

Diversification of Winter Wheat ' Beef Cattle Production fields Through Agroforestry ' Covercrop integration

Final Report for FS14-283

Project Type: Farmer/Rancher

Funds awarded in 2014: \$9,107.00

Projected End Date: 12/31/2017

Region: Southern

State: Oklahoma

Principal Investigator:

[Doug Ringer](#)

Farmer

Project Information

Abstract:

A two-year diversification project using agroforestry and cover crops was implemented in Mulhall, Oklahoma. The project purpose was to diversify the traditional winter wheat and beef cattle wheat system by utilizing agroforestry and cover crop components. Initial project results were presented at the 2016 Organic Oklahoma Conference and with a group of 4H students who were involved in cattle judging. The barriers to implementation include high labor cost of planting and watering permanent trees and the proper timing of cover crop planting. The agroforestry system shows promise for use but still needs work on better medium-term, high-value crops and pollinator habitat.

Introduction

Background of the problem

The problem that I am faced with as a producer is the need to conserve moisture and sustain yields. I have a smaller amount of acreage than most large scale producers so I need to maximize the value I get for the grain that I grow. I also want to see if I can diversify into other crops that will provide higher income per acre. I've attended the past five Oklahoma State University No-Till conferences. At these conferences I've learned more about the value of cover crops in building soil health. I want to utilize cover crops to conserve moisture. I've tried tillage radish as a cover crop in some of my fields but have been concerned that the cover crops may take up more moisture than they conserve. One of my concerns is how I can improve the fertility and management practices on my farm so that it sustainably provides income for me as I get older and for my sons who want to help me on the farm. We've talked about how to move away from commodity wheat and into specialty grains that bring higher economic return. In order to diversify though it is important to understand the available market and if I can get high enough quality product to meet the demand.

Literature Review

The beef cattle/winter wheat dual purpose system in central Oklahoma has developed into a reliable production system (Gadberry & Beck, 2013). Hard Red Winter wheat is planted from September to October, allowed to establish, and then beef cattle are introduced to the wheat fields to graze until before the boot (wheat growing point) emerges (Feb. 20 – March 15). The wheat plant will then continue to grow and produce grain to be harvested in the first two weeks of June. The producer can make a market driven decision at boot stage to remove cattle and produce grain if wheat prices are high, or allow the cattle to graze out the wheat and not harvest for grain if cattle prices are better. The system is useful because the times of growth are matched with the highest times of rainfall in Oklahoma. This system has its drawbacks which include low cattle and wheat prices and the difficulties of finding other options that still fit within the growing season like canola. Wheat production year after year has also allowed for higher and higher weed pressure which requires more chemical use (OCES, 2010). Other options are needed.

Sustainably maintain income

The common response to lower grain prices has been to get bigger as a producer. This means buying more land. This is not a good option for our farm because we are as big as we can get currently and on dryland. After reading the literature our response has been to try and get higher value for the crops we currently grow. I have tried canola, sorghum, and soybeans. The struggle I have is that our driest month in the summer growing season is in August. We have had drought for the past four years and so my soybean crop needs rain in August to develop fully. I just have not received sufficient rain during August. This is why the agroforestry option has looked promising (Shepard, 2013).

Cover crops

Utilizing cover crops have been encouraged by no-till researchers at OSU. They talk about the value of cover crops but caution that because of the moisture taken up by the cover crop it can lead often lead to low soil moisture in September when I normally plant wheat or canola. On the positive side for cover crops there are farmers who have seen positive benefits when they utilize a high biomass crop like Sorghum Sudan and then kill it. Brunetti (2013, p. 243-257) provides great examples of the practical considerations of biotic factors and microbial species interaction once there is enough cover on the soil to allow it to happen.

