Relationship between Soil Pore Space Indices and Greenhouse Gas Fluxes in a Corn-soybean Rotation in Central Missouri

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Introduction and Rationale

- The exchange of gases between the atmosphere and soil is facilitated by mass flow (convection) and diffusion mechanisms via soil pores
- Several management practices are supposed to help in mitigation of greenhouse gas fluxes from soils
- Very few authors have focused on pore space indices: the relative gas diffusion coefficient (Ds/Do) and the pore tortuosity factor (τ) as potential controlling factors for greenhouse gas fluxes from soil (Nkongolo et al. 2010)

Objectives

- To assess the effect of tillage, cover crop and crop rotation on soil pore space indices
- To assess the relationship between soil pore space indices and greenhouse gas fluxes

Experimental Procedure

- Study was conducted from 2011-2014 on a silt loam soil at Freeman farm of Lincoln University
- Total 48 plots, arranged in RCBD
- Treatments: Tillage (No till Vs Conventional tillage), Cover Crop (No rye Vs Rye crop), Crop Rotation (Continuous corn, Continuous soybean, Corn-soybean & Soybean-corn rotations)
- Soil samples were collected at two depths: 0-3.93 in & 3.93-7.87 in, relative gas diffusion coefficient (Ds/Do) and pore tortuosity factor (τ) were computed using 5 diffusivity models
- CO_2 & N_2O fluxes were measured using Gas Chromatograph- 2014 & Photoaccostic Gas Analyzer

