Effects of Soil Warming on Soil Carbon and Cotton Production under Residue and Irrigation Management.

Pawan Devkota[1*], Nicholas G. Smith[1], Lindsey C. Slaughter[2], and Natasja van Gestel[1]

[1]Department of Biological Sciences, Texas Tech University, Lubbock, TX, 79409

[2]Department of Plant and Soil Sciences, Texas Tech University, Lubbock, TX, 79409

INTRODUCTION

- Cotton productivity in Texas High Plains is declining due to higher mean temperatures, droughts, and extreme rainfall events during growing season (Steiner et al., 2018).

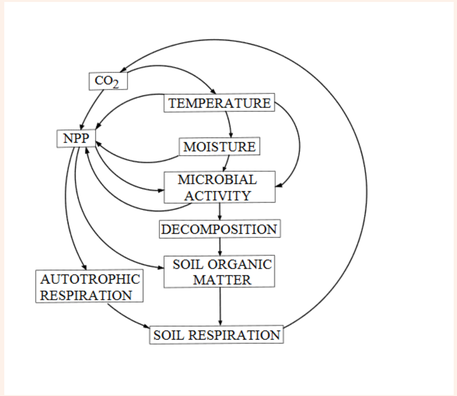

Figure 1: Visual representation of climate carbon feedback .

- The water table in Ogallala aquifer is declining which could reduce yields by up to half (Dorminey, 2012).
- Residue reduces soil temperature and moisture fluctuation in soil profile (Russel 1940). Therefore, residue retention could be an effective strategy for reducing the degradation of soil health during climate extremes.

OBJECTIVES:

- Study the effects of warming on soil carbon dynamics and cotton production.
- Determine how irrigation and residue management affects warming effects on soil carbon stocks and cotton production.

MATERIAL AND METHODS

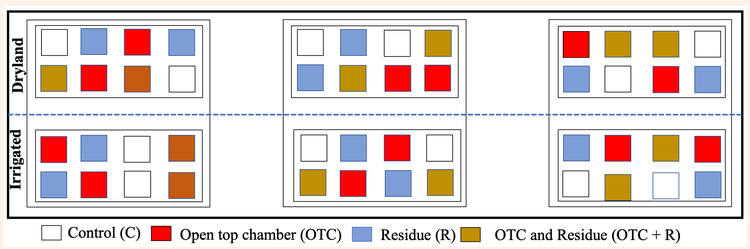

Fig 2: Split plot randomized complete block design

Fig 3: A) Field setup b) Soil respiration measurement c) Chloroform fumigation for microbial biomass measurement

RESULTS

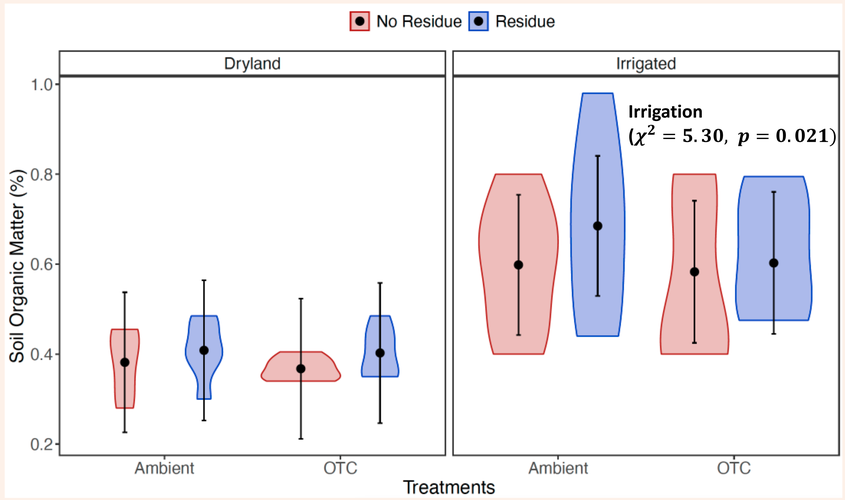

Fig 8: Average soil organic matter content across OTC and residue treatments in irrigated and dryland cotton. The error bars represent 95% confidence interval, n = 5-7.

