Effects of Corn Residue and Cover Crops on Soil Greenhouse Gas Emissions

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Background

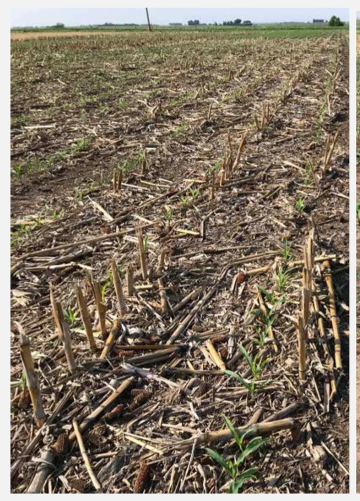
Figure 1. No residue removal with no cover crop


Figure 2. Maximum residue removal with no cover crop

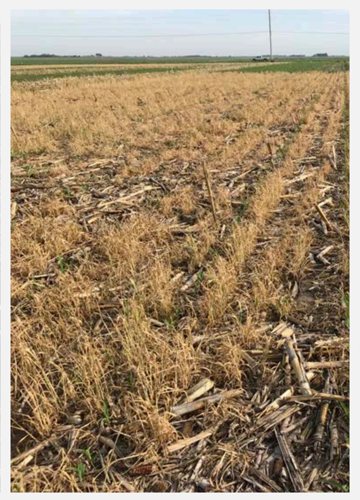
Figure 3. No residue removal with cereal rye cover crop


Figure 4. Maximum residue removal with cereal rye cover crop

Benefits of Corn Residue Retention

- Source of grazing for livestock
- Protects soil from wind and water erosion
- Increases soil organic matter, moisture and nutrient holding capacity

Benefits of Corn Residue Removal

- Improves soil conditions for crop planting and germination
- Source of biofuel and pelletized feed for livestock

Benefits of Winter Cover Crops

- Protects soil from wind and soil erosion
- Increases soil organic matter, moisture and nutrient holding capacity
- Suppresses weed growth, soil diseases, and pests

Objectives

- Evaluate how corn residue/stover management and cover crop use affects soil greenhouse gas (GHG) emissions in an intensively managed no-till continuous corn (*Zea mays* L.) production system
- Determine corn residue removal effects on carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) emissions
- Determine winter cover crop effects on CO_2, N_2O, and CH_4 emissions

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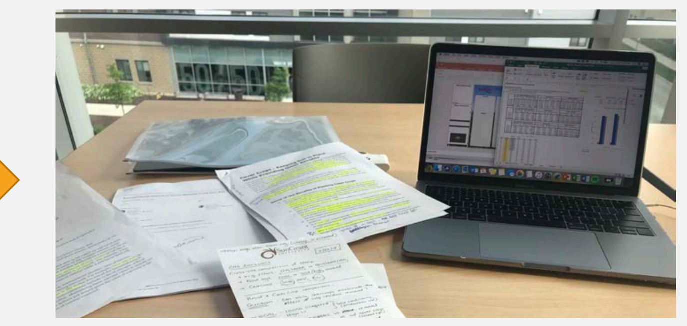
Materials and Methods


Planting and Treatment


Gas Sampling


Sample Analysis


Data Processing

- For crop-year (CY) 2011 to CY2014 at the University of Nebraska's South Central Agricultural Laboratory (Clay Center, NE)
- USDA-ARS GRACEnet (Greenhouse gas Reduction through Agricultural Carbon Enhancement) protocol (Parkin & Venterea 2010)
- Samples taken every 5-10 days during growing season and once every month during the non-growing season
- Daily GHG flux rate calculated as a linear or quadratic curve
- Cumulative emissions are calculated by taking the trapezoidal integration of the daily GHG fluxes measured throughout the crop year
- Annual GHG emissions are analyzed with a 3-way mixed ANOVA, with residue and cover crop management as fixed effects, and year and field replicate as random effects

