Tillage, Crop Rotation, Nitrogen Fertilizer and Cover Crop Impacts on Greenhouse Gas Fluxes from an Ohio Soil

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ABSTRACT

The effects of crop production practices on fluxes of greenhouse gases from soil are not fully understood. Gas fluxes were measured from a field plot study involving the variables of tillage, crop rotation, N fertilizer, and cover crop. Fluxes of greenhouse gases were measured by gas chromatography bi-weekly during the growing season. Emission of N_2O and uptake of CH_4 were decreased when soils were under no-tillage (NT) compared to minimum tillage (MT). Nitrogen fertilizer, however, significantly increased emission of N_2O from the soil for more than one month after application. Emission of N_2O from the soybean (*Glycine max*) plots was more than from corn (Zea mays) plots except for the period after application of N fertilizer in the corn plots. Emission of CO_2 from plots with cover crops was increased, especially in early spring, and emission of N_2O and uptake of CH_4 were decreased as compared with plots without cover crops. Fluxes of CO_2 from soil were not significantly impacted by fertilizer applications, different crops and different tillage systems.

INTRODUCTION

Climate change is closely related to the increasing emissions of the greenhouse gases CO_2, CH_4, and N_2O to the atmosphere, and soils may be a source or sink of greenhouse gases. Greenhouse gases are naturally cycled through soil and are part of the C and N cycles. Agricultural practices may affect the emissions of greenhouse gases from soils to the atmosphere. However, there is little information regarding the effects of tillage, crop rotation, N fertilizer, and cover crop on greenhouse gas fluxes in soils. The objective of this study was to evaluate the impacts of these agricultural practices on greenhouse gas fluxes in a corn and soybean field soil in Ohio.

MATERIALS & METHODS

A field plot study involving the variables of tillage (NT, no-tillage and MT, minimum or chisel tillage), crop rotations (CC, corn after corn and CS, corn after soybean), N fertilizer rates (34 and 224 kg/ha), and rye cover crops (plus or minus) was conducted in a field at Wooster, Ohio. Fluxes of greenhouse gases from soil were measured by gas chromatography bi-weekly during the growing season.

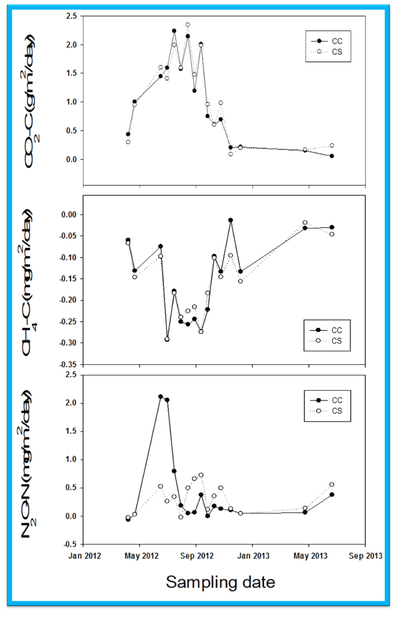

Figure 1. Greenhouse gas fluxes as affected by crop rotation.

RESULTS & DISCUSSION

Emission of N_2O from the soybean plots was more than from corn plots except for the period after application of N fertilizer in the corn plots (Figure 1). Fluxes of CO_2 and CH_4 from soil were not significantly impacted by different crops. Emissions of N_2O and uptakes of CH_4 were decreased when soils were under NT compared to MT (Figure 2). Fluxes of CO_2 from soil were not significantly impacted by different tillage systems. Emissions of CO_2 from plots with cover crops were increased, especially in early spring, by1-3 times and emissions of N_2O and uptake of CH_4 were decreased as compared to plots without cover crops (Figure 3). Nitrogen fertilizer significantly increased emission of N_2O from the soil for more than one month after application, which was approximately 5-10 times greater by high N fertilizer than by low N fertilizer. Fluxes of CO_2 and CH_4 from soil were not significantly impacted by fertilizer applications (Figure 4).

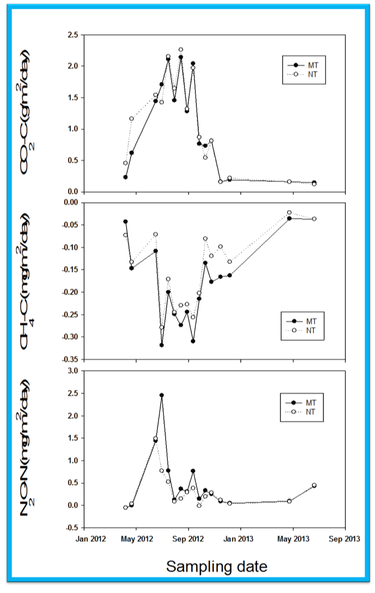

Figure 2. Greenhouse gas fluxes as affected by tillage.

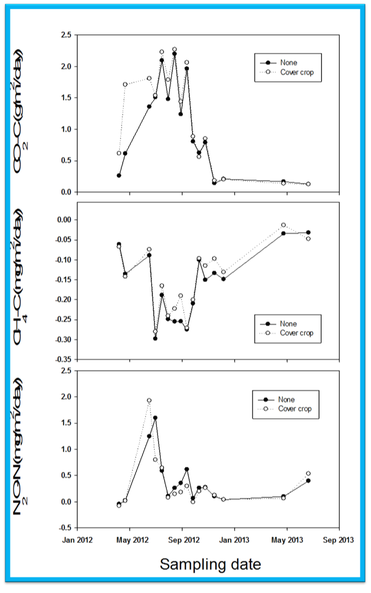

Figure 3. Greenhouse gas fluxes as affected by cover crop.

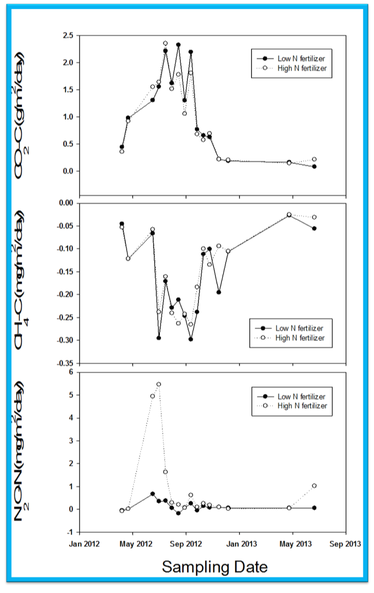

Figure 4. Greenhouse gas fluxes as affected by N fertilizer.

CONCLUSION

Nitrous oxide is the greenhouse gas most affected by tillage, crop rotation, nitrogen fertilizer and cover crop applied to an Ohio Soil. Carbon dioxide fluxes are tied to longer-term soil/crop management practices.

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