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

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ABSTRACT

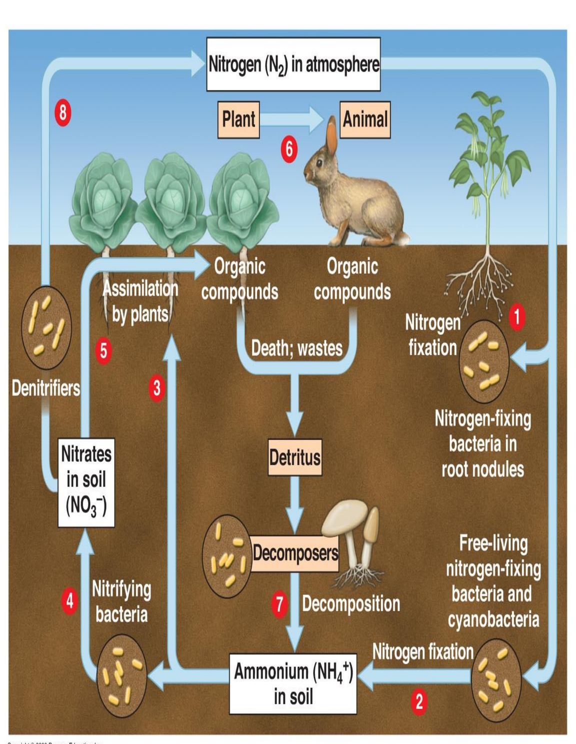
Agricultural practices affect soil fluxes of the greenhouse gases CO_2, CH_4 and N_2O. The effects of gypsum and crop residues on these fluxes are not fully understood. A greenhouse experiment was conducted in Ohio using Wooster silt loam and Hoytville clay loam soils treated with gypsum and crop residues. Emissions of CO_2 and N_2O were significantly less ($P < 0.10$) from Wooster soil as compared to Hoytville soil. Gypsum plus residues, as compared to their alone application, decreased ($P < 0.10$) soil as a source for CO_2 and increased soil as a sink for CH_4. The cumulative emissions of CO_2 were 13% and 19% less with the addition of gypsum alone as compared to the control in the Wooster and Hoytville soils, respectively. Gypsum applied with residues reduced CO_2 emissions suggesting more efficient soil organic matter sequestration with this treatment combination.

INTRODUCTION

Climate change is impacted by greenhouse gas emissions from soils. Soils may act either as a source or a sink for greenhouse gases (**Figure 1**) depending upon 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. Gypsum can also affect soil chemical, physical and biological properties that are hypothesized to affect greenhouse gas fluxes.

OBJECTIVE

❖ To determine whether gypsum and crop residues, applied alone or in combination, can reduce greenhouse gas fluxes from two contrasting soils in Ohio.



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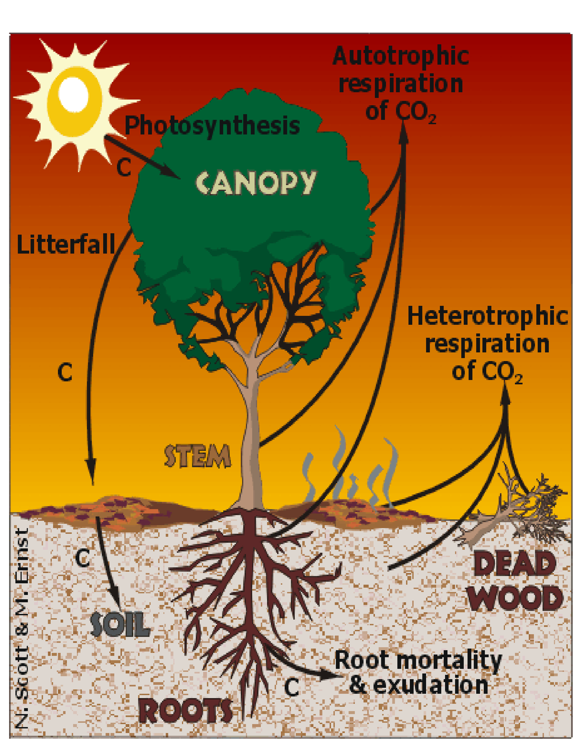

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Figure 1. Nitrogen cycle and carbon cycle.

MATERIALS & METHODS

A greenhouse experiment was conducted in Wooster, Ohio, USA. Two contrasting soil types (Wooster silt loam and Hoytville clay loam) were treated with gypsum (cumulative 26.9 Mg/ha applied in four equal doses of 6.72 Mg/ha each) and crop residues (13.4 Mg/ha, incorporated into soil as a single dose). Fluxes 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.

