RESEARCH FACTS

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Livestock and Forage Centre of Excellence
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IN PROGRESS

Effects of annual and perennial forage systems on plant, soil and water parameters, grazing animal performance and system economics

PROJECT TITLE

Effects of annual and perennial forage systems on plant, soil and water parameters, grazing animal performance and system economics

In progress:

Results expected in December 2022

RESEARCHERS

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Background:

Beef and forage producers managing grazing systems need process-based knowledge and strategies using novel forage species to better understand and quantify good grazing practices that harvest biomass efficiently with good animal growth, manage soil nutrients and water cycling and understand the complexity of capturing carbon (C) while reducing enteric methane (CH_4) emissions in grazing programs.

Objectives:

The objectives of this study are to:
- determine differences in novel grass + legume annual and perennial forage mixtures for nutritional and biomass capacity under grazed conditions;
- identify grazing strategies to optimize forage and beef production from tame perennial + annual forage systems;
- determine pasture soil moisture cycle dynamics, nitrogen (N) cycles and C sequestered;
- evaluate enteric emissions of cattle grazing novel forage mixtures; and
- quantify economic and agronomic benefits of annual and perennial forage systems.

What They Will Do:

A four-year study will be conducted at USask's Livestock and Forage Centre of Excellence, located south of Clavet Sask. A 180-acre (72 ha) field site located on Section 5 will be further divided into three blocks of 60 acres (24 ha) each. Subsequently, each block will be further sub-divided to four replicate paddocks of 15 acres (6 ha) for a total of 12 paddocks. Paddocks within block will be randomly assigned to either:

(1) AC Success hybrid bromegrass + PS3006 alfalfa mixture (**HBG-ALF**);
(2) AC Armada meadow bromegrass + AC Glenview sainfoin (**MBG-SF**);
(3) AC Hazlet fall rye + Frosty berseem clover mixture (**FR-CLOV**); or
(4) Winfred (kale/turnip) + Gorilla forage brassica + Performance 4010 forage pea + Austenson barley mixture (**TUR+BRAS+PEA+BAR**).

The HBG-ALF and MBG-SF mixtures as perennials will be established in 2018. The FR-CLOV and TUR+BRAS+PEA+BAR mixtures as annual forages will be established annually. Each year, in each paddock, 12 steers (~300 kg) will be grazed for approx. 90 days. Steers will be weighed over two days at the start and end of the study period and every 14 days throughout the grazing period. Animal sub-cutaneous body fat thickness will be measured at the start and end of the study period. Forage yield, quality and dry matter intake will be estimated according to Jasmer and Holechek (1984). