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Greenhouse Gas Emissions from Soil Treated with Dung Pats

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Greenhouse Gas Emissions from Soil Treated with Dung Pats

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Rationale

Change in grazing density can influence dung distribution patterns, with potential impacts on the abundance and frequency of dung beetles populations and nutrient cycling in grazing systems. The goal of this research was to quantify and characterize the fate of nutrient pulses from cow dung after deposition, and the associated effects of dung beetle activity. Mass and nutrient loss of dung, changes in soil nutrients below and around dung pats, and fluxes of greenhouse gases (GHGs) were monitored over time. The results on GHG fluxes are presented here and another paper by Evans et al. presents soil results.

Hypotheses

Dung beetles activity can affect the amount and timing of pulses of GHGs emitted from decomposing dung pats. 
- Dung pats exposed to dung beetle activity will emit higher fluxes of CO₂ and N₂O, and lower fluxes of CH₄, than those not exposed to dung beetles.
- Dung pats exposed to dung beetle activity will exhibit peak fluxes of CO₂ earlier and peak fluxes of N₂O later than those not exposed to dung beetles.

Materials & Methods

Site Description

Research was conducted at the University of Nebraska-Lincoln, Barra Brothers Ranch (42°12’5.69”N, 99°38’11.79”W) on silt loam, sandy to fine sandy loam soils in the Valentine series.

Experimental Design and Treatments

- Three treatments were arranged in a repeated measurement RCB with 8 blocks and replicated during grazing season (sequential June and July experiments).
- Treatments included artificially created 20 cm diameter pats from 1.5L of homogenized beef cattle manure placed directly on the ground (BEETLE); inside a wire-mesh exclusion cage (NO BEETLE), and a no dung treatment (CONTROL).
- Gas samples were taken at 1, 2, 3, 7, 14, 21, and 56 days after dung pat application (DAA).

Measurements and Analyses

- GHGs sampling followed GraceNet protocols for chamber method (Parkin and Venturea, 2010), with collection in 10 min. intervals for up to 30 min. on specified DAA.
- CO₂-C, N₂O-N, and CH₄-C concentrations were determined using a Varian GC-450.
- Soil temperature and moisture at 10 and 20 cm depths, air temperature, and precipitation were monitored continuously at a weather station.
- Fluxes of GHGs were calculated from regression analysis for each DAA (Parkin and Venturea, 2010).

Acknowledgement

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References

Pentilla et al. 2013. Integrated Water Quality Grant Program, no. 2013-67019-21394 from the USDA National Institute of Food and Agriculture. We would like to thank Jon Soper, Heidi Hillhouse, Pat Wagner, Mea Juddke, Erin Hatch, Tony Lindsey, and Jennifer Beckman for their assistance in field and laboratory work.

Summary and Conclusions

- Treatment was significant for CO₂-C flux but not for N₂O-N and CH₄-C fluxes.
- CO₂-C flux was highest in NO BEETLE TRT 5 out of the 9 sampling dates.
- There was no consistent trend in GHG flux when pat was covered to exclude dung beetles and flux was similar between NO BEETLE and BEETLE TRTs.
- Contrary to Pentilla et al., 2013 and initial hypothesis, June CO₂-C flux was most often highest from NO BEETLE treatment and there was no significant difference in treatments during July.
- In accordance with Pentilla et al., 2013 and initial hypothesis, July peak N₂O flux occurred at later DAA in BEETLE compared to control and NO BEETLE.

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