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Cover crops and crop residue management under no-till systems improve soils and environmental quality

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Crop residue harvest is a common practice in the Midwestern USA for the ethanol production. However, excessive removal of crop residues from the soil surface contributes to the degradation of important soil quality indicators such as soil organic carbon (SOC). Addition of a cover crop may help to mitigate these negative effects. The present study was set up to assess the impacts of corn (Zea mays L.) residue removal and cover crops on various soil quality indicators and surface greenhouse gas (GHG) fluxes. The study was being conducted on plots located at the North Central Agricultural Research Laboratory (NCARL) in Brookings, South Dakota, USA. Three plots of a corn and soybean (Glycine max (L.) Merr.) rotation under a no-till (NT) system are being monitored for soils and surface gas fluxes. Each plot has three residue removal (high residue removal, HRR; medium residue removal, MRR; and low residue removal, LRR) treatments and two cover crops (cover crops and no cover crops) treatments. Both corn and soybean are represented every year. Gas flux measurements were taken weekly using a closed static chamber method. Data show that residue removal significantly impacted soil quality indicators while more time was needed for an affect from cover crop treatments to be noticed. The LRR treatment resulted in higher SOC concentrations, increased aggregate stability, and increased microbial activity. The LRR treatment also increased soil organic matter (SOM) and particulate organic matter (POM) concentrations. Cover crops used in HRR (high corn residue removal) improved SOC (27 g kg-1) by 6% compared to that without cover crops (25.4 g kg-1). Cover crops significantly impacted POM concentration directly after the residue removal treatments were applied in 2012. CO_2 fluxes were observed to increase as temperature increased, while N2O fluxes increased as soil moisture increased. CH4 fluxes were responsive to both increases in temperature and moisture. On average, soils under cover crop management had lower N2O fluxes than soils that did not have a cover crop. Results from this study concluded that it is important to allow crop residues to return to the soil as they help to improve soil quality indicators. The presence of cover crops also will contribute to the improvement of these indicators once established and may help mitigate greenhouse gas emissions.