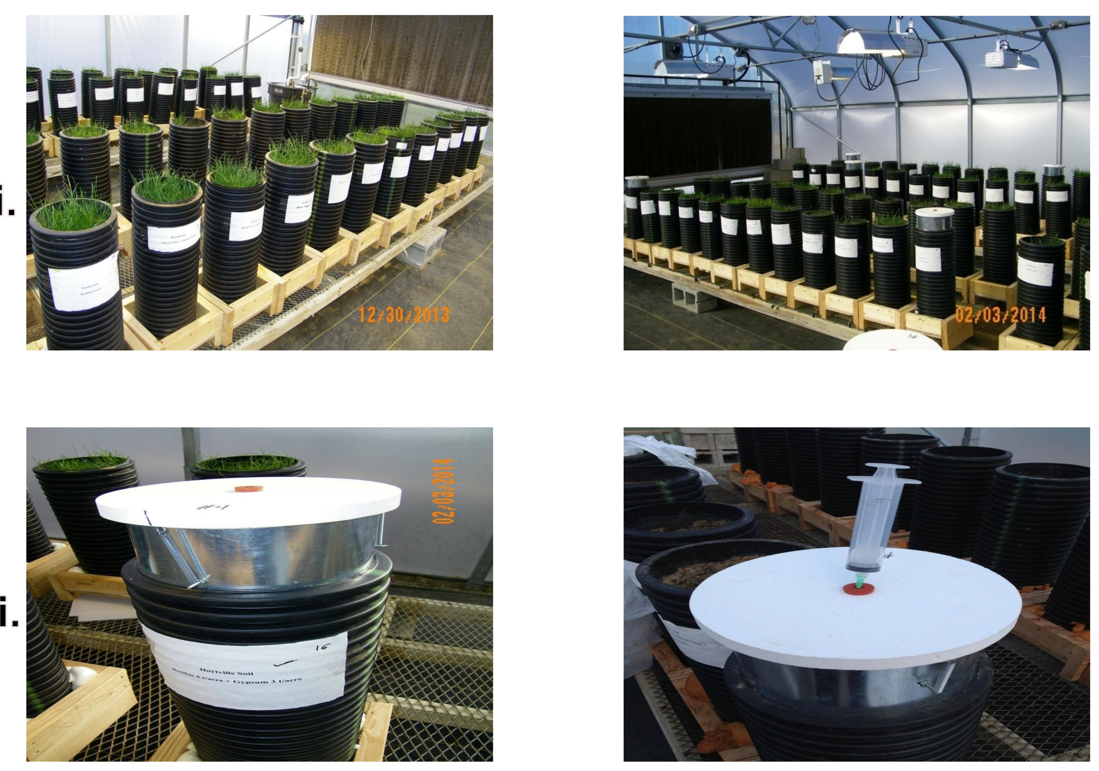

Figure 2. Greenhouse experiment (i,ii) and greenhouse gas chambers inserted in soil columns (iii, iv).

RESULTS AND DISCUSSIONS

Emissions of the greenhouse gases CO_2 and N_2O were significantly less from Wooster soil as compared to Hoytville soil (**Figure 3**). A significant reduction in the emissions of CO_2 and in the uptake of CH_4 was observed with the combined application of crop residues plus gypsum as compared to their alone applications (**Figure 4**). Emissions of N_2O was not significantly impacted by the combined application of crop residues and gypsum. Cumulative uptake of CH_4 was about 46% more in the Wooster soil with the application of gypsum alone as compared to the control. Cumulative emissions of CO_2 were 15% and 10% less with the addition of gypsum and residue as compared to the control in Wooster and Hoytville soils, respectively. However, the cumulative emissions of CO_2 were 13% and 19% less with the addition of gypsum alone as compared to the control in Wooster and Hoytville soils, respectively (**Figures 5**). The effect of residue treatment alone on CO_2 and N_2O emissions was significantly less for Wooster than for Hoytville soil (**Figure 6**).

CONCLUSION

❖ Increased uptake of CH_4 by soils as affected by gypsum plus residues is attributed to improved soil aeration.

❖ Emissions of N_2O are not affected by addition of gypsum and the combination of gypsum plus crop residues.

❖ Reduced emissions of CO_2 from soils with crop residues and gypsum may be due to formation of soil organic and inorganic carbon.