Here are some of the benefits of cover crops as described in the SARE handbook "Managing Cover Crops Profitably (3rd Ed., p. 9-11)

- *Cut fertilizer costs by contributing to Nitrogen and by scavenging and mining other soil nutrients*
- *Reduce the need for herbicides and other pesticides by smothering or restricting light to weeds & by exuding chemicals to inhibit weed growth.*
- *Improve yields by enhancing soil health by speeding water infiltration into the soil; relieving soil compaction, adding organic matter, enhancing nutrient cycling.*
- *Prevent soil erosion by holding soil in place, reducing crusting, and preventing raindrop to soil impact.*
- *Conserve soil moisture by reducing evaporation and increasing infiltration.*
- *Protect water quality by slowing erosion and runoff & taking up excess nitrogen to help reduce mobile nitrogen from flowing into the groundwater.*
- *Help safeguard personal health by reducing reliance on agrichemicals which is better for neighbors, family, and farm workers.*

There are also examples of cover crops as part of market farms - <http://www.cias.wisc.edu/wp-content/uploads/2003/09/covercrop09final.pdf> and these may have use in the infield hedge component of the hedgerow system. As we've looked through literature we've seen some useful tools like a decision making process for assessing the applicability of cover crops for an agroecosystem (SARE, 2012, p. 12-15). This is important as we move forward and make decisions about how to proceed.

Providing a beneficial insect habitat

To be more sustainable as a farm it is important to preserve pollinators. Beneficial pollinator habitat is not that difficult to encourage and has many benefits (Mader, Spivak, and Evans, 2010; Gliessman, 2015). In addition, if we are going to not use chemical and organic/natural production we need to encourage as many beneficial insects as possible. The benefits of agroforestry as a system is that it provides beneficial insect habitat throughout the field.

Developing alternative crops

The value of developing alternative crops in this area is that the Oklahoma City and Tulsa demand for locally sourced foods is growing. Sixty percent of the state's residents are located in these two urban areas and this trend is continuing. This is a great opportunity to use the agroforestry system as a way to produce smaller amounts of high value crops.

Build up soil organic matter

Agroforestry systems like the one envisioned in this project have a strong potential to improve organic matter when combined with cover crops (Wojtkowski, 2002; Magdoff & Van Es, 2009). When these are also combined with no-till wheat production then returning these soils to organic matter to 4 - 5 % is achievable (Moyer, 2011; Shepard, 2013).

Agroforestry as a practice

Agroforestry has been demonstrated to be feasible in places like Wisconsin (Shepard, 2013), and in other locales with higher rainfall (Univ. of Missouri, 2016). I've also seen examples of agroforestry alley cropping on videos from the University of Missouri Agroforestry Center and from what my son and I've been reading in Mark Shepard's book "Restoration Agriculture." I've not seen if agroforestry systems have been shown to be consistently viable yet in Oklahoma. There is a gap in the literature about this practice in Oklahoma in predominately winter wheat producing areas that this project can shed light on.

Bibliography citations supporting Literature review

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Project Objectives:

Objective 1

Set up two 10 acre agroforestry alley cropping sections in wheat fields.

Objective 2

Develop a more diversified approach to winter wheat production that encourages a mix of economically viable trees with insect trap crops in the hedgerow.

Objective 3

Provide beneficial insect habitat within the each of the 10 acre systems.

Objective 4

Develop production expertise for several alternative crops.

Objective 5

Use cover crops to build up soil organic matter.

Objective 6

Monitor any changes in wildlife presence at the two locations.

Cooperators

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Research

Materials and methods:

Materials

20 acres to be used for agroforestry

Tractor for planting

No-Till planter

Water bags

Used fence wire (calf or hog wire)

T posts

Methods

I propose that I set up two 10-acre agroforestry alley cropping sections of my wheat fields to track the results and see if I can develop a more diversified approach to winter wheat production that encourages a mix of economically viable trees with insect trap crops in the hedgerow. The hedgerows would follow the contour and be widely spaced so that a John Deere 7700 Harvester can fit down the row. One field site would be in more productive bottom land and the other field site would be in a field that is more marginal. These two sites range from the best of my wheat land to the poorest.

This solution fits within the focus areas of providing a beneficial insect habitat, developing alternative crops, develops the production expertise for several alternative crops, builds up soil organic matter, tests and potentially demonstrates a more sustainable way to grow winter wheat, and utilizes agroforestry as a practice.

