Tillage, Crop Rotation, Nitrogen Fertilizer and Cover Crop Impacts on Greenhouse Gas Fluxes in Ohio

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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. Emissions of N_2O were decreased by 40% when soils were under NT compared to MT. Application of N fertilizer, however, significantly increased emission of N_2O from the soil. Emission of N_2O from the soybean plots was less than from corn plots. Emissions of CO_2 from plots originally with cover crops were increased as compared with those plots without cover crops. Fluxes of CO_2 and CH_4 were not significantly impacted by fertilizer applications and 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 field in Ohio.

Figure 1. Installation of greenhouse gas chambers, sampling of greenhouse gases, and determination of greenhouse gases.

MATERIALS & METHODS

A field plot study involving the variables of tillage (NT, no-tillage and MT, minimum or chisel tillage), crop rotations (CC, corn (*Zea mays*) after corn and CS, corn after soybean (*Glycine max*)), N fertilizer rates (0 and 225 kg/ha), and rye cover crops (plus or minus) was conducted in a field at Wooster, Ohio. Fluxes of greenhouse gases were measured by gas chromatography bi-weekly during the growing season. Installation of greenhouse gas chambers, sampling of greenhouse gases, and determination of greenhouse gases are shown in Figure 1.

RESULTS & DISCUSSION

Fluxes of CO_2 as affected by crops, tillage, cover crops, and N fertilizers are presented in Figure 2. Results indicate that emissions of CO_2 from plots originally with cover crops were increased by 20% as compared with those plots without cover crops. Fluxes of CO_2 were not changed by crops (corn and soybean), tillage (NT and MT), and N fertilizers.

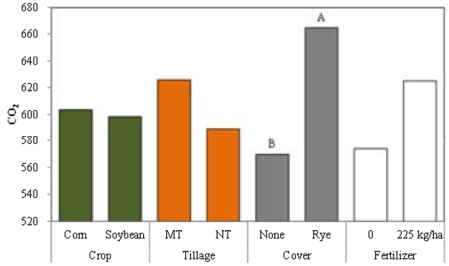

Figure 2. Fluxes of CO_2 as affected by crops, tillage, cover crops, and N fertilizers.

Fluxes of N_2O as affected by crops, tillage, cover crops, and N fertilizers are presented in Figure 3. Results indicate that application of N fertilizer significantly increased emission of N_2O from the soil four fold compared to the control. Emission of N_2O from the soybean plots was much less than from corn plots. Emissions of N_2O from plots under NT were decreased by 40% as compared with those plots under MT. Emissions of N_2O were not impacted by cover crops.

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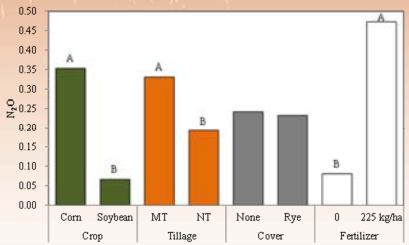

Figure 3. Fluxes of N_2O as affected by crops, tillage, cover crops, and N fertilizers.

Fluxes of CH_4 as affected by crops, tillage, cover crops, and N fertilizers are presented in Figure 4. Results indicate that fluxes of CH_4 were not changed by crops, tillage, cover crops, and N fertilizers.

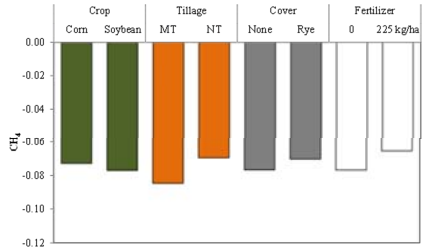

Figure 4. Fluxes of N_2O as affected by crops, tillage, cover crop, and N fertilizers.

CONCLUSION

Total greenhouse gas emissions were decreased when soils were under NT compared to MT. Application of N fertilizer significantly increased emission of N_2O from the soil. Emission of N_2O from the soybean plots was less than from corn plots. Emissions of CO_2 from plots originally with cover crops were increased as compared with those plots without cover crops.