Effects of extremely dry and wet soil conditions on GHGs emission from Wisconsin soils

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INTRODUCTION

Climate change projections suggest an increased variability of extreme climate conditions, such as sustained drought or prolonged precipitation (1,2). The early growing season for 2012 and 2013 contrasted significantly in Wisconsin, where 2012 was one of the direst seasons ever recorded while 2013 was one of the wettest. These events had a negative effect on Wisconsin crop production but also created many questions on the intensity of three major greenhouse gass (GHGs) emissions from soils which when trapped in the atmosphere warms the surface of the Earth via infrared radiation (1,3). Corn rotation is a management practice of high mitigating potential, but due to recent economic influences is often neglected. The effect of crop rotation on GHGs emissions is usually positive for mitigation (4,5).

Our objective was to compare early-season GHGs emission between 2012-2013 of six rotation treatments at the Arlington Research Station, WI. Sufficient time has passed to allow these extended crop rotation experiments to equilibrate differences within treatments.

MATHERIALS & METHODS

Location	Arlington, WI
Data Type	CO_2, N_2O and CH_4 (GHGs) field emissions
Sampling Interval	Weekly up to end of Jun of 2012 & 2013
Treatments	1. Continuous corn (C)* 2. Corn-soybeans (CSc) 3. corn-Soybeans (CSs) 4. Corn-soybeans-wheat (CSWc) 5. corn-Soybeans-wheat (CSWs) 6. corn-soybeans-Wheat (CSWw) *Capital = current crop
Method	In-situ closed-cover flux chambers
Chamber Placement	IR-in row, BR- between row (12 per rep)
Detailed Description	Gas fluxes were measured at four-20 minute sampling intervals. Samples are taken from gas traps by inserting a 30 mL syringe into the rubber septa from where 20 mL was used to flush a vented 5 mL glass vial and remaining 10 ml was placed in the glass vial, giving the vial a gas overpressure.
Analysis	The experimental design was a randomized complete block in a split-plot arrangement, with three replications. Whole plot factors were rotation treatment, and the split plot factor was the chamber placement. Analysis of variance for the factors location, treatment, chamber placement, and replications as blocks was performed using the PROC MIXED procedure of SAS (SAS Inst., 2008).

Fig.1. Averaged N_2O flux across sampling dates in Arlington, WI, followed by four detailed flux distributions across sampling days for selected corn treatments. Data show comparisons between years and chamber placements.

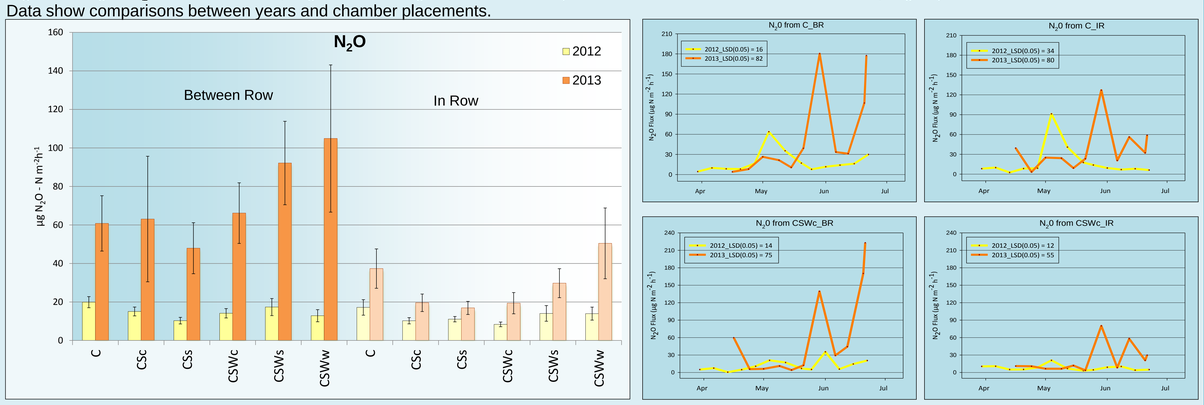


Fig.2. Averaged CO_2 flux across sampling dates in Arlington, WI, followed by four detailed flux distributions across sampling days for selected corn treatments. Data show comparisons between years and chamber placements.

