Analysis of Missouri Soil Health and Manure Application Data

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Background

- Agricultural practices are very important for maintaining soil health and crop production.

Manure application 

Cover crop 

Inorganic fertilizer 

Crop rotation 

- A Missouri state-wide effort to encourage the adoption of cover crop is underway.
- The Missouri N340 Cover Crop Cost-Share Program (Soil and Water Conservation, Missouri Department of Natural Resources) provides incentives to farmers.

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Objectives

1. To analyze multi-year soil health variables and land application of manure data cross Missouri (Statewide data).
2. To evaluate the effects of manure application and cover crop practice on soil health improvement (Research farm data).

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First Objective

Statewide soil health data analysis

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Materials and Methods

Sample collection
- Soil samples and corresponding field management information were collected through a statewide cover crop cost-share program.
- Soil sampling was done at 7 cm depth.

Physicochemical analysis
- Physicochemical analyses of soil samples were carried out at the soil health assessment center, Mizzou.

Statistical analysis
- R software was used for all statistical analyses (t-test and two-way ANOVA).

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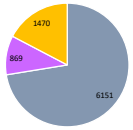
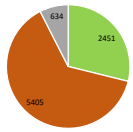
Results and Discussion – Statewide Data



Soil samples based on fertilizer type

- ✓ 8490 soil samples were received from 96 counties from 2016-2019.
- ✓ Soil samples treated with manure - 10.24%.
- ✓ Manures are classified based on animal species, and mostly are cattle, poultry, and swine.



Soil samples based on cover crop practice

- ✓ Soil samples with cover crop practice - 28.87%.

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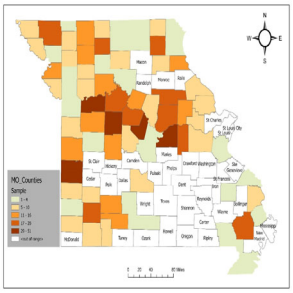

- ✓ Among 96 counties, a total of 81 counties were identified for soil samples with manure treatment from 2016-2019.
- ✓ Osage, Pettis, Nodaway, Vernon, and Lafayette are top-listed counties for manure application.

Soil sample distribution based on manure application

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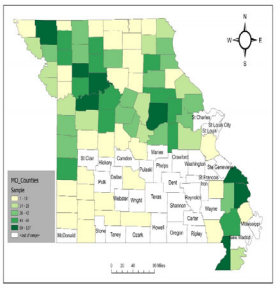

- ✓ Cover crop practice can be seen in 87 counties from 2016 to 2019.
- ✓ Lafayette, Cape Girardeau, Perry, Nodaway, Carroll, Caldwell, Dunklin, and Callaway are the top listed counties.

Soil sample distribution based on cover crop practice

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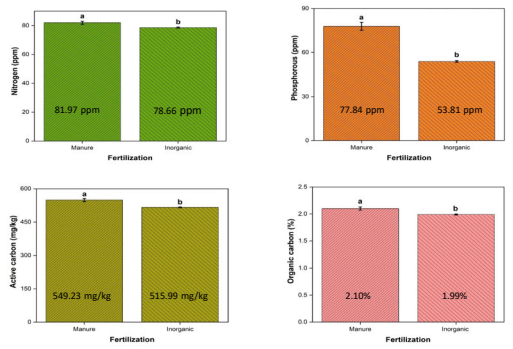
Effects of manure application (Bar graphs showing Mean ± Standard Error)

Different letters indicate significant differences at 5% level



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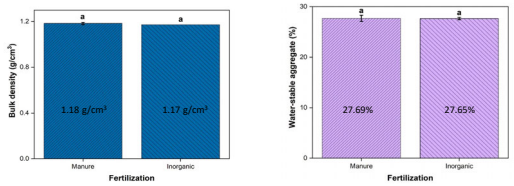

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Results and Discussion – Statewide Data

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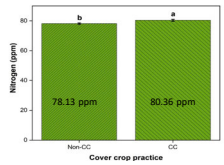

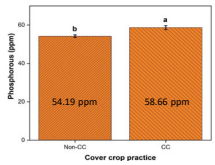

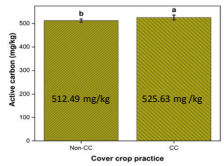

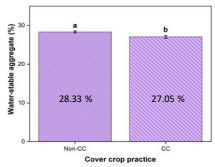

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Results and Discussion – Statewide Data