Approach and Methods

In order to show that the solution works I will mark off control plots near the two treatment sections of the same size and track the same information. I'm going to track the economic costs and outputs. I'll also closely track the soil water content, soil fertility, changes in soil health, insect pests and beneficial insects, and time invested. My son has experience in setting up agronomic field tests so he will help

me set up and track the most important information for my own production purposes. We will also check with some of the agronomy professors at OSU who can provide additional insight into useful comparisons. My son will keep records of the most important data and we will regularly meet to walk the field tests to track the progress. I have several sources for small stature native fruit varieties that have potential for canning and commercializing using expertise from the Oklahoma Food and Agricultural Products Center (FAPC). Along with testing some older wheat varieties that have potential for locally grown flour production these native fruit varieties that can be grown in the hedgerow have the highest opportunity to offset the loss of production in the wheat field due to the area for the hedgerow.

Training Activities

This project was focused upon testing out a method and has been shared with the following groups.

- October 6, 2016 - OSU OKC - Organic Oklahoma Presentation - This presentation was in front of 45 attendees and focused upon on the results so far in the production. There were a mix of farmers and organic producers, OCES extension agents and specialists, and other USDA and foundation staff members.
- An additional presentation about the project was scheduled for Nov. 12, 2016 at the Oklahoma Farmers and Ranchers Association Annual Meeting. This meeting was cancelled but was one of the planned outlets to reach organic producers who were interested.
- A group of Logan County (Mulhall, OK is in Logan County) Crescent 4H and FFA high school students visited the Douglas Ringer Skyland Farm and Ranch location on April 4, 2017. This group was led by Christie Jenkins who is the Crescent, OK (in Logan County) FFA and 4H teacher. There were fifteen students in this group. The group focused on cattle judging practice and observed the cattle on winter wheat.

Proposed Timetable

#	Activity	Timeframe
1	Complete design and layout of the two sites & solicit input from OSU professors	February 15 - May 15, 2015
2	Purchase plant varieties and all equipment for monitoring the sites	May - June, 2015
3	Record pre-test site data and information to maximize educational impact	August 2015
4	Layout sites, set up soil moisture monitoring equipment, etc.	August 1 - September 1, 2015
5	Plant fields & hedge components during species specific planting times.	September 1 - October 15, 2015
6	Begin monitoring sites and continue.	October 15, 2015 - December 30, 2016
7	Work on grazing issue using electric fencing or other solution	Nov. 1, 2015 - February 15, 2016
7	Conduct initial field day for local farmers/FFA Students/OSU Agronomy Students	October 20, 2016
7	Harvest Wheat	June 1 - July 5, 2016
8	Plant summer cover crop	June 2 - July 5, 2016
9	Continue monitoring hedge and add additional income generating component.	June 1 - July 15, 2016
10	Plant fields	September 1 - October 15, 2016

11	Conduct 2 nd field day for local farmers/FFA Students/OSU Agronomy Students	October 20, 2016
12	2 year project end date and final report along with continuation plan	Dec. 20, 2016

Research results and discussion:

A two-year diversification project using agroforestry and cover crops was implemented in Mulhall, Oklahoma. The project purpose was to diversify the traditional winter wheat and beef cattle wheat system by utilizing agroforestry and cover crop components. Initial project results were presented at the 2016 Organic Oklahoma Conference and with a group of 4H students who were involved in cattle judging. The barriers to implementation include high labor cost of planting and watering permanent trees and the proper timing of cover crop planting. The agroforestry system shows promise for use but still needs work on better medium term high value crops and pollinator habitat.

Information was gathered from the Oklahoma State University Department of Horticulture and Landscape Architecture. OSU research concerning specialty crops and fruit trees have been useful in deciding what possible specialty crops could be used in the hedgerows. Another source of valuable information is the Noble Research Foundation which is developing a Center of Excellence for Small Farms which they call a focus on the household "Patio to 200 acres." The Kerr Center and Dr. David Redhage have conducted native pollinator research and also conducted research about the bio-organic method of organic production. Finally, Dr. Mike Gold was a great resource for Chinese chestnuts as a component within an agroforestry system. A visit in 2016 to the University of Missouri Center for Agroforestry - <http://www.centerforagroforestry.org/> provided valuable insight from Dr. Mike Gold about possible use of mushrooms and other options like PawPaw as a low maintenance fruit tree that is more robust than peaches and apples.

What has worked

Objective 1

Set up two 10-acre agroforestry alley cropping sections in wheat fields. These two 10-acre agroforestry sections were developed.

Objective 2

Develop a more diversified approach to winter wheat production that encourages a mix of economically viable trees with insect trap crops in the hedgerow. Use of insect trap crops needs more work to make a better fit. A use of variety of grain crops alternating in each alley way may be of use.

