U.S. Department of Agriculture
National Institute of Food and Agriculture

Project Update

Advancing Organic Agriculture in the Mid-South

August 15, 2023

This project is supported by the U.S. Department of Agriculture, National Institute of Food and Agriculture, Organic Research and Extension Initiative. Award number 2021-51300-35727.

The findings and conclusions in this preliminary report have not been formally disseminated by the U.S. Department of Agriculture and should not be construed to represent any agency determination or policy.

Table of Contents

Advancing Organic Agriculture in the Mid-South: Evaluating Systems and Reducing Barriers to Entry

A project funded by the USDA National Institute of Food and Agriculture, Organic Research and Extension Initiative.

Award # 2021-51300-35727

Sept. 1, 2021 to Aug. 31, 2025

PRIME AWARDEE: Winrock International

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University of Arkansas, Division of Agriculture, Fayetteville, AR

University of Missouri, Southwest Research, Extension, & Education Center, Mt. Vernon, MO

Natural Soybean and Grain Alliance, Fayetteville, AR

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A public Project Website contains more information, photos, videos, and documents.

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Cover page photo credit: Kelly Cartwright/NSGA

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Acronyms

USDA	United States Department of Agriculture
NIFA	National Institute of Food and Agriculture
OREI	Organic Research and Extension Initiative
DBSFRC	Dale Bumpers Small Farms Research Center
NSGA	Natural Soybean and Grain Alliance
ARS	Agricultural Research Service

Summary of Project Observations to Date

- Successful rotations of organic cover crops and summer cash crops has been accomplished on four sites in the Mid-South region
- Organic winter cover crops have been installed and grown successfully
- Cereal rye appears to establish better and is more resilient as a cover crop than winter wheat but markets for harvested crop are more established for winter wheat
- Rotating into an organic summer cash crop has been challenging due to weed competition
- In addition to weed control issues, dryland production adds drought risk to summer cash crops
- Early planting appears crucial to success in production of an organic summer cash crop
- Integrated systems (grazing) have promise to provide economic returns in organic systems
- Integrated systems require a higher level of management, especially regarding timing of grazing and field preparation for the summer cash crop
- The no-till systems appear to be inferior to the conventionally tilled systems given fewer weed control options with no-till
- Selection of suitable cover crops is important for best overwintering and biomass production
- Weed pressure in mid to late summer in organic systems is very high
- Diversity of crops and high levels of management are crucial to success
- Proper equipment is necessary for field preparation, planting, and in-season cultivation
- Organic production in the Mid-South using cover crops holds promise but the learning curve is substantial
- Economic advantages for organic production compared to conventional production with herbicides can be favorable since price premiums and herbicide cost savings lessen break even yield requirements
- Crop failures in the 2022 plots were similar to much of the non-organic production throughout the Mid-Sough region, due to widespread drought and high temperatures
- Dryland production (no irrigation) in a double-crop system in the Mid-South increases the risk for crop failure

Project Background

The number of certified organic farms (nationally) has increased dramatically along with an increase of organic farm related sales that have reached almost $10 billion. Demand for organic food products is outpacing supplies, with growth rates quadrupling those of non-organic food sectors during the last 15 years. Demand for organic non-food items is growing steadily as well.

The Mid-South lags other regions in organic farm acres. The reasons vary, but the extended growing season, high temperatures and humidity, and diverse pest issues combine to make organic management difficult, especially in areas where weed problems are heightened. Management demands in organics are higher compared to conventional production. Weed control, in particular, is a formidable task, and the transition to organic crop production can be economically challenging due to a three-year transition period requirement. This project is designed to address these barriers to organic production in the Mid-South region.

The objectives of the project are to:

1) Conduct replicated, controlled research trials on organic crop management systems and the subsequent impacts on crop production, pest management, soil health and economic viability;

2) Implement geographically diverse, farm-scale trials (demonstrations) to substantiate best management practices observed from the first objective; and

3) Perform education and outreach activities to enhance farmer adoption of organic production in the Mid-South area.

