OPTIMIZING AGRICULTURAL PRACTICES: SYNERGISTIC EFFECTS OF ROTATIONS, TILLAGE, COVER CROP, AND NITROGEN

MISSISSIPPI STATE UNIVERSITY
Department of Plant and Soil Sciences

Dylan Williams*, Jay Mahaffey, Dorivar Ruiz Diaz, Jagmandeep Dhillon

[1]Department of Plant and Soil Sciences, Mississippi State University; FFAR, Bayer Crop Science, Kansas State University

*Email: bdw390@misstate.edu

INTRODUCTION

- Increasing water productivity, soil carbon, and sustainability of croplands is imperative for the future of agricultural economy and overall farm success [1].
- Most studies are limited by the number of parameters tested within a field experiment [2].
- *Objective: Determine the long-term impact of multi-factor experiment testing combinations of cover crops, crop rotation, nitrogen, and tillage on crop productivity and environmental sustainability.*

Fig 1: Birds Eye view of experiment taken on July 31, 2024, showing corn and cotton in replication 3 (no-till without cover crop) and 4 (no-till with cover crop).

MATERIALS AND METHODS

- Location: Scott, Mississippi
- Design breakdown: Split-plot design
  - Main plot: different combination of cover crop (with or without) and tillage (conventional or strip-till)
  - Subplots: defined by crop rotation (continuous corn, continuous cotton, corn-cotton, and cotton-corn) and nitrogen rate (farmer rater or farmer rate + 60 lbs.)
  - Blocks – 4; Replications – 3 (within each block)
- Materials: 12 row plots, corn (DKC 6835), cotton (2328 B3TXF)
- Statistical analysis: Generalized linear mixed effect model using 'lmer' package in R and visualization using 'tidyverse' package.

Table 1: P-value for corn grain yield and cotton seed yield (kgha^{-1}) analyzed by main effects, two, three and four-way interactions in a study on crop rotation, cover crop, tillage (2023 & 2024) and nitrogen rate treatments (only in 2023).

		Corn 2023	Cotton 2023	Corn 2024	Cotton 2024
SOV	DF	p-value			
Rotation (R)	1	0.99	0.29	0.88	0.08
Nitrogen Rate (N)	1	0.84	**0.001**	--	--
Cover crop (C)	1	0.76	0.54	0.74	0.59
Tillage (T)	1	0.90	0.96	**0.007**	**0.001**
R x N	1	0.63	0.34	--	--
R x C	1	0.46	0.34	0.46	0.22
R x T	1	0.97	0.77	0.52	**0.04**
N x C	1	**0.02**	0.07	--	--
N x T	1	0.97	**0.001**	--	--
C x T	1	0.80	0.08	**0.001**	**0.002**
R x N x C	1	0.29	0.93	--	--
R x N x T	1	0.08	0.28	--	--
R x C x T	1	0.09	0.18	0.74	0.52
N x C x T	1	0.73	**0.002**	--	--
R x N x C x T	1	0.33	0.07	--	--

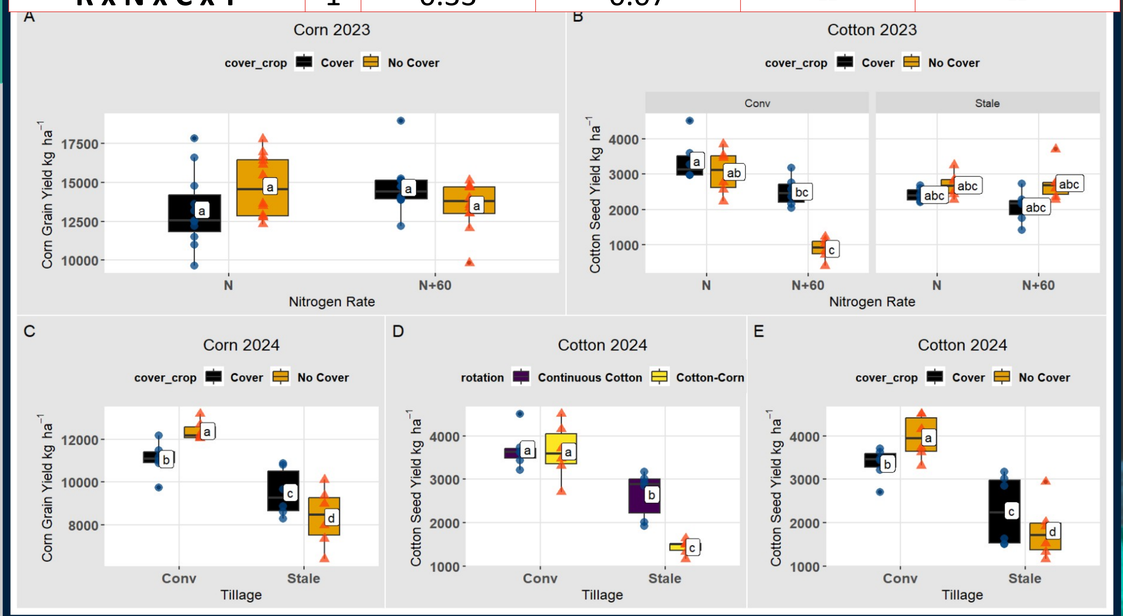

Fig 2: Corn grain yield influenced by N rate and Cover crop in 2023 (A), tillage and cover crop in 2024 (C); Cotton seed yield influenced by N rate, cover crop and rotation in 2024 (B), tillage and rotation (D), and tillage and cover crop (E) in 2024. Means with same letter are not significantly different (Tukey-test)

Fig 3: Snapshots of corn and cotton: (A) taken on June 26, 2024, and (B) on August 15,2024

RESULTS

- **Corn (2023):** Corn yield was influenced by interaction between nitrogen and cover crops (Fig 2A).
- **Cotton (2023):** Cotton seed yield was significantly affected by a three-way interaction involving nitrogen, cover crop and tillage. Adding extra nitrogen reduced cotton seed yield under conventional tillage without cover crop (Fig 2B).
- **Corn (2024):** Corn yield was lower in strip-till systems compared to conventional, with reduction being more pronounced in plots without cover crop (Fig 2C).
- **Cotton (2024):** Cotton seed yield was independently influenced by the interaction between tillage and rotation (Fig 2D), and tillage and cover crop (Fig 2E). Yield was lower in strip-till systems compared to conventional, with more pronounced differences in cotton-corn rotation than in continuous cotton. Additionally, yield was lower without cover crops in strip-till production systems.

CONCLUSION AND RECOMMENDATIONS

- Additional N application effect was negligible in corn. In cotton, it was dependent on cover crop and tillage.
- Positive yield effect of cover crop inclusion for both crops was only noted in strip tillage systems in 2024.
- Cotton yield was lower in strip tilled plots, especially in cotton-corn rotation.

References

1. Shah, F., & Wu, W. (2019). Soil and crop management strategies to ensure higher crop productivity within sustainable environments. *Sustainability*, *11*(5), 1485.
2. Clewer, A. G., & Scarisbrick, D. H. (2013). *Practical statistics and experimental design for plant and crop science*. Wiley & Sons.

ACKNOWLEDGEMENTS

This study is funded by the FFAR and Bayer Crop Science (Increasing Water Productivity, Soil Carbon, and Sustainability of Integrated Multi-Crop Systems Using Field-Scale Research). We thank Bayer Scott Learning team, and corn agronomics lab team for their assistance