cropping systems, type of livestock or dairy production, grazing systems, family operation, etc.)

Our farm operation consists of 798 acres of land for corn, beans, and wheat, and 10 acres for producing vegetables. Soils in our farm are Carbington – Benington - Alexandra associations, which are deep, rolling, and heavy clayey in texture. The soil pH is ranged 6.4 to 7.3 with an average of 2.5% soil organic matter content.

Like any other farmers, I was very much interested to follow integrated management systems using cover crops as source of biomass, nutrients, and bio-physical plow on my NT field to break-up compaction and improve soil quality to support the sustainable agriculture in Ohio. Presently, we use continuous no-till with the use of a variety of cover crops..

2. Before receiving this grant, did you carry out any sustainable practices? If so, briefly describe what they were and how long you had been practicing them.

Started no-till in 1971, we used some cover crops on small scale since 1978. Our preferred crop rotation is corn-bean-wheat. However, wheat to corn rotation had trouble getting good stands. Onwards from 1978, I have been using sustainable practices with different organic amendments especially cover crops in continuous no-till for growing grain crops to improve my soil health and improve farm profitability. We are using Austrian winter peas, cereal rye, hairy vetch, radish, etc. as cover crops in continuous no-till corn-soybean-wheat rotation with minimum input of nitrogen

fertilizer and herbicides.

III. PROJECT DESCRIPTION AND RESULTS

This is the core of the report. Consider what questions your neighbors or other farmers or ranchers would ask about what you did with this grant. Describe how you planned and conducted your research, demonstration, or education project to meet your goals and discuss the results.

I used mixed cover cropping with Austrian winter peas (N source), oilseed radish (biological plow) and cereal rye (weed suppressor) as biomass provider, nutrient recyclers, and N source for NT grain crops, and bio-physical plow to reduce soil compaction of my farm.

GOALS

By researching "economically viable and environmentally manageable" farming practices under continuous NT, My GOALS were to demonstrate the effective use of cover crops to break-up soil compaction as a biological plow and recycle nutrients thru N rich labile biomass for crops. Specific objectives of my research were to:

(1) Evaluate the effects of mixed cover crops (oilseed radish and winter peas) for biomass N contribution for succeeding grain crops (reduce input costs)

(2) Measure the biological and physical effects of cover crops especially oilseed radish on reducing soil compaction

(3) Evaluate the impact of cover crops biomass and N contribution on soil quality

(4) Promote the research findings in on-farm trial to state regulators, county Extension Educators, and local farmers.

PROCESS

Describe the steps involved in conducting the project and the logic behind the choices you made. Please be specific so that other farmers and ranchers can consider what would apply to their operations and gain from your experiences.

I used the NC SARE grant money to set-up field experiments on my farm with the help and advice of researchers from the OSU research and Extension. A total of five treatments arranged in randomized complete design were laid-out in the field in 150 ft x 300 ft long replicated plots with a 10 ft wide buffer strip between plots. My long-term experimental treatments were:

(1) Conventional tillage (CT) corn-soybean rotation: The CT plots were received 150 lbs N/ac from UAN for corn and 50 lbs N/ac for wheat. Phosphorus (P), potassium (K), herbicides were applied based on soil tests. This was one of my control treatments.

(2) No-till (NT) corn-soybean rotation: The NT plots were received 150 lbs N/ac from UAN for corn and 50 lbs N/ac for wheat. P, K and herbicides will be applied accordingly. This was also one of my control treatments to evaluate the effects of transitional NT on creating soil compaction.

(3) NT corn-soybean-wheat rotation with oilseed radish and cereal rye as cover crops: After harvesting wheat, oilseed radish was planted in late July and allowed to be winter-killed. Corn was

planted in following spring within winter killed oilseed radish residues with 150 lbs of N/acre. The P and K were applied to corn. Immediately after harvesting corn, cereal rye was planted followed by rolling-over of rye in the late April. After 1 week, soybean was planted within rye residues. Winter wheat was planted after harvesting soybeans followed by oilseed radish after harvesting wheat.

(4) NT corn-soybean-wheat rotation with winter peas and cereal rye as cover crops: After harvesting wheat, winter peas were planted in late July and allowed to be winter-killed. Corn was planted in the following spring within the winter killed pea residues without any N fertilization. It was expected that required amount of N for corn will be released from decomposition of winter pea residues. The P and K were applied to corn. Immediately after harvesting corn, cereal rye was planted followed by rolling-over of rye in the late April. After 1 week, soybean was planted within rye residues. Winter wheat was planted after harvesting soybeans followed by winter peas after harvesting wheat.

