RESEARCH FACTS

UNIVERSITY OF SASKATCHEWAN
Livestock and Forage Centre of Excellence
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IN PROGRESS

Performance, environmental and economic benefits of biochar supplementation in beef cattle grazing systems

PROJECT TITLE

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In progress:

Results expected in August 2023

RESEARCHERS

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Background:

Improving forage utilization is critical for profitability of all sectors of the beef cattle industry. Dietary manipulation through the use of novel additives may serve as a means to achieve this objective. Biochar or biocarbon is generated as a result of the partial pyrolysis of organic matter and, although primarily used as a soil amendment, it has recently been reported to enhance feed digestibility. Agricultural methane emissions worldwide account for approximately 43 per cent of all methane emissions with the majority attributed to enteric fermentation within ruminant livestock. Methane emissions from beef cows account for 84 per cent of the total. Therefore, mitigation strategies to reduce methane emissions in grazing ruminants are key. It has been reported that the addition of biochar to a forage-based diet *in vitro* reduces ruminal enteric methane emissions. Although biochar can be purchased commercially, there is little Canadian scientific work done to show that biochar improves efficiencies and, therefore, reduces methane emissions in beef cattle managed on pasture systems.

Objectives:

This research aims to quantify the effect of biochar on beef cattle performance, greenhouse gas (GHG) emissions, rumen fermentation and pasture (grazing) costs.

What They Will Do:

Study 1: 4X4 Latin Square (UofG)
Eight cows will be housed at Elora Beef Research Centre and individual animals will be assigned to an Insentec feed bunk (Insentec, Voorsterweg, The Netherlands) in order to measure individual feed intake. They will be supplemented with biochar at either zero, one, two and three per cent of total diet. Cows will be fed a diet consisting of 50 per cent alfalfa haylage, 30 per cent wheat straw, 17 per cent corn silage, and three per cent mineral premix. The biochar will be incorporated into a pellet containing 45 per cent biochar, 42.5 per cent wheat midds, 10 per cent canola oil, and 2.5 per cent dry molasses. Each period consists of 21 days: 14 days for diet adaptation and seven days for data collection. Methane emissions will be monitored using C-Lock GreenFeed technology (C-Lock Inc., Rapid City, SD, USA). At the start and end of each period, cows will be weighed, body condition scored, and ultrasounded for rib and rump fat. Rectal manure grab samples and oral rumen fluid samples will be obtained from each cow at the end of each period. Weekly feed samples will be obtained for nutrient composition analyses.

Study 2: Pasture Grazing Trial (UofG)
The experiment will be conducted at the Elora Beef Research Centre. Sixty-four Angus crossbred beef cows and their calves will be blocked by weight and calf age and randomly allocated to eight paddocks of eight cow-calf pairs per paddock. Each period will consist of 21 days of biochar adaptation, followed by seven days of enteric emission collection. Each paddock will be assigned to one of two treatments: biochar supplemented (biochar + high fibre pellet at approximately three per cent of dry matter intake) or control (no biochar + high fibre pellet). Biochar will be fed once daily to each pasture group via a portable trough. Each pasture paddock will be subdivided into eight cells and cows will be rotated through the cells within each paddock every three days. The amount of forage consumed by the animals will be estimated. Cow body weight, body condition score and back fat ultrasound measurements will be measured at the start and end of each period. Calf body weight will be measured at the start and end of each period. Rectal fecal grab samples and oral rumen fluid samples will be obtained from each cow at the end of each period for analysis of fecal nutrients, volatile fatty acids (VFA) and the microbial community.

Study 3: Pasture Grazing Trial (USask)
A three-year grazing study will be conducted at the Livestock and Forage Centre of Excellence (LFCE), located south of Clavet, Sask., similar to Study 2 at University of Guelph. Each year, 48 cow-calf pairs stratified by body weight and calf age will be randomly assigned to one of two treatments differing in pellet strategies. Treatments include either (i) pelleted supplement with biochar or (ii) control pellet (no biochar). At LFCE's Forage and Cow-Calf Research and Teaching Unit, the study site is a 48-hectare grass-legume pasture, sub-divided into two, 24-hectare paddocks. Treatment pellets will be provided in a portable trough once daily at 0800 hours. During the study period per year for three years (2020, 2021 and 2022), enteric GHG emissions will be measured using two methods: (i) SF6 tracer gas technique and (ii) C-Lock Greenfeed Emission Monitoring (GEM) system. Other measures include cow body weight change, cow body condition score, subcutaneous fat thickness at the start and end of the study. Dry matter intake will be estimated and calf weaning weight will be taken. Forage laboratory analysis will determine dry matter, crude protein, acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN) and digestible energy (DE) levels. Manure samples will be analyzed for dry matter, total carbon (C), total nitrogen (N), total potassium (K), available phosphorus (P), NH_3-N and C:N ratio. Rumen fermentation for short chain fatty acids (SCFA) and microbial population diversity will be determined. Graze system economics will include calculated cost of providing a supplemented biochar pellet with benefits to be considered.

Implications:

This project will identify biochar levels that promote and maintain optimal rumen function while exploring strategies that may reduce enteric emissions in grazing systems. This project will also evaluate costs associated with pasture systems where beef cattle are provided a novel supplement. Overall, the results will identify opportunities to enhance sustainability of the beef industry.

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