Effect of Gypsum and Crop Residues on Greenhouse Gas Fluxes from Two Contrasting Soils in Ohio

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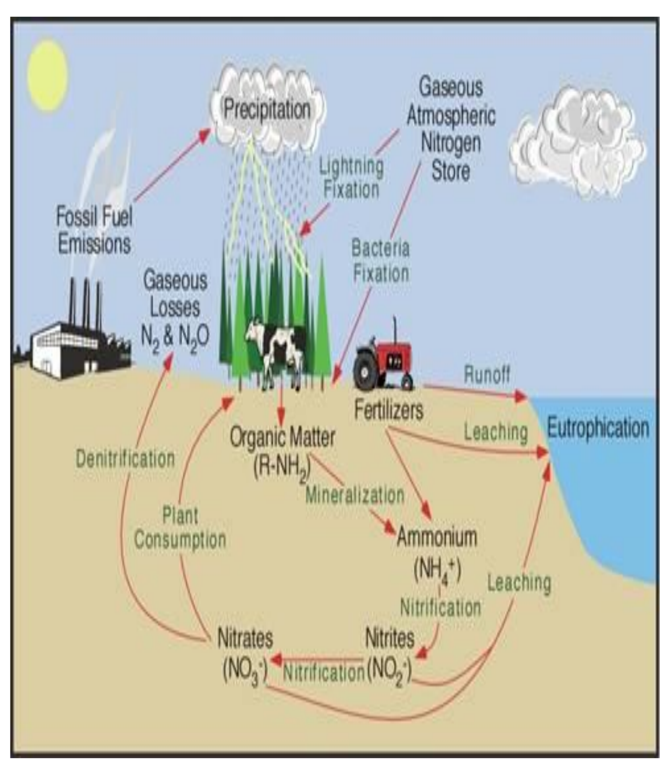
ABSTRACT

The emissions from soil of the greenhouse gases carbon dioxide, methane and nitrous oxide soil as affected by agricultural practices, such as the application of gypsum and the return of crop residues to soil, are poorly understood. Greenhouse gas emissions in a greenhouse experiment were statistically less from Wooster soil (silt loam) as compared to Hoytville soil (clay loam). A reduction in emissions of carbon dioxide and methane from soils was also measured when gypsum plus residues were added to soil together as compared to their alone application and soil became a consistent sink for methane. We conclude that application of gypsum and plant residues affect the emissions of greenhouse gases differently in soils. Also, gypsum plus residues reduced carbon dioxide emissions, suggesting this treatment combination can efficiently form soil humus.

INTRODUCTION

Climate change is closely related to greenhouse gas emissions from soils (**Figure 1**). Soils may act either as a source or a sink for the greenhouse gases depending upon the management practices. In Ohio and the Midwest, there is an abundant supply of gypsum (calcium sulfate dihydrate) that is created by removal of sulfur dioxide from flue gases. Gypsum, as a soil amendment, can improve crop yields, soil quality and water quality. The objective of this study was to determine whether gypsum and crop residues, applied alone or in combination, could reduce greenhouse gas emissions from soils.



Source: http://www.physicalgeography.net.