(5) NT corn-soybean-wheat rotation with oilseed radish, winter peas and cereal rye as cover crops: After harvesting wheat, oilseed radish and winter peas were planted in late July in alternate rows, and allowed to be winter-killed. Corn was planted in the following spring within the winter killed pea residues with only 50 lbs of N/acre. It was expected that remainder of the N for corn will be released from decomposition of winter pea residues. The P and K were applied to corn. Immediately after harvesting corn, cereal rye was planted followed by rolling-over of rye in the late April. After 1 week, soybean was planted within rye residues. Winter wheat was planted after harvesting soybeans followed by winter peas after harvesting wheat.

However, this spring (at the initiation of the experiment), I had 8 different covers (oats, cereal rye, oilseed radish-drilled, buckwheat, hairy vetch, alternating rows of Austrian winter peas and oilseed radish, cowpeas, newlon peas, and Austrian winter pea) into which I planted corn with a White planter on April 27th. Corn emergence was evaluated and that information is found on the yield data sheet attached. A chlorophyll meter was used to determine the amount of nitrogen to be applied for all covers. Leaf tissue samples were sent to a lab to evaluate available nitrogen for use to compare with meter readings. I applied nitrogen according to recommendations of the meter and lab results. The corn was harvested in late October with Gleaner R62 combine using yield monitor with GPS to record data.

Before the planting each cover, soil samples were collected to determine initial soil properties including pH, organic matter, total N, soil compaction and porosity, water holding capacity. I had a soil bulk density, penetration resistance, and compaction reading taken. There was a check for earthworms with the most worms found in soils of radish and winter peas planted in alternating rows. I am attaching the soil quality information from some of the covers.

The SARE funds were used to but cover crop seeds, get special plates for White planter, lab fees for meter reading, soil samples and tissue tests, large picture poster display for field days, twilight tour, and speaking engagements, postage for flyers sent to No-till on the Plains and other organizations to tell about the results (See attached expenditure).

PEOPLE

List other farmers, ranchers, or businessmen who assisted with the project and explain how they were involved. List any personnel from a public agency, such as the Extension Service, NRCS, or Soil and Water Conservation Districts who may have assisted with this project.

Organization	Name	Activities
Fairfield county SWCD	Dave Hippen	Plan Field day
State NRCS	Mark Scarpotti	Plan Field day
Ohio State University	Randall Reeder	Penetration resistance
Ohio State University	Kenan Barik	Soil compaction
OSU South Centers	Rafiq Islam	Data organization/analysis
OSU South Centers	Yogi Raut	Soil/plant analyses
AGCO	Larry Mayer	Machinery dealer/Planter adjustment

RESULTS

What results did you achieve and how were they measured? For production projects, include yields, field analysis, and related data. How do these compare with conventional systems used previously? For education projects, include outcomes achieved and how you measured them through surveys, attendance, or other methods (if appropriate). Were these results what you expected? If not, why? What would you do differently next time? (Use as much space as necessary to answer the questions. You are not restricted to the space on this form.)

The information for corn yield data and return per plot is on the attached 2009 data sheet. I have learned that oats, rye, and buckwheat control soil erosion and build soil tilth but did not retain/recycle nutrients sufficiently to lower fertilizer input costs.

With radish and Austrian winter peas alternating rows, I found that N-P-K stored for the next crop significantly reduced the fertilizer needed. This was determined by taking soil samples and sending plants to be evaluated for nutrients (see attached chart: Recycling of nutrients by oilseed radish). We have found that radish and winter peas grow more vigorously when planted in alternating rows due to their synergistic effects. Radish obtained some N from peas to grow deeper and bigger and peas used radish as mechanical support to grow better for greater biological N fixation. Oilseed radish was found to be cracked the compacted soil layers and moved the soil upward to reduce soil compaction, improve drainage, and support earthworms and microbial diversity. Results are presented below in pictures, charts, and tables to summarize the multiple benefits of cover crops in continuous NT cropping systems:

Table 1: Biomass production of oilseed radish and Austrian winter peas

Growth	Oilseed radish		Winter peas
	w/peas	wo/peas	
Root dia. (in)	2 ¾	2	---
Root length (in)	22	12	7
Fresh biomass (t/a)	40	56	21.6

