ABSTRACT. Corn stover has been identified as a potential cellulosic ethanol feedstock prompting assessments of the effects of residue removal on soil processes. The objective of this study was to determine the effect of corn residue removal on carbon dioxide (CO₂) and nitrous oxide (N₂O) fluxes from soil. A replicated field trial of continuous corn (Zea mays L.) production was established in 2007 on Endoaquoll and Hapludoll soils near Ames, IA. Treatments included 0, 50, and 100% surface residue removal from corn under chisel plow (CP), no-tillage (NT), and chisel plow with a one-time 18,500 kg ha⁻¹ biochar application (Biochar). Soil CO₂ flux was measured using a Li-Cor LI-8100 infrared CO₂ analyzer at one PVC collar (0.031 m² area) inserted into the soil at in-row and between-row positions in each plot. Soil N₂O flux was measured by collecting gas samples beneath closed covers on the same collars followed by sample analysis by gas chromatography. Hourly soil water content (θ) and temperature (T) at 5 cm adjacent to each collar were measured with Decagon 5TM or EC-TM sensors and EM50R dataloggers. 100% and 50% residue removal reduced annual soil CO₂ flux by an average of 11% and 2.5% across all years and treatments. Fluxes of N₂O were dominated by high values following a sidedress application of 32% UAN at 180 kg ha⁻¹ rate and with Agrotain urease inhibitor. The measured N₂O fluxes in 2011 had an average global warming potential (GWP) equivalent to 15.8% of the CO₂ fluxes, also with lower fluxes with increasing residue removal.

OBJECTIVE
Use static chamber, soil T and θ measurements to estimate the annual soil CO₂ and N₂O fluxes for continuous corn cropping systems under chisel plow (CP), no-tillage (NT), and chisel plow with a single biochar application (Biochar) with removal of No, 50% and 100% of surface residue following grain harvest.

MATERIALS & METHODS
- Study initiated in 2008 at Iowa State University Agronomy/Agricultural and Biosystems Engineering farm located in central Iowa.
- Randomized complete block with 4 replicates of 22 treatments in 12.2 x 91.4 m plots.
- Soils: Webster silty clay loam (fine-loamy, mixed, superactive, mesic Typic Endoaquolls), Clarion loam (fine-loamy, mixed, superactive, mesic Typic Hapludolls ), and Canisteo silty clay loam (fine-loamy, mixed, superactive, calcareous, mesic Typic Endoaquolls).
- CO₂ and N₂O fluxes were measured from 2 20 cm-diameter PVC collars (in-row and between-row) in each plot of 9 treatments (CP, NT, and Biochar with No, 50%, and 100% surface residue removal) with a Li-Cor LI-8100 analyzer and 8100-103 survey chamber and constructed static chambers following GRACEnet (http://www.ars.usda.gov/research/programs/programs.htm?np_code=204&docid=17271&pagel=f) protocols, respectively. Measurement intervals ~biweekly during growing season and ~monthly over winter with strategic N₂O sampling follow N fertilization.
- Soil T and θ measured with Decagon 5TM or EC-TM sensors and EM50R dataloggers at 5 cm depth adjacent to each flux collar.
- Annual flux estimates from interpolation between means of treatment data points.
RESULTS

100% and 50% surface corn residue removal reduced annual soil CO₂ flux by an average of 11% and 2.5%, respectively, across all years and treatments.

2011 N₂O flux had on average 15.8% of the GWP as CO₂ (CO₂-Eq range 11.0 to 23.5%). 100% and 50% residue removal reduced N₂O fluxes by 33% and 39%, respectively.

Compared with CP, Biochar and NT treatments had comparable CO₂ fluxes for No and 100% residue removal but 14.7% and 10.4% reductions with 50% removal. (Note that no CO₂ flux measurements are made during tillage operations.)

Continuous 2012 CO₂ flux measurements were within 9% of estimates from survey data.

Residue removal rates did not have significant effects on 5 cm soil T and 5 cm Soil Temp.

CONCLUSIONS

- 100% and 50% surface corn residue removal reduced annual soil CO₂ flux by an average of 11% and 2.5%, respectively, across all years and treatments.
- 2011 N₂O flux had on average 15.8% of the GWP as CO₂ (CO₂-Eq range 11.0 to 23.5%). 100% and 50% residue removal reduced N₂O fluxes by 33% and 39%, respectively.
- Compared with CP, Biochar and NT treatments had comparable CO₂ fluxes for No and 100% residue removal but 14.7% and 10.4% reductions with 50% removal. (Note that no CO₂ flux measurements are made during tillage operations.)
- Continuous 2012 CO₂ flux measurements were within 9% of estimates from survey data.
- Residue removal rates did not have significant effects on 5 cm soil T and °C.

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