Research Design

Four treatments in a replicated, random design with four replicates per treatment are utilized, all under organic protocols. These are as follows:

A. **Conservation System**. No-till management for cash crops. Cover crops (e.g. rye or winter wheat) used over winter, terminated with crimping in spring, with the cash crop planted into the terminated, biomass/ground cover.
B. **Profit-Driven System**. Conventional till management for cash crops. Cover crop used over winter, grown to maturity and harvested in spring, then a late cash crop planted in early summer.
C. **Integrated Conservation System**. No-till management for cash crops. Cover crops (e.g. rye or winter wheat) used over winter, grazed by cattle or sheep, etc. as growth allows. Cover crop then terminated with grazing in spring followed by cash crop planted into the ground cover left after grazing.
D. **Integrated Profit-Driven System**. Conventional till management for cash crops. Cover crop used over winter, grazed by cattle or sheep, etc. as growth allows. Following grazing, conventionally tillage is used to prepare seedbed for summer cash crop installment.

The research activities are located at the USDA Dale Bumpers Small Farms Research Center (DBSFRC) near Booneville, Arkansas. The replicated research plots are approximately 0.3 acres each.

Management Systems									
Tillage	Year One	Year Two			Year Three			Year Four	
System 1: Conservation Management									
	Fall 2021: All Sites	Spring 2022: Cover Crop Termination	Summer 2022: Planting Primary Crop	Fall 2022	Spring 2023: Cover Crop Termination	Summer 2023: Planting Primary Crop	Fall 2023	Spring 2024: Cover Crop Termination	Summer 2024: Planting Primary Crop
No Till	Cereal Rye and Legume	Roller Crimp	Soybean	AR & TN: Winter Wheat MO: Rye & Clover	Roller Crimp	AR: Sorghum MO: Corn and Sorghum TN: Corn	Cereal Rye and Legume	Roller Crimp	Soybean
System 2: Integrated Enterprise									
No Till	Cereal Rye and Legume	Grazing	Soybean	AR & TN: Winter Wheat MO: Rye & Clover	Grazed, then roller crimp	AR: Sorghum MO: Corn and Sorghum TN: Corn	Grazing residue followed by cereal rye and legume	Grazing	Soybean
Tillage	Cereal Rye and Legume	Grazing followed by tillage	Soybean	AR & TN: Winter Wheat MO: Rye & Clover	Grazed until tillage	AR: Sorghum MO: Corn and Sorghum TN: Corn	Grazing residue followed by cereal rye and legume	Grazing followed by tillage	Soybean
System 3: Profit Driven									
Tillage	Cereal Rye and Legume	Rye grain harvest followed by tillage	Soybean	AR & TN: Winter Wheat MO: Rye & Clover	Harvested then tillage	AR: Sorghum MO: Corn and Sorghum TN: Corn	Cereal Rye and Legume	Rye grain harvest followed by tillage	Soybean

Demonstration sites have been installed at four locations:

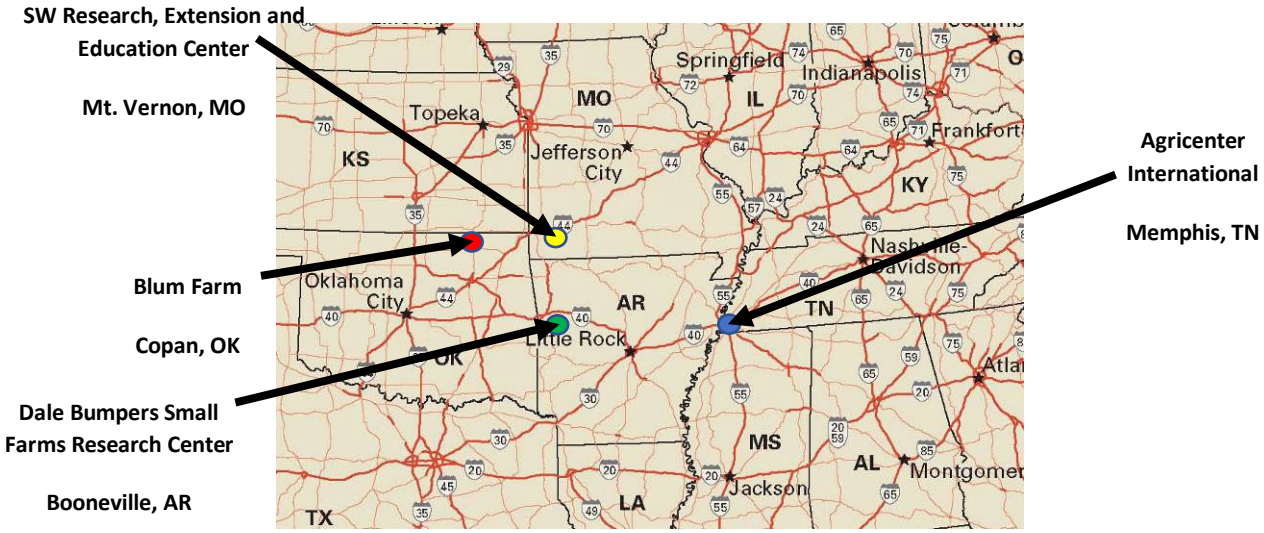
1. Booneville, Arkansas. At the DBSFRC. Approximately 12 acres. This site implements the Conservation and Profit-Driven systems side by side.