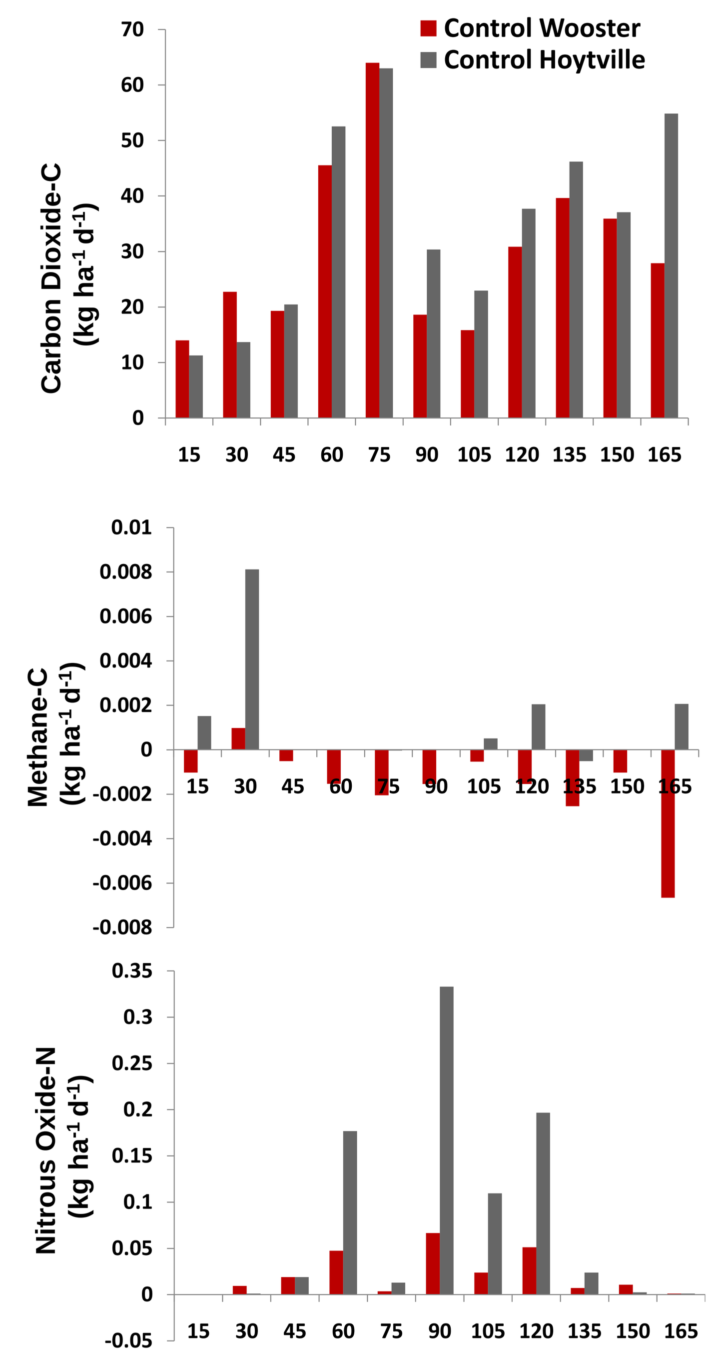

Figure 3. Greenhouse gas emissions from two soil types.