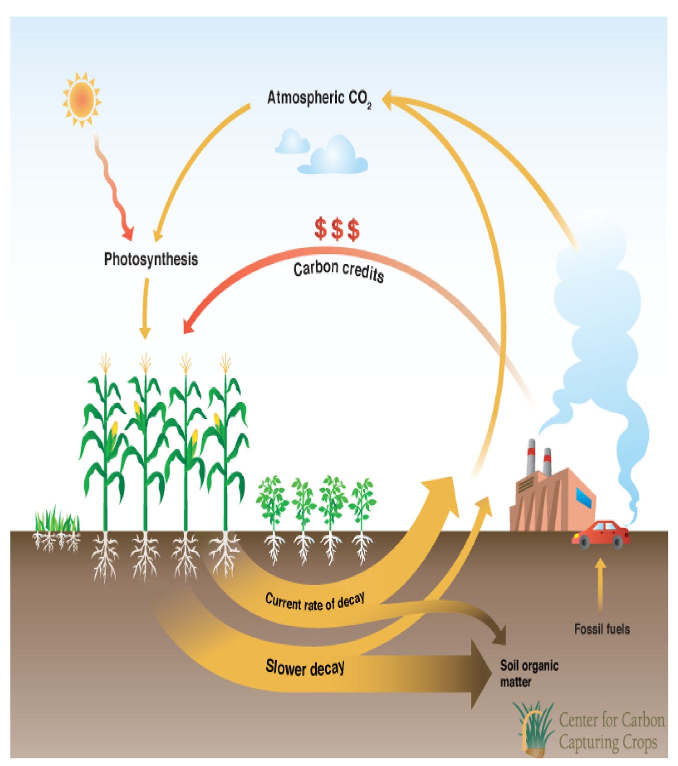


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Figure 1. Nitrogen cycle and carbon cycle.

MATERIALS & METHODS

A greenhouse experiment was conducted in Ohio. Two contrasting soil types (Wooster silt loam and Hoytville clay loam) were treated with gypsum (cumulative of 12 tons per acre, applied in four equal doses of 3 tons per acre each) and crop residues (6 tons per acre, incorporated into soil as a single dose). Emissions of greenhouse gases from soil were measured by the closed chamber method (Rolston (1986) (**Figure 2**) and analyzed by gas chromatography every other week for twenty weeks.

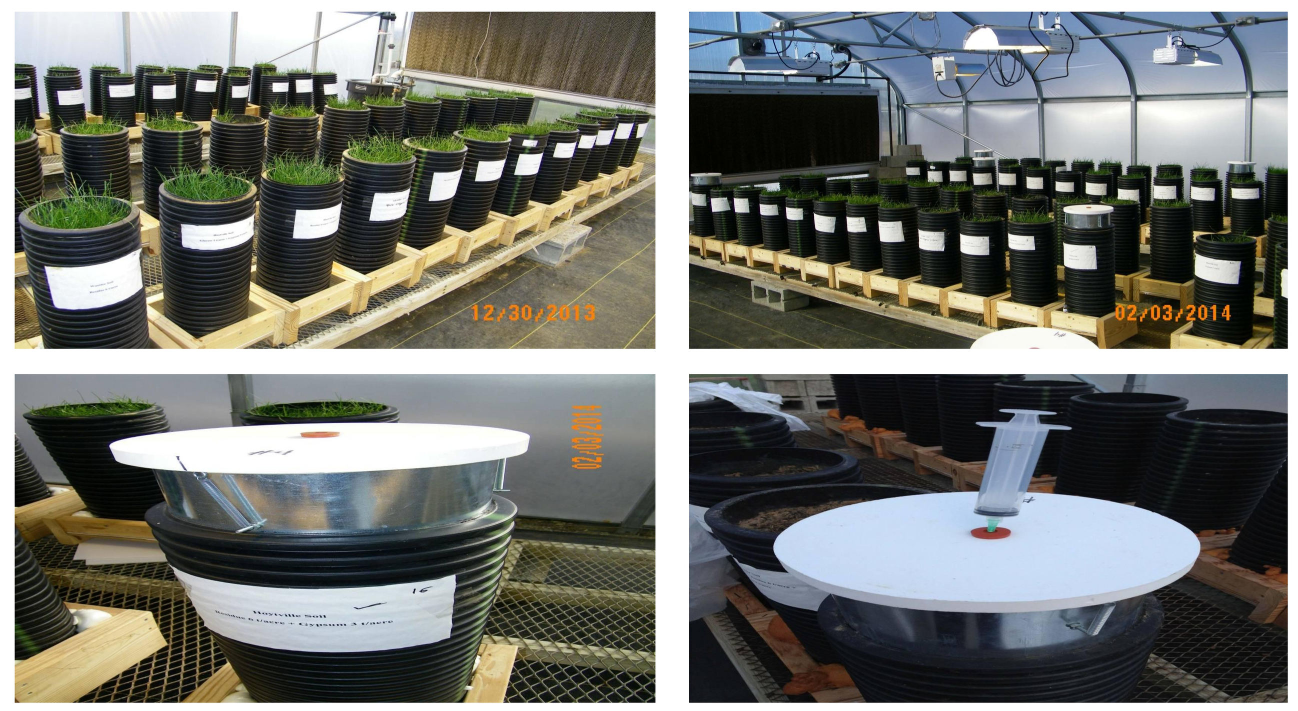

Figure 2. Greenhouse experiment and greenhouse gas chambers inserted in soil columns.