2. Mt. Vernon, Missouri. At the University of Missouri's Southwest Research, Extension and Education Center. Approximately 12 acres. This site implements both Integrated systems side by side.

3. Memphis, Tennessee. At the Agricenter International complex. Approximately 20 acres. This site implements the Conservation and Profit-Driven systems side by side.

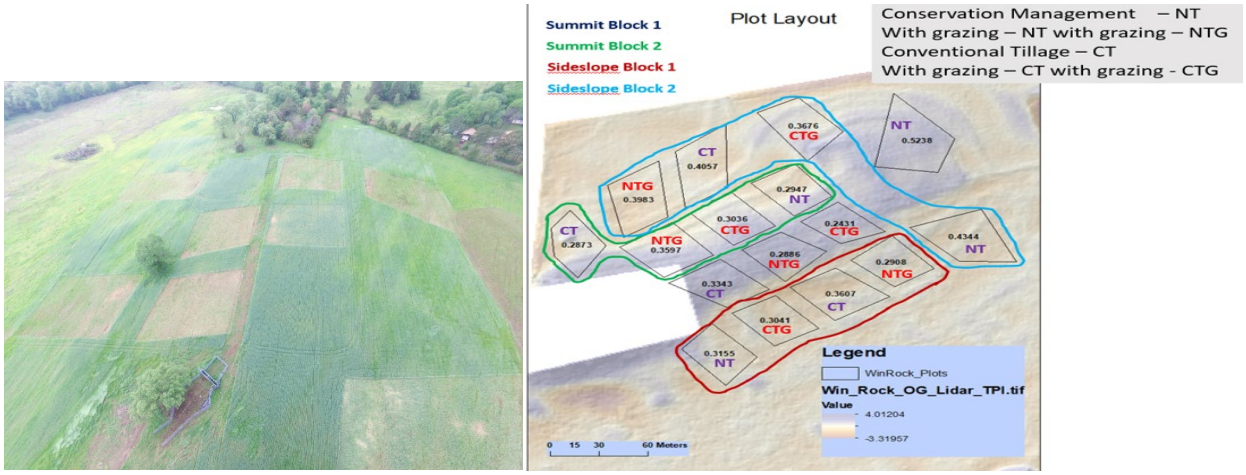
4. Copan, Oklahoma. A fourth site was developed on a commercial farm after the start of the project. The site implements the Conservation and Profit-Driven systems and is about ten acres.

PROJECT FIELD SITES



Research Trials at the Dale Bumpers Small Farms Research Center, Booneville, Arkansas

Field plots sites for research (and demonstration) purposes were established in fall, 2021, and planted with a cover crop of rye mixed with clover. The plots were randomized in the pattern shown in this illustration. (*Images courtesy of DBSFRC.*)



The cover crop grew well over winter, and the integrated plots were grazed with cattle multiple times from February to April of 2022. The rye was thick on the plots, terminated well, and soybeans planted into the rye mat came up with good stand establishment.

