Greenhouse Gases Emissions as Affected by Tillage and Cropping Systems

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ABSTRACT

Greenhouse gases (GHGs) warm the atmosphere by absorption of the sun's energy and contribute to global warming. The most common GHGs are carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4). Unfortunately, agriculture is cited among the sources contributing to increase these gases in the atmosphere. We are conducting a study along the Missouri River floodplains in Jefferson City Missouri, to investigate the effect of tillage and cropping systems on GHG emissions. Our treatments are: conventional tillage vs. no-till, cover crop vs. no cover crop, continuous corn, continuous soybean, soybean corn rotations, and corn soybean rotations for a total of 48 plots. Air samples for analysis of CO_2, CH_4 and N_2O samples are collected every two weeks since August 2011 in each plot from static and vented chambers installed in the field since June 2011. The air samples are stored in tedlar bags, and analyzed within 24 hours of collection with a Shimadzu gas chromatograph (GC). After analysis, data on gas concentrations are recorded for later statistical analysis.

INTRODUCTION

Total GHG emissions from agricultural activities in the United States have produced an average of 514 MMT CO_2-Eq from 2003 to 2007 (Johnson, 2009). The burning of fossil fuels, application of nitrogen fertilizers, and soil management are major agricultural sources of CO_2, N_2O, and CH_4, respectively (Johnson, 2009; Smith et al., 2010).

The proper management of cropping systems is essential in the reduction of GHG emissions.

OBJECTIVES

To measure and characterize GHG fluxes in response to tillage treatments and cropping systems.

METHODS

Study area/soils: Freeman Farm in Jefferson City, MO
Soil type varies as a result of flooding events (1993 & 1995).
Laboratory analysis: Gas samples were collected from static and vented chambers in 48 plots. Gas concentrations were analyzed on a Shimadzu gas chromatograph within 24 hours of collection.

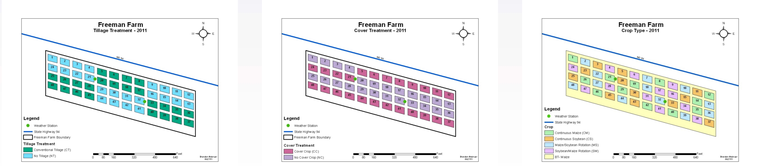

Fig.1 (Tillage, Cover, Crop Type). Field experiment

RESULTS

	CO_2 (08-02)	CO_2 (08-16)	CO_2 (08-30)	CH_4 (08-02)	CH_4 (08-16)	CH_4 (08-30)	N_2O (08-02)	N_2O (08-16)	N_2O (08-30)
Mean	404.73	434.3	325.13	234.12	236.34	-915.21	82.406	78.787	-29.253
SD	191	152.78	122.1	767.7	182.24	324.08	93.599	59.305	75.416
C.V.	47.193	35.179	37.554	327.91	77.11	35.41	113.58	75.273	257.81
Min	45.064	178.26	118.18	-384.65	-174.38	-1211.8	-25.537	10.357	-157.02
Med	350.23	416.83	288.98	-35.44	216.24	-963.66	58.693	62.29	-33.406
Max	1034.9	1180	642.57	2994.8	753.15	1005.2	602.82	311.55	146.09
Skew	0.9072	2.3393	0.776	1.8975	0.5366	4.5638	3.7753	1.8246	0.3608
Kurtosis	1.2531	9.9292	0.1211	2.8797	0.7579	24.158	18.239	4.0473	-0.5413

Table 1. Summary of simple statistics for carbon dioxide (CO_2, mg C-CO_2 m^2h^{-1}), methane (CH_4,ug C-CH_4 m^2 h^{-1}) and nitrous oxide (N_2O, ug N-N_2O m^2 h^{-1})

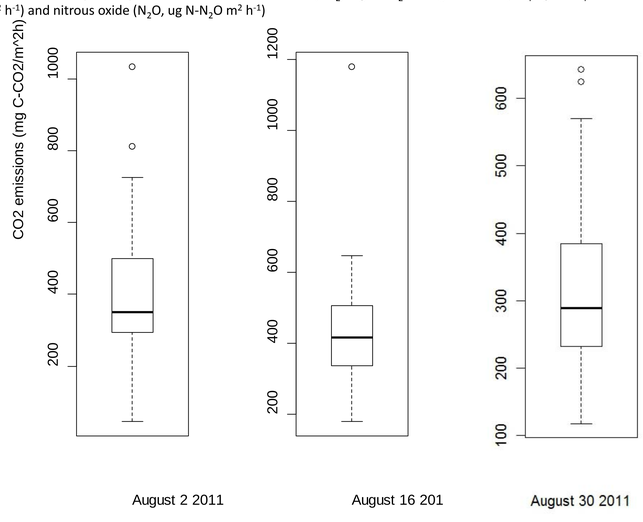

Fig.2. CO_2 emissions during the first three samplings.

DISCUSSION

Preliminary results show that CO_2 emissions increased from the first to the second sampling date, but decreased during the third sampling period. Plots emitted CH_4 and N_2O on the first two sampling dates and sequestered CH_4 and N_2O on the third sampling dates. Plots planted in soybean crop consistently emitted greater amounts of GHGs as compared with plots planted in corn. These results were consistent on all three sampling dates. A significant interaction was found between tillage and crop rotation during the third sampling period, approximately 2 months after tillage and planting. Overall, these preliminary results indicate that plots under the no-tillage treatment emitted greater amounts of CO_2 in comparison to conventional tillage treatments.

SUMMARY

1. Research plots emitted CO_2 into the atmosphere over the three sampling dates.
2. Research plots both emitted and sequestered N_2O and CH_4 over the three sampling dates.

REFERENCES

Johnson, R. 2009. Climate Change: The Role of the U.S. Agriculture Sector. Congressional Research Service.

Smith, K. E., Runion, B. G., Prior, S. A., Rogers, H. H., Torbert, H. A. 2010. Effects of elevated CO2 and agricultural management on flux of greenhouse gases from soil. Soil Science. 175:349-356.

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