Objective 3

Provide beneficial insect habitat within each of the 10-acre systems. We have utilized a local beekeeper to provide additional income within organic production. In order to build local habitat, we planted pollinator mix in early spring in both the hedgerow between the planted hedge fruit and nut trees and along the field border.

Objective 4

Develop production expertise for several alternative crops. We are developing production expertise with oats harvested for local granola producers. We intend to build expertise in other crops.

Objective 5

Use cover crops to build up soil organic matter. With each winter wheat crop that is planted it is inter-sown with tillage radish. In the second year Bullseye radish was

planted.

Objective 6

Monitor any changes in wildlife presence at the two locations. Wildlife presence was monitored and Whitetail deer, turkey, and rabbits were noted. The deer and rabbit are a concern for peeling bark off of the fruit and nut tree's. The watering tree bags helped protect the saplings from rabbit predation. The rings of woven wire fence around each individual tree protects the tree from loss of bark to white tail deer. There are signs that the deer and turkey are bedding down in the hedgerow area. Maintenance of deer and turkey for hunting is an important multi-land use purpose for this area.

What has not worked

It looks like that there is a certain scale in which it is too time consuming to water hedgerow trees if there are too many acres. Part of this is also the cost of diversification in using different equipment depending upon the crop. The biggest problem currently is finding the right planter for the hedgerow shorter term crop. There is increased labor so that needs to be factored in.

#	Activity	Timeframe	Actual Activity / Milestones
1	Complete design and layout of the two sites & solicit input from OSU professors	February 15 - May 15, 2015	The design was completed and discussions were had over the design from February through June 2015. The important issue was to make sure the alley way area was wide enough for two passes of a 24-foot-wide header. The two sites had winter wheat planted on the sites and were not harvested till mid- June.
2	Purchase plant varieties and all equipment for monitoring the sites	May - June, 2015	Oats were planted at the end of June after winter wheat was harvested in the alley way.
3	Record pre-test site data and information to maximize educational impact	August 2015	Soil samples were taken in the two agroforestry sites and the two comparison sites.
4	Layout sites, set up soil moisture monitoring equipment, etc.	August 1 - September 1, 2015	The sites were laid out using survey equipment so that the hedge row alleys will follow contour. Soil moisture equipment was not installed because of the cost.
5	Plant fields & hedge components during species specific planting times.	September 1 - October 15, 2015	Winter wheat was planted after the oats were to be harvested. The weed issue prevented us being able to harvest and sell so we mowed the oats down. The best time for planting the fruit trees is during dormancy so fruit tree seedlings were purchased and planted in October. This mix of trees included apples, pears, apricots, and peaches.
6	Begin monitoring sites and continue.	October 15, 2015 - December 30, 2016	An initial survey of wildlife was done to establish a baseline for what wildlife were present on the sites.
7	Work on grazing issue using electric fencing or other solution	Nov. 1, 2015 - February 15, 2016	Began working on the grazing issue in order to have mob grazing after each season. Additional trees were planted. Chinese chestnuts were planted to supplement the fruit trees that were planted during the previous fall.
7	Conduct initial field day for local farmers/FFA Students/OSU Agronomy Students	October 20, 2016	Instead of the initial field day we presented at the October 6, 2016 - OSU OKC - Organic Oklahoma Presentation - This presentation was in front of 45 attendees and focused upon on the results so far in the production.
7	Harvest Wheat	June 1 - July 5, 2016	Winter wheat was harvested.
8	Plant summer cover crop	June 2 - July 5, 2016	Soybeans were planted in the summer. The summer had little rainfall so the soybeans died out and harvest was very poor.
9	Continue monitoring hedge and add additional income generating component.	June 1 - July 15, 2016	The fruit trees were watered at least once a week during the summer using Dewitts 20 Gallon tree bags. The additional income generating component is sunflowers. The difficulty for planting in the hedgerow is having a planter small enough to not encroach too far in the alleyway.