Results

Figure 1. Mean CO_2 Emissions

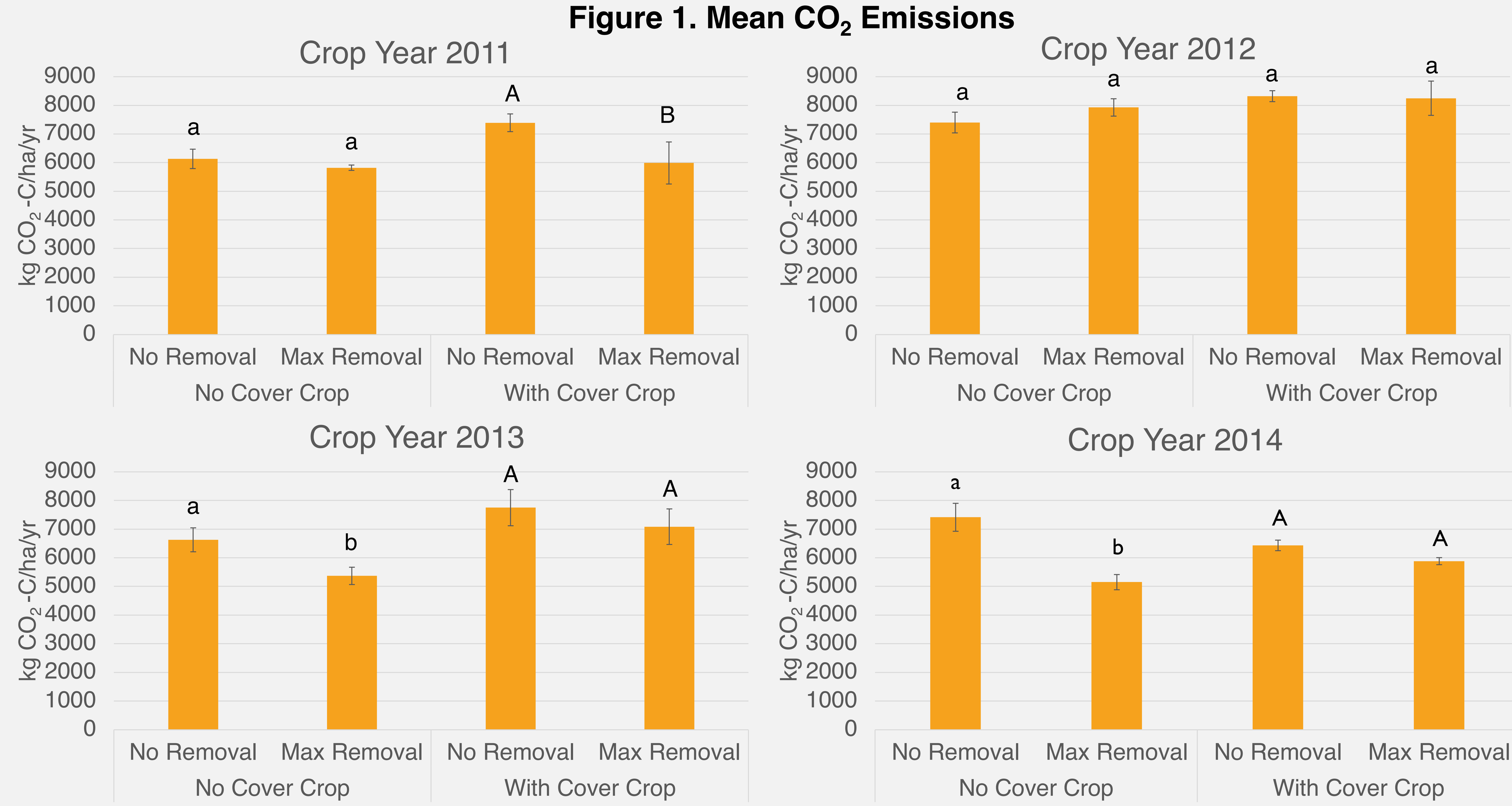


Figure 2. Mean Crop Year N_2O Emissions

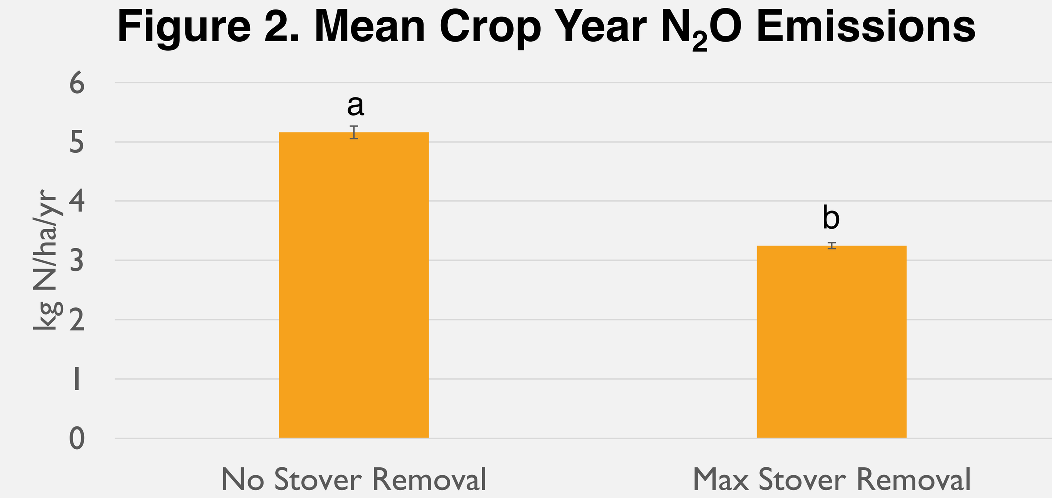


Table 1. CY Weather Averages for Growing Season

	Growing Season Start	Growing Season End	Total Ppt (mm)
CY2011	4/29/11	10/5/11	363.47
CY2012	4/24/12	9/24/12	300.99
CY2013	5/16/13	10/22/13	442.47
CY2014	5/2/14	10/15/14	518.16

- No treatment effect on CH_4 emissions. CH_4 Mean Crop Year Emissions: 4.21 +/- 0.04 kg CH_4-C/ha/yr

Conclusion

- CO_2 generally reduces by a reduction in biomass input
- N_2O increases with an increase in moisture retainment and biomass residue
- System's CH_4 emissions negligible compared to other two GHGs
- Effect of residue management outweighs the impact of cover crop use or annual weather
- Study limited to a single geographical climate and crop
- Future work: expand the study to various crops and climates

Acknowledgements & References

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Parkin, T.B. and Venterea, R.T. 2010. Sampling Protocols. Chapter 3. Chamber-Based Trace Gas Flux Measurements. IN Sampling Protocols. R.F. Follett, editor. p. 3-1 to 3-39. Available at: www.ars.usda.gov/research/GRACEnet

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