Terminated rye (left) formed a thick mat initially with beans emerging well (right).
(Images courtesy of NSGA)

Planting occurred (except in the profit driven system) in May and soybean stands were very acceptable. However, by the middle of June, conditions deteriorated (drought and heat) resulting in failure of the soybean crop, more specifically seen in the no-till compared to the conventionally tilled research plots. Deer grazing also caused extensive damage resulting in high levels of defoliation throughout the plots.

Rapid deterioration from drought and heat (left) combined with deer browsing (right) eventually led to crop failure in the research plots. (*Images courtesy of NSGA.*)

Harvesting hay off of the plots captured some economic value after the crop failure. A winter wheat cover crop was planted in November 2022. Heavy rains and cold temperatures thinned the wheat (despite adequate stands) and the height on the crop was only a few inches by early March 2023. Favorable weather allowed good growth and eventual grazing, but compared to the cereal rye (prior year), the wheat did not terminate (by roller crimping) as well and the biomass mat was thin. The cattle seemed not to favor the winter wheat as much as the cereal rye. All research plots were prepared and planted to sorghum the third week of May 2023. Stand establishment has been reasonable and cultivated (conventionally tilled) plots look much stronger than no-till plots.

Sorghum in conventionally tilled research plot (left) compared to no-till plot (right), June 2023. (*Images courtesy of NSGA.*)

The plots have received more timely rains in 2023 and the sorghum is growing out well, though a small (100 ft2) 'clean' section within each 0.3 acre plot is being hand weeded/cleaned to preserve integrity of the sorghum crop for data collection. The remainder of the plot areas are struggling, especially in the no-till research plots.

Sorghum in conventionally tilled plots (left) compared to conventionally tilled (right) that has been hand weeded (Johnsongrass in background), July 2023. (*Images courtesy of DBSFRC.*)

Demonstration site at DBSFRC, Booneville, Arkansas

Following a reasonable winter cover crop of cereal rye (2021-2022), the demonstration site suffered extensively from drought and deer grazing in the summer cash crop of soybeans. The no-till side had acceptable soybean stands initially but drought, heat and deer eventually

decimated the crop. In the profit driven system, the cereal rye was harvested in June, and the plot was cleaned up and tilled. The drought and lack of moisture prevented planting of this system until the latter part of July. At that point, sufficient moisture allowed good stand development and these late-planted soybeans grew well in late season, and showed potential for significant yield.

Soybeans emerging in the profit driven demonstration (left) and growing well in September 2022 (right). (*Images courtesy of NSGA.*)

The no-till demonstration side/plot failed due to drought and deer browsing. Fencing established to curtail browsing was installed, but the overall damage was too much to overcome.

An early frost in October 2022 killed the soybeans on the profit driven side. Both demonstration plots were cleaned up, prepared, and planted to winter wheat in November. The wheat was slow growing and thin. On the no-till side, the wheat was too thin to terminate by roller crimping and was, instead, mowed for termination at planting of corn during the third week of May 2023. On the conventional tilled side, the wheat was harvested (about 36 bu/ac) during the third week of June, a seed bed prepared and corn planted a week later with very good stand establishment.

Corn planted in no-till demonstration site (left) compared to conventionally tilled demonstration site (right), July 2023. (*Images courtesy of DBSFRC.*)

As of July 2023, the no-till site will not make a corn crop, while the conventionally tilled side looks promising for corn harvest. Disease issues have been limited these two years and insects are minimal, though grasshoppers at multiple sites continue to be somewhat problematic.

Demonstration site at University of Missouri, Mt. Vernon, Missouri

At the Missouri demonstration site, during the spring and early summer of 2022, the cereal rye/clover mix (planted fall, 2021) grew out well and stocker calves were grazed late in the spring due to the very wet conditions. The cover crop was not roller crimped but grazed down, then mowed where applicable prior to planting the soybean crop.