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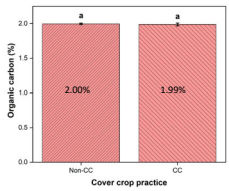

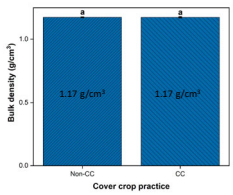

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Results and Discussion – Statewide Data

Table 1: ANOVA for interaction between fertilization and cover crop practice

Soil health property	Variances	Df	Sum Sq	Mean Sq	F value	P
Nitrogen (ppm)	CC×F	1	226	226	0.234	0.628712
Phosphorous (ppm)	CC×F	1	68756	68756	24.468	7.73e-07 ***
Active carbon (mg C/kg)	CC×F	1	85745	85745	2.778	0.09562
Organic carbon (%)	CC×F	1	3	3.436	6.177	0.013 *
Bulk density (g/cm^3)	CC×F	1	0.03	0.02819	0.674	0.412
Water-stable aggregate (%)	CC×F	1	137	136.7	0.395	0.530

(Significant codes: '***' 0.001 '**' 0.01 '*' 0.05)

- Interaction between fertilization and cover crop practice had significant effects on phosphorous and organic carbon contents.

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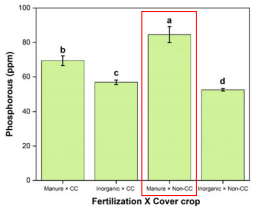
Results and Discussion – Statewide Data

Interaction effects on phosphorous (Bar graphs showing Mean ± Standard Error)

Different letters indicate significant differences at 5% level



- ✓ All treatments are statistically significant in terms of phosphorous content.
- ✓ The highest phosphorous content was found as an interaction effect between manure and non-CC.
- ✓ The lowest phosphorus was reported for the inorganic fertilizer and non-CC group.

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Results and Discussion – Statewide Data

Interaction effects on organic carbon (Bar graphs showing Mean ± Standard Error)

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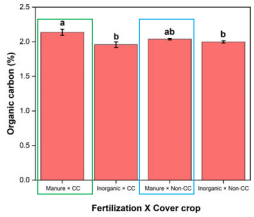

- ✓ The highest organic carbon was observed for manure with CC although it was not significantly different than observed for manure with non-CC treatment.
- ✓ The lowest organic carbon was found for inorganic fertilizer with CC.

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Second Objective

Research at University Farm

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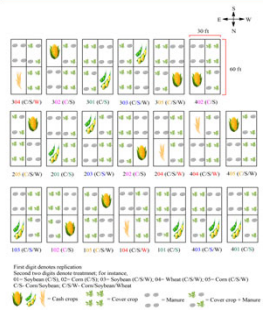
Research Plot Set-up



Plot distribution at Bradford research farm

Each plot is 30' wide x 60' long and further divided into 4-15'x30' split plots.

The treatments include:
Crop rotation: Corn/soybean and corn/soybean/wheat- planted each year;
Fertilization: Inorganic fertilizer and manure;
Cover crop: Cover crop and non-cover crop.
Replication: 4

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Summary – Research Farm Data

Soil samples are being analyzed.

Cash crops' yield

- The application of inorganic fertilizer increased corn yield.
- The manure application increased the soybean yield.
- Although there was no significant difference, the application of manure increased the wheat yield.
- The soybean yield was lower for the cover crop group compared to the non-cover crop group. Again, the wheat yield was higher for cover crop practice.
- The project will collect three more years of data.

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Conclusions – Statewide Data

- Manure application results in significantly higher N, P, active carbon, and organic carbon.
- Cover crop practice leads to significantly high amounts of N, P, and active carbon in soils.
- Interaction between manure and cover crop increased the P and organic carbon compared to inorganic fertilization with/without cover crop practice.
- Variations of soil type, farm management, weather, and cropping systems can contribute to the high variations of soil health variables, especially across different geographical regions. Long-term and more controlled research data can hopefully better explain the impacts. More analyses based on region, specific soil, manure types, etc., are being conducted.

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Thank you
for your attention!

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