RESULTS & DISCUSSION

Emissions of greenhouse gases were significantly less from Wooster soils as compared to Hoytville soils (**Figure 3**). A significant reduction in the emissions of carbon dioxide and methane was observed with the combined application of crop residues plus gypsum as compared to their alone applications (**Figure 4**). Nitrous oxide was not significantly impacted by the combined incorporation of crop residues and gypsum. Emissions of cumulative nitrous oxide from the Wooster soil was less with the application of gypsum alone as compared to crop residue alone application (**Figures 5,6**). Emissions of cumulative carbon dioxide was less with the addition of gypsum alone as compared to crop residues alone in Hoytville soils. The way that the residue treatment applied alone affected carbon dioxide and nitrous oxide emissions was significantly less for Wooster soil than for Hoytville soil (**Figure 6**). Soil was often a sink for methane.

CONCLUSION

Reductions in methane emissions by gypsum plus residues is attributed to improved soil aeration. Reduced emissions of carbon dioxide from soils with crop residues and gypsum may be due to formation of soil organic and inorganic carbon.

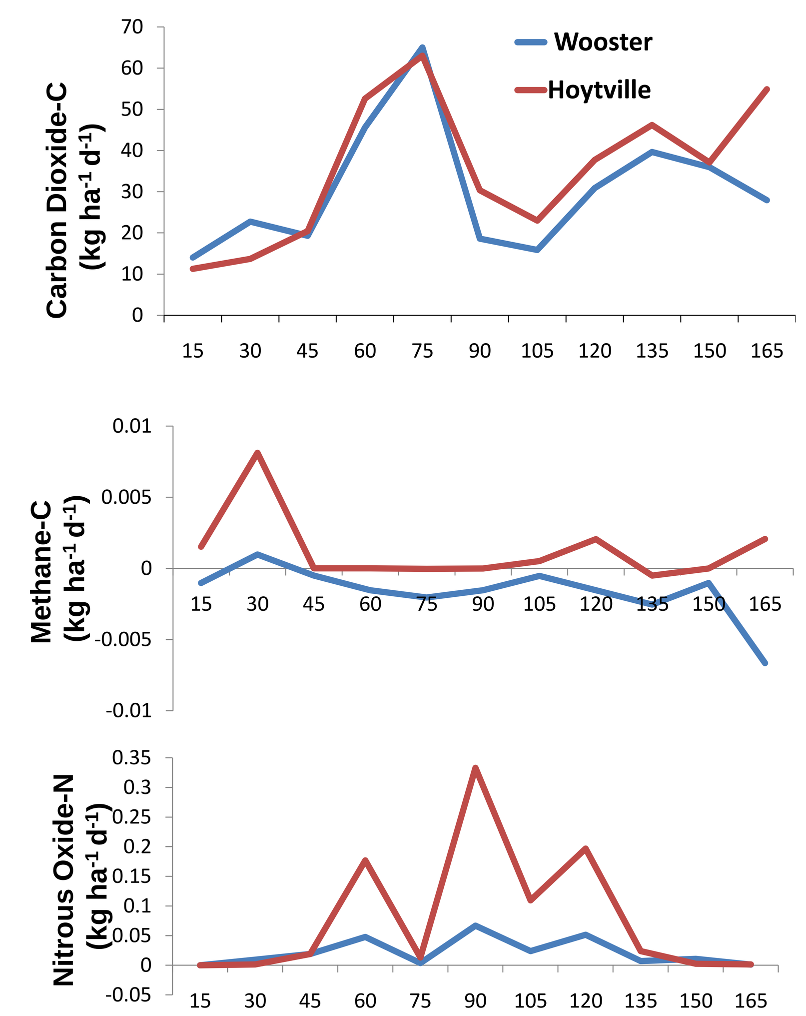

Figure 3. Greenhouse gas emissions from two soil types.