10	Plant fields	September 1 - October 15, 2016	Winter wheat was planted again in the alley ways.
11	Conduct 2 nd field day for local farmers/FFA Students/OSU Agronomy Students	October 20, 2016	Because of slower results than anticipated the field day for local FFA students was moved to April 2017. That field day was combined with a cattle judging practice and was conducted on April 4, 2017.
12	2-year project end date and final report along with continuation plan	Dec. 20, 2016	The actual project end date was March 15, 2017. Although the project is ended additional work will be done over the following year to continue to improve the components within the agroforestry system.

Participation Summary

Educational & Outreach Activities

PARTICIPATION SUMMARY:

Education/outreach description:

I will tell producers, extension staff, and researchers about the progress and results of the project through having two field days where local farmers, the local FFA chapter, and extension staff are invited to attend. I will work with the Logan County extension staff member to conduct the field days. I will also write a report on the data I gather along with pictures that can be used by the appropriate professors at Oklahoma State University and cooperative extension. If the results are promising I will continue the project and look to expanding it to other fields that I farm. The results will tell me if I have a viable method of producing grain crops in a more sustainable manner that is more reliant on natural methods of soil fertility and makes me less reliant on chemical fertilizers and insect control. My farm location is 6 miles southwest of Highway 51 and Interstate 35 and therefore provides a convenient location for interacting with other farmers and extension staff who go to OSU.

The outreach plan includes the following Training Activities:

- October 6, 2016 - OSU OKC - Organic Oklahoma Presentation - This presentation was in front of 45 attendees and focused upon on the results so far in the production. There were a mix of farmers and organic producers, OCES extension agents and specialists, and other USDA and foundation staff members.
- An additional presentation about the project was scheduled for Nov. 12, 2016 at the Oklahoma Farmers and Ranchers Association Annual Meeting. This meeting was cancelled but was one of the planned outlets to reach organic producers who were interested.
- A group of Logan County (Mulhall, OK is in Logan County) Crescent 4H and FFA high school students visited the Douglas Ringer Skyland Farm and Ranch location on April 4, 2017. This group was led by Christie Jenkins who is the Crescent, OK (in Logan County) FFA and 4H teacher. There were fifteen students in this group. The group focused on cattle judging practice and observed the cattle on winter wheat.

- Farmer Adoption

I do not have any evidence yet that this has impact yet for practice on other farms. A post-event evaluation was not conducted. It is planned that interaction with Oklahoma Farmers and Ranchers Association (OFRA) will help share more information about the project and the agroforestry system as implemented in Oklahoma.

Project Outcomes

Project outcomes:

Approximately 45 people were trained. Tests were not given out. There are not any demonstrable impacts with other producers yet. During the following year contact has been made with the Logan County extension educator to host another field day in 2017. The Oklahoma Farmer and Rancher's Association has biweekly emails that provide information. This will be used to share information about the project and have more impact.

Recommendations:

Potential Contributions

Comparison between regular practice and agroforestry system

Site	Growing Period	Regular Practice	Agroforestry System	Comparison
Site 1 (Gooch)	Summer 2015 - fallow/grain sorghum	Died out	Grain sorghum was not planted	At this point the agroforestry system costs more and it will take more years of focus upon soil health and cover cropping.
	Winter wheat 2015-2016 - Wheat but grazed out	stockers	There was more cost with the agroforestry due to labor and fencing, and watering needs.	
	Summer fallow - cattle grazing			
	Planted Winter Wheat			
Site 2 (Matthews)	Summer 2015 Oats	fallow	The oats were viable as a crop and can be sold to local granola producers. Weeds are a problem.	The local granola makers do not want to use oats that have been grown using inorganic chemicals. There is more cost with the agroforestry system but specialty crops get higher value with a natural production system.
	Fall 2015 - Spring 2016 Winter Wheat	Winter Wheat Graze out	The cover crops do well in the system and are a cost. More cost due to extra fencing to protect the fruit trees in the hedge row	
	Summer 2016 Soybeans	Cover crop		
	Fall 2016 - Spring 2017	Winter Wheat Graze out		

Future Recommendations

What areas are needed for improvement:

- Better use of mob grazing in order to control weeds within the system. The specific weed that has caused the most problems is hairy vetch. In addition, this includes cheat and Marshal Ryegrass. Small scale amounts of organic burn down were used to see if it was effective. It was not and so cover crops were used.
- Better diversification of grains such as older wheat and organic grains.
- Better production within the hedgerow.

Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture or SARE.



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