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

Marisa Grubb¹, Virginia Jin², Marty Schmer²

¹Purdue University, West Lafayette, IN; ²USDA-Agricultural Research Service (ARS), Lincoln, NE

Background

Benefits of Corn Residue Retention
- Source of grazing for livestock
- Protects soils 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 soils 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 affect 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 (CO₂), nitrous oxide (N₂O), and methane (CH₄) emissions
- Determine winter cover crop effects on CO₂, N₂O, and CH₄ emissions

Materials and Methods

Planting and Treatment
- 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

Data Processing

Results

Crop Year 2011
- Figure 1. Mean CO₂ Emissions
  - No Removal
  - Max Removal
  - No Removal
  - Max Removal

Crop Year 2012
- Figure 2. Mean Crop Year N₂O Emissions
  - No Removal
  - Max Removal
  - No Removal
  - Max Removal

Crop Year 2013
- No treatment effect on CH₄ emissions. CH₄ Mean Crop Year Emissions: 4.21 +/- 0.04 kg CH₄-C/ha/yr

Crop Year 2014
- No treatment effect on CH₄ emissions. CH₄ Mean Crop Year Emissions: 4.21 +/- 0.04 kg CH₄-C/ha/yr

Table 1. CY Weather Averages for Growing Season

<table>
<thead>
<tr>
<th>CY</th>
<th>Growing Season Start</th>
<th>Growing Season End</th>
<th>Total Ppt (mm)</th>
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<tr>
<td>2011</td>
<td>4/29/11</td>
<td>10/5/11</td>
<td>363.47</td>
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<tr>
<td>2012</td>
<td>4/24/12</td>
<td>9/24/12</td>
<td>300.99</td>
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<td>2013</td>
<td>5/16/13</td>
<td>10/22/13</td>
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<td>2014</td>
<td>5/2/14</td>
<td>10/15/14</td>
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Conclusion

- CO₂ generally reduces by a reduction in biomass input
- N₂O increases with an increase in moisture retention and biomass residue
- System’s CH₄ 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

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