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

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Introduction and Rationale

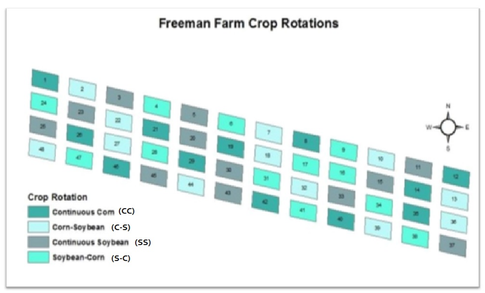
Pore space is one of the most important factors to assess the degree of change in soil physical properties. Activities such as tillage, legume inter-cropping (Huth et al. 2010) and others play a part in emissions of greenhouse gases from soils which move through the pore space before emitted to atmosphere.

Knowledge of the impact of soil management practices on soil pore space indices such as relative gas diffusion coefficient (Ds/Do) and the pore tortuosity factor (τ) is therefore important in farming operations and in mitigating greenhouse gases emissions from agricultural soils.

The objective of this study was to assess the effects of tillage, cover crop and corn-soybean rotation on soil pore space indices.

Experimental Procedure

- The study was conducted in 2011 and 2012 on a silt loam soil at Freeman farm of Lincoln University
- 48 research plots, individual size: 40 ft x 70 ft (12.19 m W x 21.34 m L)
- 16 treatment combinations: (i) Tillage (No-Tillage vs Conventional Tillage), (ii) Cover Crop (Rye vs No-rye) and (iii) Cropping Rotation (Continuous Corn, Continuous Soybean, Corn-Soybean and Soybean-Corn)
- Soil samples were collected at four depths: 0-3.93 in (0-0.1 m), 3.93-7.87 in (0.1-0.2 m), 7.87-15.74 in (0.2-0.4 m) and 15.74-23.62 in (0.4-0.6 m) and on later air-filled porosity (AFP) and other soil properties were calculated
- The relative gas diffusion coefficient (Ds/Do) and pore tortuosity factor (τ) were computed using 5 diffusivity models based on AFP as described in Nkongolo et al (2010).



Results and Discussion

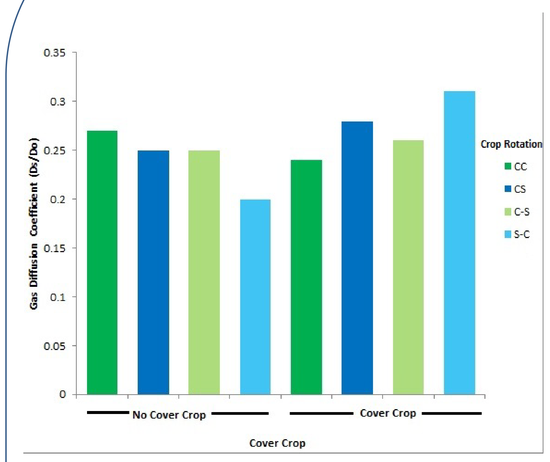


Fig 1. Cover crop x crop rotation interaction for Ds/Do

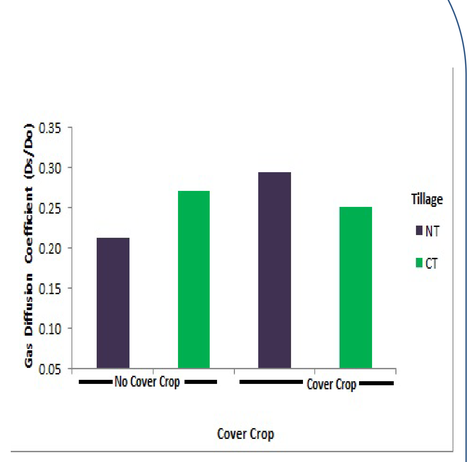


Fig 2. Cover crop x tillage interaction for Ds/Do

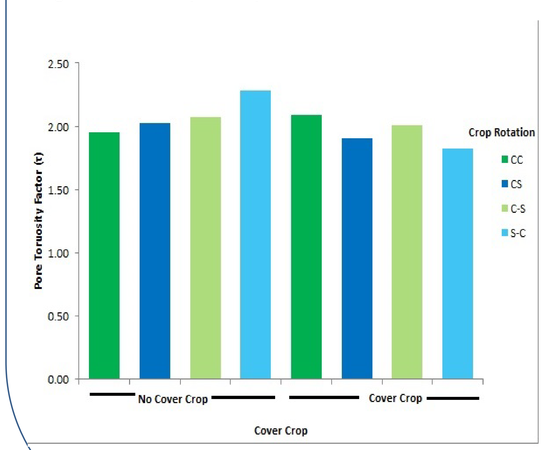


Fig 3. Cover crop x crop rotation interaction for τ

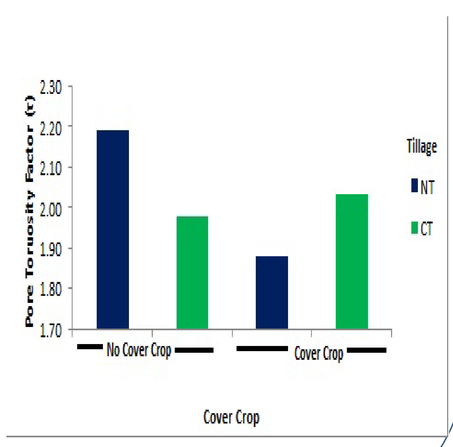


Fig 4. Cover crop x tillage interaction for τ

- Results showed that either tillage or cover crop or crop rotation alone did not affect the relative gas diffusion coefficient (Ds/Do)
- However, cover crops were significantly affected by the pore tortuosity factor (τ)
- Plots with cover crops and crop rotation either increased or decreased gas diffusion and soil pore tortuosity
- Similarly, plots with cover crop and tillage management also increased or decreased gas diffusion and soil pore tortuosity

Conclusions

We concluded that there were significant interactions: cover crop x crop rotation and cover crop x tillage for all diffusivity models. Thus the relative gas diffusion coefficient (Ds/Do) and pore tortuosity factor (τ) can be used to assess the impact of soil management practices on soil physical properties.

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References

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