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Grazing Management Effect on Micro- and Macro-Scale Fate of C and N in Rangelands
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Overview and Project Framework

Grazing induces pulses of energy and nutrients by defoliation, trampling of vegetation, and deposition of dung and urine. The distribution and subsequent decomposition of dung pat across the landscape are some of the many processes of nutrient cycling in managed grazing systems. It is hypothesized that the rates of decomposition and incorporation of nutrient pulses under specific grazing strategies are regulated by the spatial and temporal distribution of these pulses, thus affecting nutrient cycling and nutrient use efficiency in rangelands.

Sub-Objective Addressed

It has been postulated that grazing strategy, and particularly high stocking density grazing, can promote more uniform dung distribution and affect the abundance and frequency of dung beetles. The objective was to quantify and characterize the fate of nutrients during decomposition of cow dung and the influence of dung beetles in the decomposition process.

Goals

• Soil temperature and moisture at 10 and 20 cm depths and GHGs fluxes were calculated from regression analysis for each sampling time.
• Gas samples were taken at 1, 2, 3, 7, 10, 14, 21, 28, and 56 days after dung pat application.
• Treatments included artificially created 20-cm diameter dung pats at a location different than where plant grazing occurs, resulting in un-coupling of nutrient cycling. Dashed arrow on model indicate same excess may be returned in the grazing area. Crop and soil GHG emissions are not shown.

Experimental Design and Treatments

• Three treatments were arranged in a RCB split plot with 8 replicates.
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• Research was conducted at the University of Nebraska-Lincoln Barta Brothers Ranch (42° 13’ 14.70”N, 99° 38’ 19.17”W) on subirrigated, sandy to fine sandy loam soils in the Valparaiso series.

Methods

• Site Description
• Research was conducted at the University of Nebraska-Lincoln Barta Brothers Ranch (42° 13’ 14.70”N, 99° 38’ 19.17”W) on subirrigated, sandy to fine sandy loam soils in the Valparaiso series.
• Experimental Design and Treatments
• Three treatments were arranged in a RCB split plot with 8 blocks and replicated during grazing season.
• Blocks were split into 6 soil collection times at 1, 3, 7, 14, 28, and 56 days after dung pat application (DAA).
• Treatments included artificially created 20-cm diameter dung pats from 1.5 L homogenized beef cattle manure placed directly on the ground (BEETLE), inside a wire mesh cage (NO BEETLE), and a no dung treatment (CONTROL).
• Soil temperature and moisture were monitored continuously at 10 and 20 cm depths.
• Weather station was installed to measure air temperature and precipitation.

SOIL Sampling & Measurements

• Dung pats were harvested prior to soil sampling and litter was removed.
• Soil samples at 0-10 cm and 10-20 cm depth were collected directly beneath the dung pat and 30 cm away in the dung treatments, and just in the middle of the CONTROL plots for each sampling time.
• Soluble total N (TN) and soluble total C (TC) extracted in water from field moist samples were quantified using Shimatzu TOC-V CPN analyzer.

Data Analyses

Proc GLM model with repeated measures was employed to compare main effects and interactions. Multivariate ANOVA was used to compare the treatment effect for each sampling time (Significance level declared at alpha = 0.05).

Summary

- Placement screen over pat was effective in excluding dung beetles from pat in the field.
- Treatment effect designed to test the effect dung beetle on nutrient movement was not significant. Soluble TC and TN in BEETLE and NO BEETLE were similar at both 0-10 cm depth.
- TC, TN, nitrate-N (data not presented), and ammonium-N (data not presented) increased generally 7 DAA and were higher in soil under pat at 0-10 cm compared to soil away from the dung pat. The period between 7 and 14 DAA sampling times and BEETLE under dung pat increased significantly compared to soil away from the dung pat.
- At the 10-20 cm depths, there was significant effect of sampling time but no significant differences in treatment and interactions effects (data not presented).

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