Cereal Rye/Clover cover crop (left) and stocker calves used for grazing. March 2022.
(*Images courtesy of Univ. of Missouri.*)

Conditions prevented early planting of soybeans in 2022 and weed pressure turned extreme. The conventionally tilled plot, due to lack of equipment, was tilled to prepare a seed bed, but in-season cultivation did not occur. While early stands were adequate in both the conventionally tilled plot and no-till plot, the lack of cultivation, and the extreme heat and drought starting in June resulted in a failure of the soybean crop in mid to late summer.

Early stands (June) of soybeans in conventional (left) prepared and no-till field, June 2022. (*Images courtesy of NSGA.*)

Conventionally prepared field (left) and no-till plot (right), July 2022. (*Images courtesy of NSGA.*)

The soybean crop ended in failure at the Missouri demonstration site, prompting a decision to remove the remaining material as hay, thereby collecting the nutritional and economic data. A late summer forage soybean crop was planted to help condition the soil, capture additional hay

value, and prepare for planting the winter cover crop. The cereal rye cover crop was planted in early October 2022.

The cover crop did very well over the winter, though the no-till plot lagged for quite some time behind the conventionally tilled plot.

Cereal rye cover crop in January (left) and April (right), 2023.
(*Images courtesy of University of Missouri and NSGA.*)

By late March/early April, the cover crop was suitable for grazing and some plots were grazed multiple times. The weather allowed for excellent grazing, followed by an early May planting and roller crimping of the no-till plot with timely planting of corn and sorghum. For this demonstration site, corn and sorghum were planted side by side for a direct comparison of potential suitability of the crops regarding soil, geographics and dryland conditions.

Early stands were good for the corn and sorghum in the conventional tilled plot but poor in the no-till plot.

Corn stands early in conventionally tilled (left) and no-till (right) plot, May 2023.
(*Images courtesy of NSGA.*)

The conventionally tilled plot was cultivated as soon as conditions allowed and enabled both the corn and sorghum to grow out quickly, shading problematic weeds so that they had little impact on the crops. Following a six-week period of timely rains, adequate cultivation, and compatible temperatures, the corn and sorghum in the conventional plot looked excellent.

Sorghum (left) and corn (right) in conventionally tilled plots in late June 2023.
(*Image courtesy of NSGA.*)

Sufficient rain fell, allowing the corn to set ears by late July. Harvest is expected in late August to early September for evaluation of the yield and quality of the grain.

Corn ears from conventionally tilled plots (left) and sorghum heading out (right), August 2023.
(*Images courtesy of Univ. of Missouri and NSGA*)

Overall, summer weather has allowed crops to flourish at this site. The ability to cultivate in rows was also crucial to success, as was an early planting date to take advantage of timely rains and temperatures. This site has been instrumental in demonstrating the feasibility of growing a high value crop under organic conditions in the mid-south area.

As of this report, the no-till plots have failed for both corn and sorghum. Crimping of the spring cover crop was not efficient and planting may have been difficult. The no-till demonstration plots, while adequate in production of a winter cover crop, have not proven advantageous for the summer cash crop. Weed pressure has been extreme. A lack of nutrients available to the summer may be a factor in performance.

Demonstration site at Agricenter International, Memphis, Tennessee

At the Agricenter demonstration site, both the conservation (no-till) and profit driven (conventional tillage) system were used. The initial cereal rye/winter pea cover crop (planted 2021) at the site was subjected to wet and extended cold, preventing a substantial biomass cover. The stand never reached the point were adequate termination (crimping) could be conducted.

Thin stands of cereal rye cover crop at the Agricenter, May 2022. (*Images courtesy of NSGA.*)

Due to the sudden onset of hot and very dry conditions, soybean planting was delayed, and moisture became very limited. Attempts were made to plant the no-till site in June (followed by roller crimping). The conventional tilled side was disked aggressively and planted the next day. However, no rainfall occurred post planting and suitable soybean stands were never established. By August 2022 the site was considered a loss due to poor stands and weed pressure. The site was prepared for the winter wheat cover crop.

The lack of moisture delayed winter wheat planting with plots seeded during the third week of October 2022. Heavy fall rains resulted in some areas of the wheat having thin stands, but generally a cover crop was established. Unseasonably cold and wet weather during the winter resulted in dormancy break later than anticipated for the wheat. By March 2023, winter wheat stands were acceptable, but grow out was delayed until late Spring.