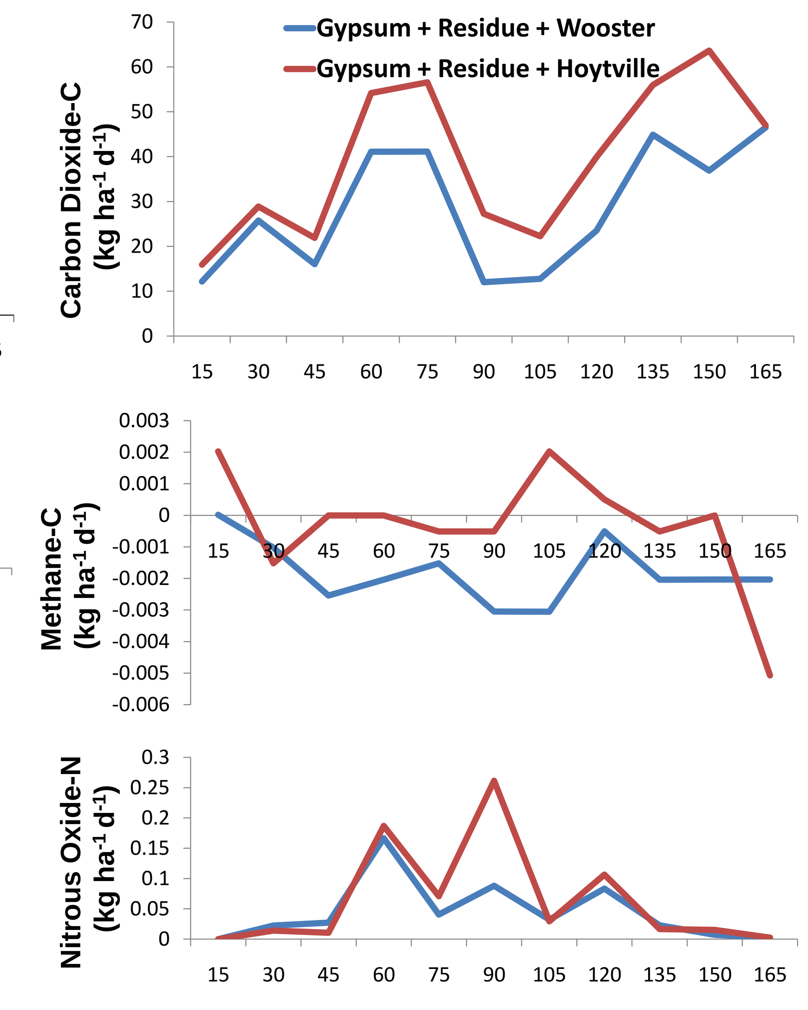

Figure 4. Greenhouse gas emissions from two soil types after addition of gypsum and crop residues.