Results and Discussion

Effect of Tillage, Cover Crop and Crop Rotation on Soil Pore Space Indices

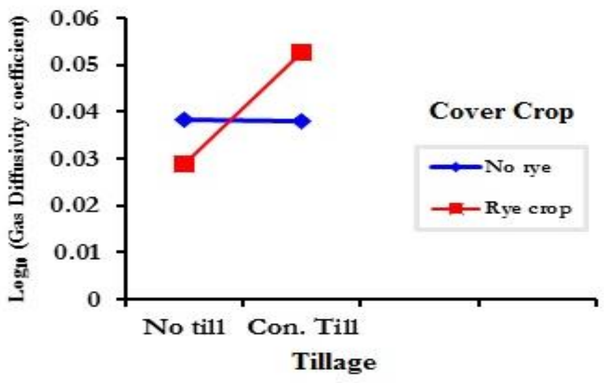

Figure 1: Tillage*Cover Crop interaction for Ds/Do

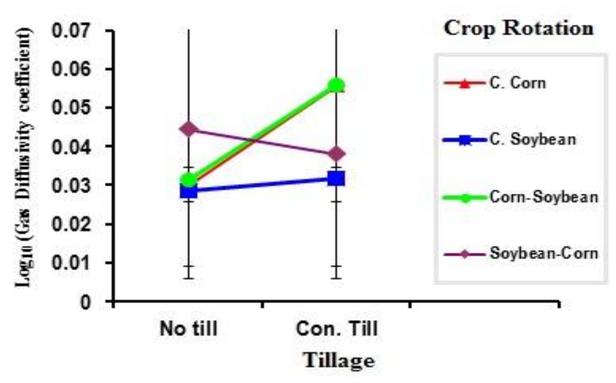

Figure 2: Tillage*Crop Rotation interaction for Ds/Do

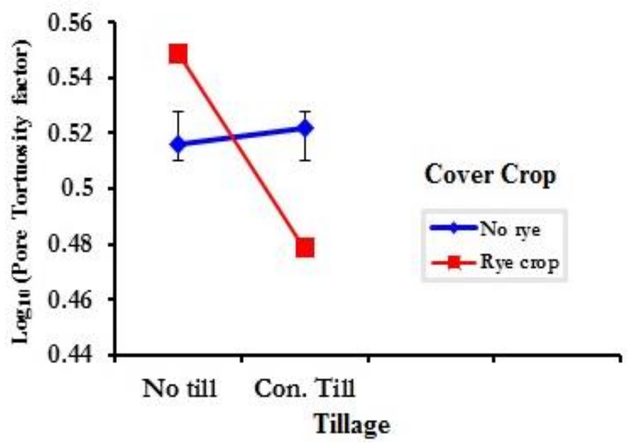

Figure 3: Tillage*Cover Crop interaction for τ

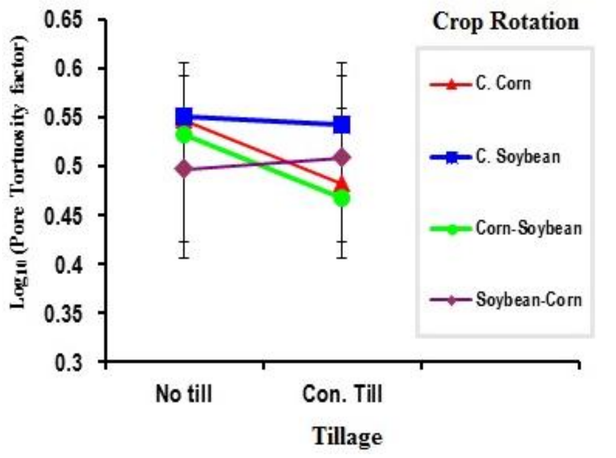

Figure 4: Tillage*Crop Rotation interaction for τ

Relationship between Soil Pore Space Indices and CO_2 fluxes

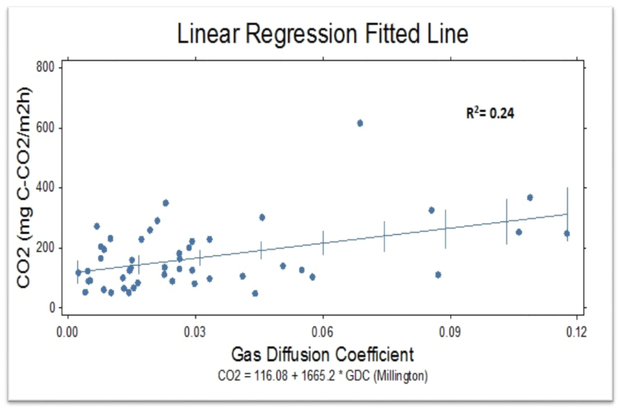

Figure 5: Relationship between CO_2 and Ds/Do

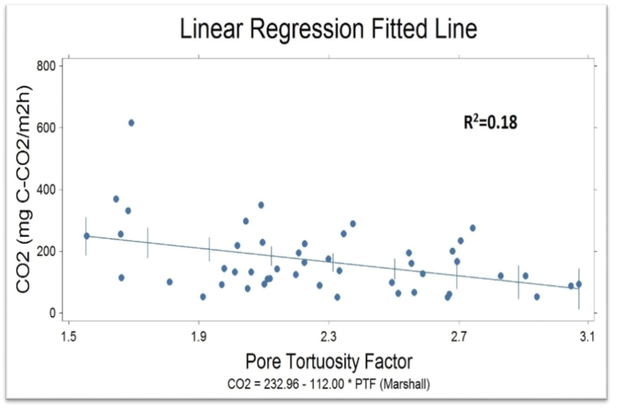

Figure 6: Relationship between CO_2 and τ

Conclusions

- Significant interactions: tillage*cover crop and tillage*crop rotation at *p<0.05* for both pore space indices in 2012-14
- CO_2 and N_2O fluxes showed positive correlation for both pore space indices with linear regression (R^2) ranging from 0.10 to 0.30

Recommendations

- Pore space indices (Ds/Do and τ) can be used as indicators of changes in soil quality as induced by soil and crop management practices
- Inclusion of Ds/Do and τ in predictive models will certainly improve our understanding of the dynamics of greenhouse gas fluxes from soil

Acknowledgements

We would like to thank Brandon Mebruer, Phillips Markway, Shelby Turner, Samuel Haruna, Ali Hasan, Mandira Sharma, Shanta Acharya, Dipti Rai and Manzeal Khanal for their help with this research.

This research is part of a regional collaborative project supported by the USDA-NIFA, Award No. 2011-68002-30190 "Cropping Systems Coordinated Agricultural Project (CAP): Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems" sustainablecorn.org