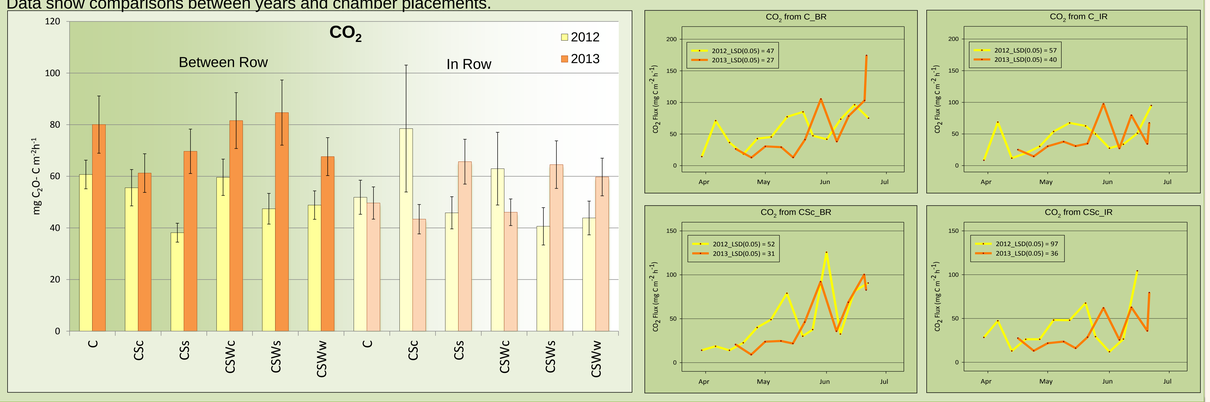
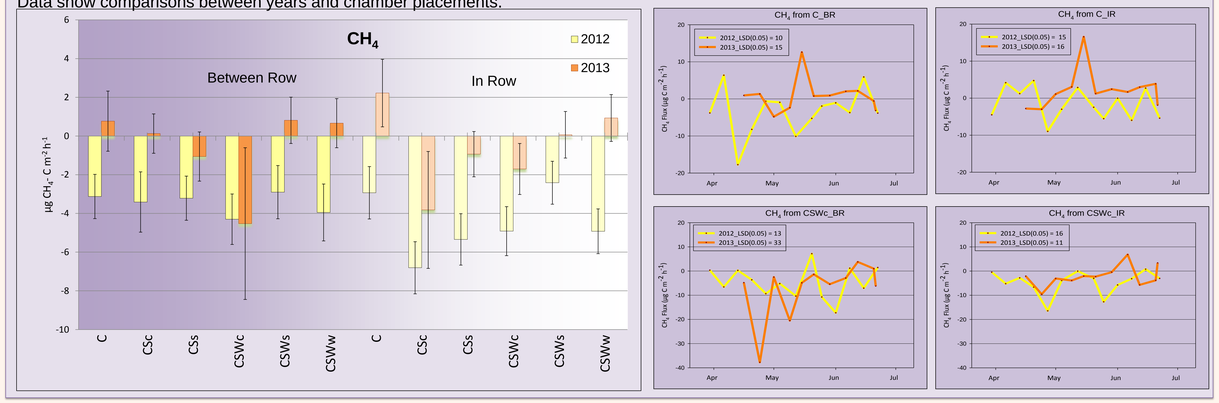


Fig.3. Averaged CH_4 flux across sampling dates in Arlington, WI, followed by four detailed flux distributions across sampling days for selected corn treatments. Data show comparisons between years and chamber placements.



Dry June 2012 — Arlington, WI — Wet June 2013

RESULTS

N_2O

N_2O emissions were highly controlled by soil moisture (Fig.1). Under very wet conditions in 2013 averaged emissions were 132% higher IR and 385% higher BR compare to 2012, where winter wheat surprisingly had the highest emissions. There was an effect ($p<0.05$) of year, treatment, chamber placement and year x place.

CO_2

Averaged between all treatments, 2013 had 43% higher emissions BR and similar IR to 2012 (Fig.2). Across chamber placements all 2012 treatments where corn was grown had the highest CO_2 emissions whereas in 2013 the lowest, except C and CSWc treatments placed BR.

CH_4

In both years, averaged within all treatments, soils were a minor CH_4 sink where 2012 was significantly greater (Fig.3). In 2013 positive CH_4 emission were recorded under C, CSWs, and CSWw treatments in both chamber placements.

CONCLUSIONS

- These results provide an important understanding on how different weather conditions might affect GHGs emission from agricultural soils.
- These results will help develop best-management recommendations for minimizing GHGs emissions from corn-based systems.

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