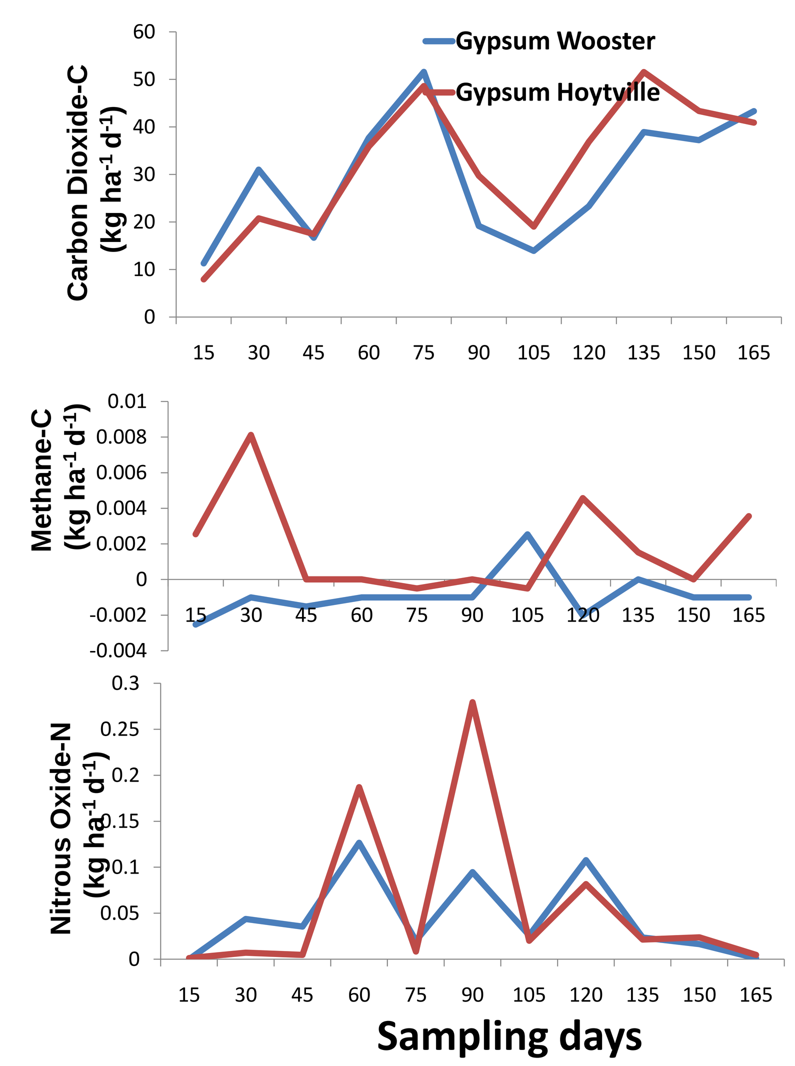

Figure 5. Greenhouse gas emissions from two soil types after addition of gypsum.

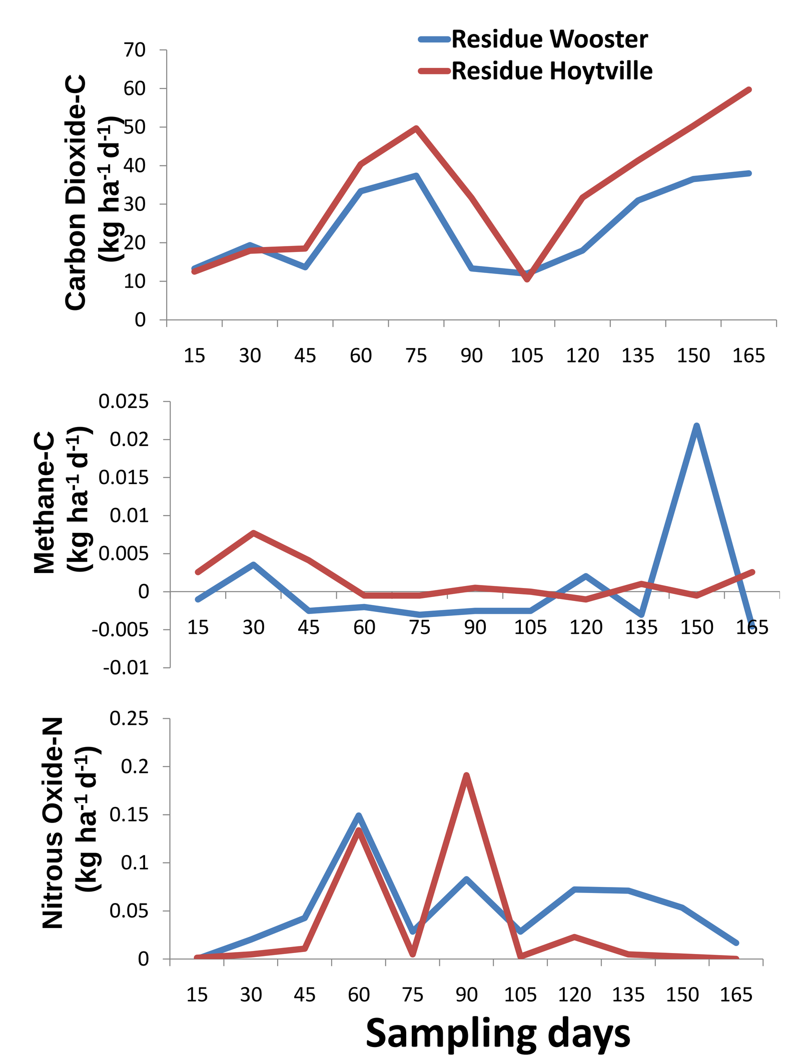

Figure 6. Greenhouse gas emissions from two soil types after addition of crop residues.

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