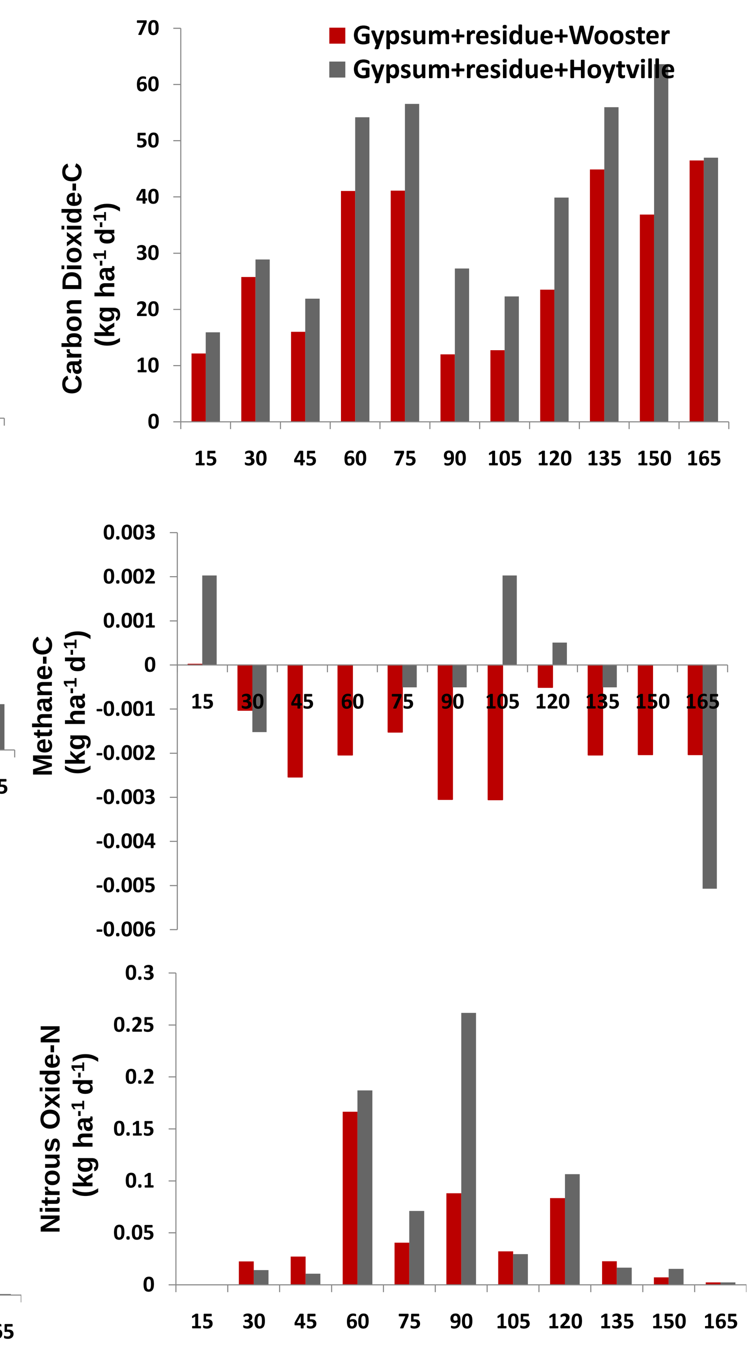

Figure 4. Greenhouse gas emissions from two soil types treated with gypsum and crop residues.