Dry biomass (t/a)	3.5	4.8	4.3
Nitrogen contribution	132	181	181 (N fixation)

Table 2: Nutrient recycling by oilseed radish biomass (Average of 4.8 tons dry-matter/acre)

Nutrient element	Concen. (%)	Content (lbs)	Release in 1st year (lbs/acre)
Nitrogen	1.89	181	127
Phosphorus	0.97	93	65
Potassium	1.27	122	85
Sulfur	0.81	78	55
Calcium	1.17	112	78
Magnesium	0.26	25	18

Table 3: Soil quality properties influenced by cover crops

Cover crops types	*p*b (g/cm3)	Tp (%)	Active C (mg/kg)		TN (%)	TC (%)	SMB (mg/kg)	BR mg/kg/d	AS (%)	Soil quality
Radish	1.46	44.9	694.0	0.29	2.83	490.2	18.6	49.9		Good
Winter pea/radish	1.53	42.1	751.7	0.24	2.45	546.5	18.7	46.5		Good
Hairy Vetch	1.65	37.8	729.9	0.18	1.82	351.6	20.4	39.7		Good
Oats	1.62	38.7	697.6	0.20	2.07	732.2	21.2	50.7		Good
Winter pea	1.65	37.9	665.3	0.19	1.93	577.1	22.9	35.0		Good
No cover	1.65	37.8	635.9	0.15	1.41	336.0	23.5	30.7		Fair

*p*b=Soil bulk density, Tp=Total porosity; TN=Total nitrogen, TC=Total organic carbon, SMB=Soil microbial biomass, AS=Aggregate stability, and SQ=Soil quality

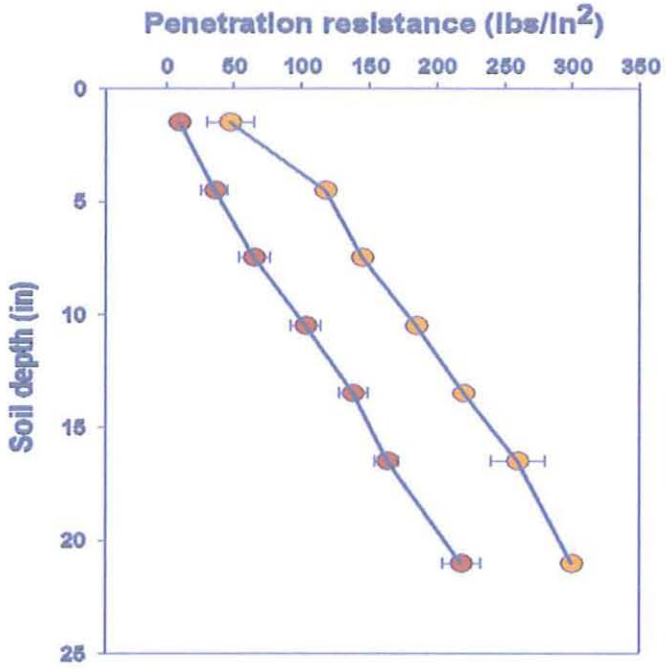

Fig.1: Soil penetration resistance (compaction)

I have a late summer plot repeating the covers used this first year and have added a plot evaluating 10 different radish covers and chickling vetch. Starting September 15 through October 15 a plot was started planting every 2 weeks: Austrian winter peas with alternating rows of radish to evaluate late fall growth and see if they over winter. Another plot has 8 varieties of vetch and 2 varieties of crimson clover. These will all have late winter soil tests and nitrogen studies for corn crop 2010. They were funded by grant monies.

DISCUSSION

What did you learn from this grant? How has this affected your farm or ranch operation? Did you overcome your identified barrier, and if so, how? What are the advantages and disadvantages of implementing a project such as yours? If asked for more information or a recommendation concerning what you examined in this project, what would you tell other farmers or ranchers?

- Learned about different types of cover crops and how they respond to different soil management practices in NT crop rotation.
- Oilseed radish and Austrian winter pea combination were found excellent summer cover crops mix if planted after harvesting wheat in a corn-soybean-wheat rotation.
- They can be winter-killed, produced ~ 5 tons of dry-matter per acre, and are efficient to fix N and recycle nutrients. On average, oilseed radish reduced compaction by >40% at 0 - 30 inches soil depth.
- Mixing covers can improve benefits like extended green cover as living mulch, lower soil loss, higher crop yields, and reduce input costs.

