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

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Grazing induces pulses of energy and nutrients by defecation, trampling of vegetation and litter, 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.

Methods

Site Description

Research was conducted at the University of Nebraska-Lincoln Barla Brothers Ranch (42° 12’38.65”N, 96° 38’19.17”W) on subirrigated, sandy to fine sandy loam soils in the Valentine 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 and moisture were monitored continuously at 10 and 20 cm depths.

• Weather station was installed to measure air temperature and precipitation.

CH4 Sampling & Measurements

• CH4 sampling followed GrazedNet protocols for chamber method (Parkin and Venturea, 2010).

• Gas samples were taken at 1, 3, 7, 10, 14, 21, 28, and 56 DAA with collection in 10-min intervals for up to 30-min.

• Gas concentrations were determined using a Varian GC-450.

• Gas fluxes were calculated from regression analysis for each DAA (Parkin and Venturea, 2010).

• Soil temperature and moisture at 10 and 20 cm depths and air temperature and precipitation were monitored continuously.

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 depths 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.

• Soil samples were collected in ten minute intervals for up to 30-min on specified days.

• Soil samples were collected from 0-10 cm and 10-20 cm depths and was significantly higher compared to soil away from the dung pat.

• Soil temperature and moisture at 10 and 20 cm depths and air temperature and precipitation were monitored continuously.

Data Analyses

Process GLM model with repeated measures was employed to compare main effects and interactions. Multivariate ANOVA was performed to compare main effects and interactions. Multivariate ANOVA 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).

Results

Soil Water Content, m$^3$, m$^{-3}$

- Volumetric soil water content was 0.17, 0.19, and 0.31 at 10, 20, and 30 cm depths respectively. At 50 cm depth or below, there was standing water from rise of water table in most of the experimental plot area.

Precipitation and Soil Water

- Cumulative precipitation up to 28 DAA for June experiment was 57 mm and average air temperature was 20.3°C.

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