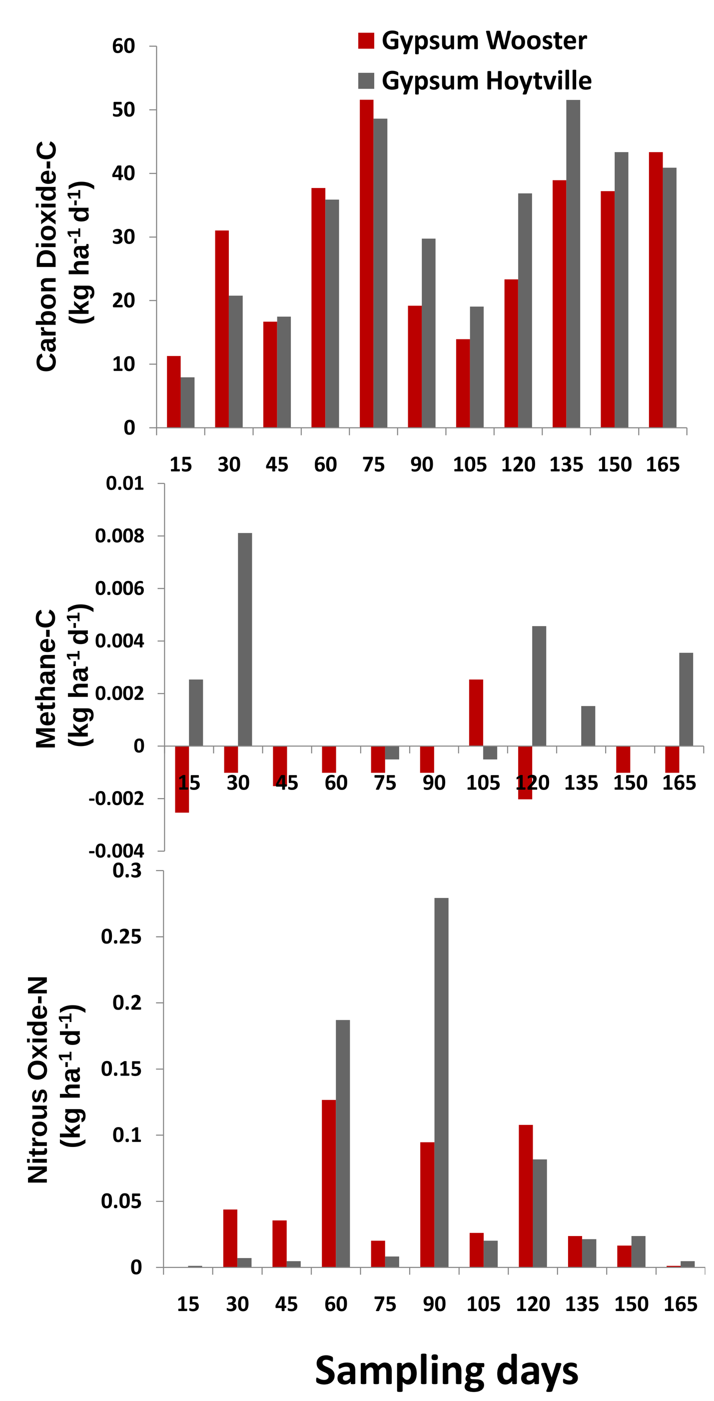

Figure 5. Greenhouse gas emissions from two soil types treated with gypsum.

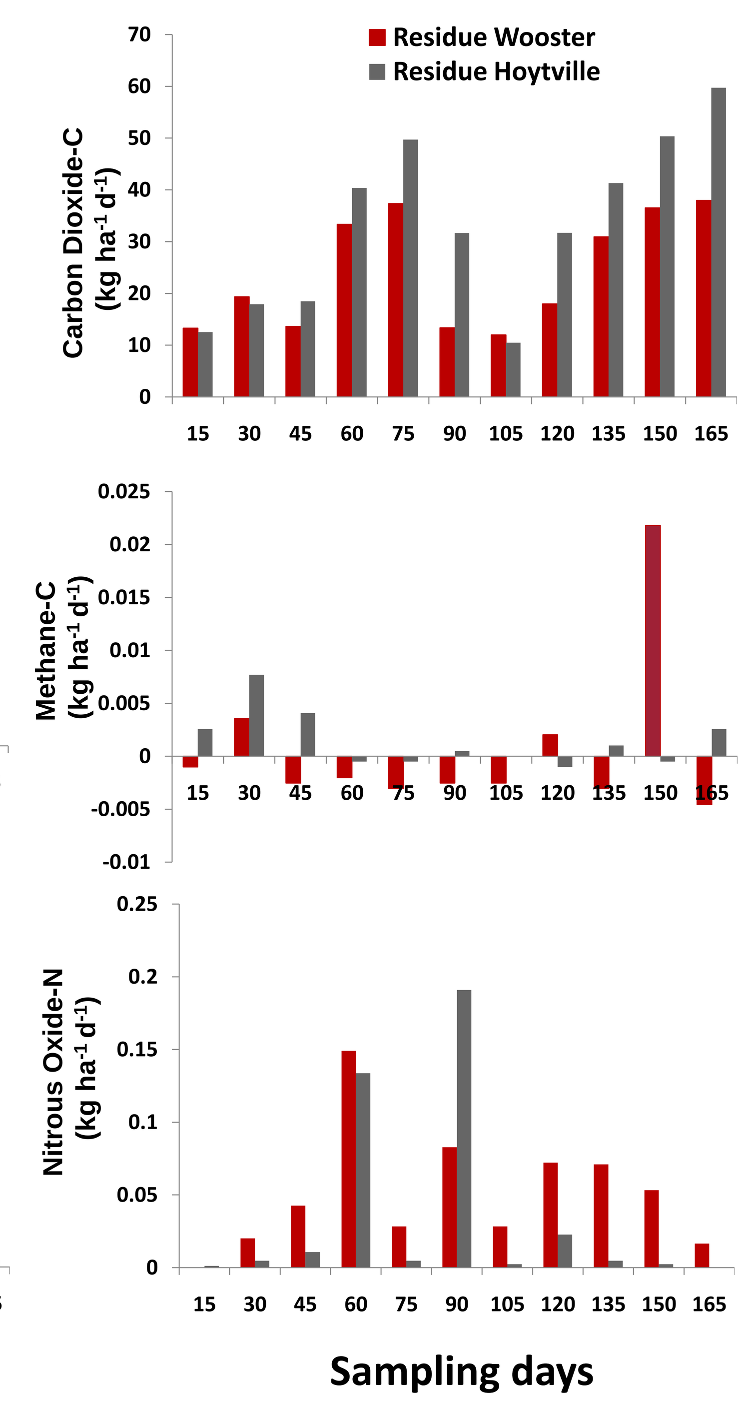

Figure 6. Greenhouse gas emissions from two soil types treated with crop residues.

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