My recommendations will be change from having small acreage and having 1/3 operation in NT with cover crops. Use radish/peas (@ 2 lbs and 25 lbs) before planting corn; 15 in row of rye before beans.

V. PROJECT IMPACTS

Evaluate the economic, environmental and social impacts of your project by completing the benefits and Impacts form and Project Profile form. Also, if possible, provide hard economic data.

The economic impacts from using cover crops in continuous NT can:

1. Lower purchased inputs (fertilizers especially N) by more than 50%
2. Reduce herbicides by 30% by providing mulch to suppress weeds.
3. Improve soil quality
4. Increase crop yields by 10 to 15%

By using different combinations of cover crops (legumes and grass or non-legumes), farmers can reduce soil and nutrient loss, reduce input costs, and maintain good yields. By reducing chemicals use will help to improve air and water quality, and public health.

I was invited to several radio/TV talk shows to discuss about cover crops and NT in different meetings, states, and regions. Receive email and telephone calls regularly to deliver information about suitable cover crops in NT farming systems.

Farmers from different countries of Ohio, Illinois, Indiana, and Pennsylvania are regularly visiting our farm. Sixty seven (67) Canadian farmers from Quebec visited our farm to learn more about short-term summer and winter cover crops and their benefits in NT crop production.

NRCS trainees visited our farm to learn more about cover crops, soil quality, soil erosion, and compaction.

V. OUTREACH

What methods did you use for telling others about: 1. Your project, 2. Project events or activities, and 3. Project results?
How and to whom did you communicate this information? Be sure to include details on how many people attended field days or demonstrations, and how information was further disseminated by media covering any events. What plans do you have for further communicating your results? Include copies of press releases, news clippings, flyers, brochures, or publications developed during this project. Also enclose any photos or slides which might be helpful in telling your story to others.

I shared information about my project at the Ohio No-till field day in Radnor, OH. Using poster pictures as a visual aid and a shovel in the soil, I explained the information gathered from the plots on my farm. About 150 people attended from a Tri-State (IN, MI & OH) area. In late September, there was a twilight tour on the farm showing growing corn, soils pit and the cover

crop plots for 2010. Seventy people attended from 5 states with many practical questions and lots of interest. Many farmers and seed and fertilizer company representatives have visited the farm and plots for information and visual tours. Graduate students (foreign and local) from The Ohio State University and employees of SWCD, NRCS, EPA, and ODA have toured the farm along with Cisco seed representatives and a Texas A&M professor.

Several articles have been written in Successful Farming, Country Journal, The Ohio Farmer, AGCO Advantage and information and photos were included in the January-February 2010 issue of Resource, the magazine of the American Society of Agricultural and Biological Engineers.

I will be presenting at the National No-till Conference in Iowa, the No-till on the Plains Conference in Kansas, the Tri-State Meeting in Pennsylvania, the International Brookside Lab Meeting in Ohio, the Innovative Farmer Meeting in Michigan, the CTC Meeting in Ada, Ohio and there will be farm tours on the home farm. My farm is one of the demonstration sites using by the Ohio State University. In brief, we have:

- Conducted several twilight tours for local farmers
- Established demonstration plots at the OSU for Farm Science Review
- Spoke at 11 field days in Ohio, Pennsylvania, Kansas, and Indiana
- Hosted 45 Canadian farmers from Saskatchewan
- Held 2 field days with high attendance
- Conducted radio/TV interviews
- Wrote several magazine publications
- Motivated Ohio 85 farmers to plant oilseed radish in wheat
- Facilitated 16 Graduate students from OSU SENR to visit my farm

VI. PROGRAM EVALUATION

This was the seventeenth year North Central Region SARE sponsored a Farmer Rancher Grant program. As a participant, do you have any recommendations for the regional Administrative Council about this program? Is there anything you would like to see changed? Please fill out the Program Evaluation form.

My recommendations are:
1. SARE state coordinators should be involved more and more with the project.
2. Farmers/Ranchers grant recipient needs support to visit SARE funded projects in other states.

VII. BUDGET SUMMARY

Complete the Final Budget form and return it with your report. You will only be reimbursed for expenses incurred and items purchased for conducting your project. Final Expenses listed by budget category which significantly exceed the amounts in the proposal should be explained in a letter submitted with the final report.