Grazing management, season, and drought contributions to near-surface soil property dynamics and greenhouse gas flux in semiarid rangeland

Mark Liebig, ARS

Rangeland soils are looked upon to serve as a foundation for ecosystem resilience under increasingly dynamic weather and market conditions. Studies evaluating management influences on soil properties within growing seasons and across consecutive years in semiarid rangelands are limited, yet such studies may provide insight into ecosystem resilience, particularly if the study period encompasses extreme weather conditions (e.g., drought).

Given this context, we sought to evaluate near-surface soil property dynamics in three long-term grazing management systems in central North Dakota: two native vegetation pastures differing in stocking rate (moderately and heavily grazed) and a fertilized, heavily grazed crested wheatgrass pasture.

Evaluations were conducted three times during the growing season (spring, summer, fall) over three consecutive years (2004-2006).

High stocking rate and fertilizer N application within the crested wheatgrass pasture contributed to increased soil bulk density and extractable N, and decreased soil pH and microbial biomass compared to native vegetation pastures. Soil nitrate-N tended to be greatest at peak aboveground biomass, whereas soil ammonium-N was greatest in early spring. Drought conditions during the third year of the study contributed to nearly twice the amount of extractable N under the crested wheatgrass pasture and heavily grazed pasture, but not moderately grazed pasture.

Regression analyses found significant relationships between greenhouse gas emissions and soil electrical conductivity, implying that the latter may serve as a useful screening property for identifying greenhouse gas 'hotspots' in grazing land.

Overall, soil properties measured in this study suggest high stocking rate combined with fertilizer N application may compromise soil functions necessary to support and regulate key ecosystem services in semiarid rangeland.

Liebig, M.A., Kronberg, S.L., Hendrickson, J.R., Gross, J.R. 2014. Grazing management, season, and drought contributions to near-surface soil property dynamics and greenhouse gas flux in semiarid rangeland. Rangeland Ecology and Management. 67:266-274.