Soil Surface Greenhouse Gas Fluxes for Differing Residue Removal Rates in a Corn-Soybean Rotation

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Overview

- Methane (CH_4), Carbon dioxide (CO_2) and Nitrous Oxide (N_2O) are the most prevalent greenhouse gasses (GHG) released from the soil.
- Management such as tillage and crop residue removal impacts soil organic carbon (SOC) and hence GHG fluxes.
- Managing residue removal on soil surface may be beneficial for the soils and the environment.
- Cover crops, and no-till (NT) systems may improve the soils when crop residue is removed.

Objectives

- Assessing the impacts of residue removal and cover crops with no-till management on soil surface GHG emissions.

Materials and Methods

- Study area was located at the USDA-ARS North Central Agricultural Research Station, north of Brookings, South Dakota.
- The experiment was conducted as a no-till corn-soybean rotation with two different residue removal; low residue removal (LRR) and high residue removal (HRR) with and without the presence of a cover crop
- Soil surface gas fluxes were collected weekly using static chamber method, and were analyzed using gas chromatography(GC) (Jacinthe and Dick, 1997) (Fig. 1, 2, and 3).

Fig. 1. Gas Chamber

Fig. 2. Collection of gas samples

Fig. 3. GC machine

Results

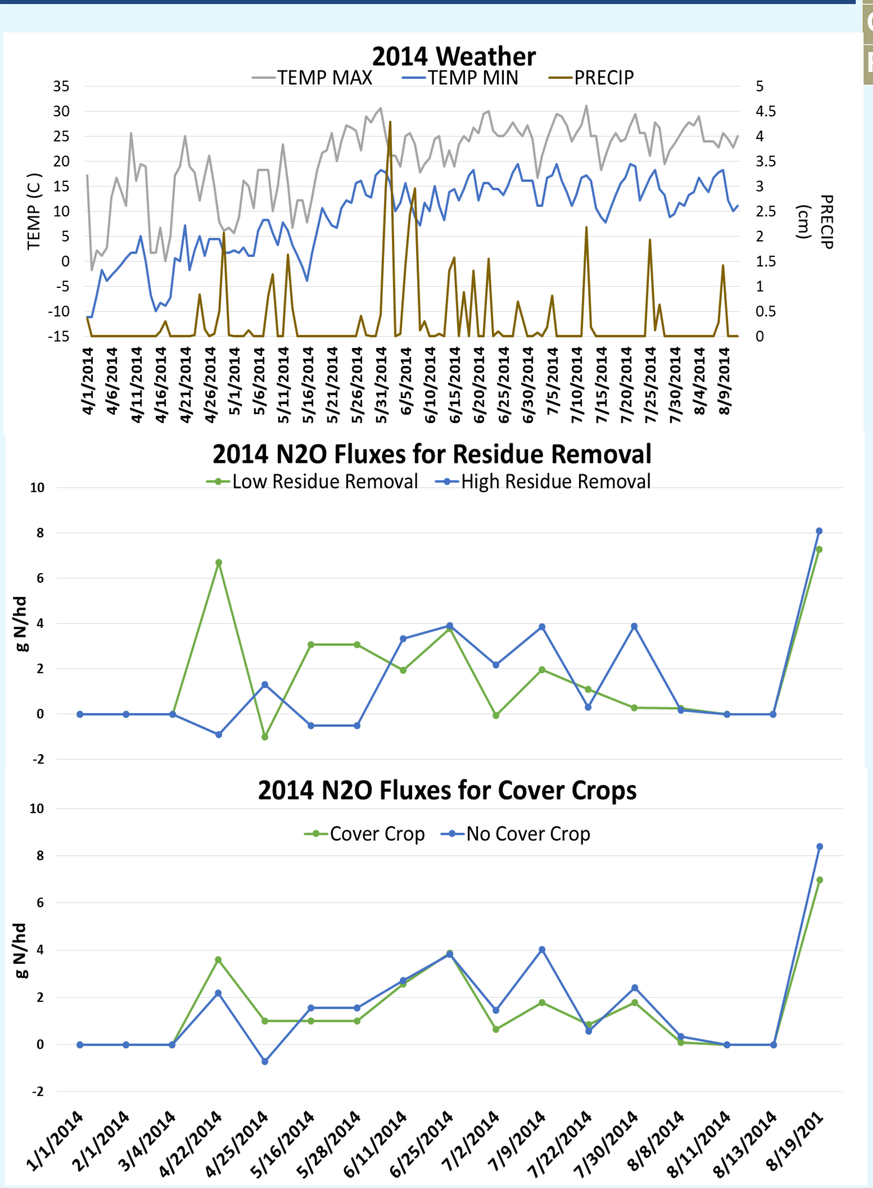

Fig. 4. Weather data from 2014 compared with N_2O fluxes from residue removal and cover crop treatments

- Snow melt and rainfall events increased N_2O fluxes for soils with residue removed than for soils with residue retained(Fig. 4).
- GHG fluxes increased as the temperature increased, but peaks were most noticeable after rainfall events (Fig. 4).

Table 1. Soil organic carbon (SOC) for residue removal and cover crop treatments. Values are compared within a column.

SOC (g kg^{-1})				
0-5 cm Soil Depth				
Treatment	2008	2009	2010	2011
LRR	2.83[a]	2.99[a]	2.88[a]	2.95[a]
HRR	2.47[b]	2.50[b]	2.38[b]	2.53[b]
Cover Crop				
Yes	2.69[a]	2.75[a]	2.67[a]	2.78[a]
No	2.63[a]	2.76[a]	2.62[a]	2.77[a]
	Analysis of Variance			
Residue	<0.01	<0.01	<0.01	<0.01
Cover Crop	0.45	0.67	0.59	0.90
Residue × Cover Crop	0.57	0.81	0.99	0.48

- SOC was higher in soils under a low residue removal treatment compared to when high levels of residue was removed (Table 1).

Conclusions

- Precipitation impacted the soil surface GHG fluxes, especially N_2O fluxes. The peaks of N_2O matched with the high precipitation peaks.
- Cover crops produced lower soil surface N_2O fluxes compared to those with no cover crop.
- This study is part of an ongoing project, and therefore, further sampling of soil GHG fluxes will be monitored for another year and data will be used in ecosystem model for finding mitigation strategies of GHG fluxes.

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References

- Jacinthe P.A. and Dick W.A. 1997. Soil management and nitrous oxide emissions from cultivated fields in southern Ohio. Soil & Tillage Research. 41:221-235.