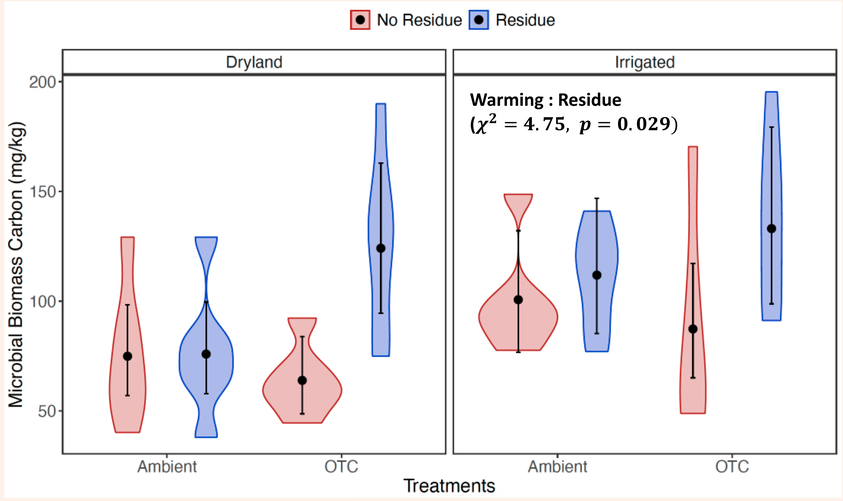

Fig 10: Average microbial biomass carbon content across OTC and residue treatments in irrigated and dryland cotton. The error bars represent 95% confidence interval, n = 5-7.

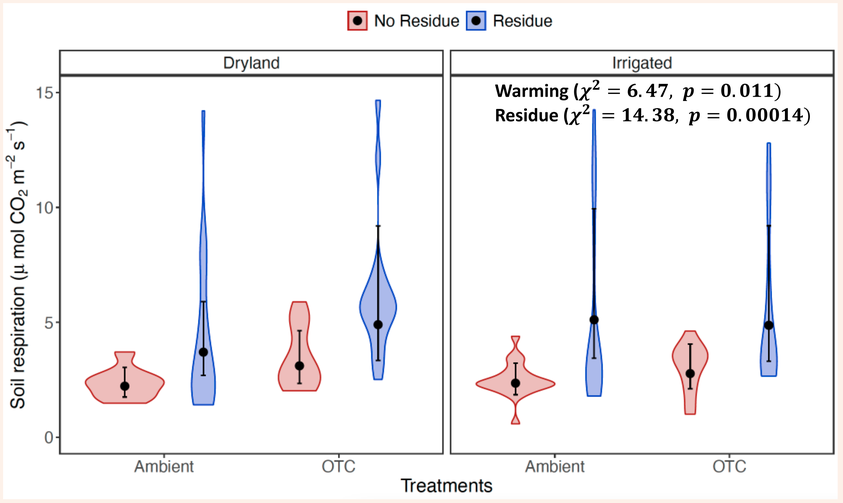

Fig 14: Growing season's average soil respiration across OTC and residue treatments in irrigated and dryland cotton. The error bars represent 95% confidence interval, n = 5-7.

RESULTS

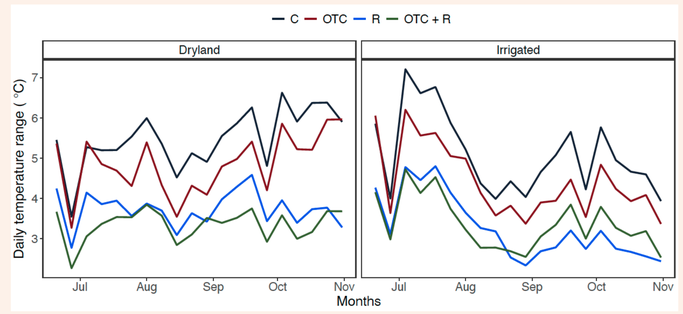

Fig 5: Weekly average of daily soil temperature range measured at 10 cm depth

CONCLUSIONS

- Higher soil temperature increases soil carbon loss through increases soil respiration, hence, deplete soil organic matter content.
- Residue addition and irrigation helped to mitigate the warming effects by increasing SOM and MBC, thus might aid to attenuate the impact of future climate change on soil health and crop production in semiarid environments
- Irrigation water is depleting in an alarming rate in the great plain region. Therefore, to ensure the sustainability of soil health and agricultural production in this area, future research should concentrate on strategies for conserving soil moisture.

REFERENCES

- Dorminey, B. (2012, November). Dryland Farmers Work Wonders without Water in U.S. West . Scientific American.
- Russel, J. C. (1940). The Effect of Surface Cover on Soil Moisture Losses by Evaporation. *Soil Science Society of America Journal*, 4(C), 65–70.
- Steiner, J. L., Briske, D. D., Brown, D. P., & Rottler, C. M. (2018). Vulnerability of Southern Plains agriculture to climate change. *Climatic Change*, *146*(1–2), 201–218.

ACKNOWLEDGEMENT

We would like to thank Cotton Inc., James A. "Buddy" Davidson Charitable Foundation, and Texas Tech University Department of Biological Sciences for funding support. We thank Dr. Dylan Schwilk for his insights and help during OTC construction, Mr Lelton Howell for facilitating field activities. Thanks to all EcoHealth lab members for their valuable supports, guidance and insights during the project period.

SCAN HERE FOR MORE