Winter wheat at the Agricenter in no-till (left) and conventionally tilled plot(s), March 2023.
(*Images courtesy of Winrock.*)

Although the wheat stand remained thin, the no-till plot was rolled and crimped followed by planting of corn in late May 2023. The field was very wet in spots and very difficult to plant.

Plans were made to harvest the wheat on the profit-driven side in June. Heavy rains fell throughout May and June, precluding the wheat harvest on the conventionally tilled side.

In 2923, weeds were prominent in both the no-till and conventionally tilled sides throughout the summer due to the high temperatures and frequent rains. Specifically, buttercup was extensive and significant across the entire demonstration area.

By July, it became obvious that the conventional tilled side was probably not going to be planted and the no-till field had been overgrown by weeds. The plots were considered a loss for the season, and plans were made for preparing the plots for planting a rye cover crop in the fall. While conditions at the Agricenter have been difficult, observations of treatments in these conditions have reinforced assumptions about the importance of planting dates, cover crop types and mixes, maintenance of seed beds, etc.

Planning is underway for the winter cover crop and summer cash crops. A combination (side by side) of soybeans and corn may be tried with variations related to variety maturities and planting dates, to maximize demonstration potential.

Demonstration site at Blum Farm, Copan, Oklahoma

An additional demonstration site was added in March 2023 by enlisting a commercial farm, the Blum Family Farm in Copan, OK. The farm grows soybeans, wheat, and hay crops. The demonstration site field is dryland with clay loam soil and follows a fallow period established after wheat harvest, 2022.

Organic wheat was planted in late March 2023 on the 10-acre site to get a small amount of biomass production. Both no-till and conventionally tilled demonstration plots were planned. Corn was planted in early April *within* the established wheat stands. No prep work or cultivation occurred. Row cultivation on the conventional tilled side was recommended based on appropriate timing. Corn stands, after three weeks, were good across both the no-till and conventionally tilled demonstration plots.

Corn stand counts being made in late April 2023. (*Images courtesy of NSGA.*)

With plenty of rain, the entire demonstration field had grown over to the extreme by late May. The new crop of wheat was tillering aggressively and growing. Italian Rye emerged and covered about 25% of the field, overtaking the wheat canopy. The corn stand thinned and bleached out. Observation suggested that the rye, wheat, and weeds (though sparse) were using up the free nitrogen, even though 2 tons/acre of poultry litter was applied in March.

As the plots struggled, crop failure became likely. Alternative plans were made to hay the plots and plant a late soybean crop. Small portions of the original corn plots were saved for observation.

Remaining corn sample plot (left) and wheat stubble (right) on July 7, 2023. (*Images courtesy of NSGA.*)

While this demonstration site has struggled, some interesting observational data was collected. The aggressive growth of the winter wheat planted in March and growth through the month of June were not expected. Reaffirming the importance of equipment use and performance, it seems

that if the planter had done a good job, a reasonable stand of corn could have been established and a crop made.

Project Partners

USDA Agricultural Research Service – Dale Bumpers Small Farms Research Center, Booneville, Arkansas. Responsible for small plot research work and hosting one demonstration site, along with soil analysis and mapping. With Cullen Pfeifer and Kolten Wright, research specialists.

Natural Soybean and Grain Alliance, Fayetteville, Arkansas.
Responsible for advising on and supporting field site activities and collaborating on education and outreach activities. With Hank Chaney, consultant agronomist.

University of Arkansas Division of Agriculture, Fayetteville, Arkansas.
Responsible for economic analysis of treatments in the research and demonstration sites. With Riley Smith, graduate research assistant.

University of Missouri, Southwest Research and Extension Center, Mt. Vernon, Missouri.
Responsible for hosting a demonstration site. With Caleb O'Neal, research specialist.

Agricenter International, Memphis, Tennessee. Responsible for hosting a demonstration site.

Blum Family Farm, Copan, Oklahoma. Responsible for hosting a demonstration site.

Winrock International, North Little Rock, Arkansas.
Responsible for prime award management, overall project management, education and outreach activities, reporting to funder.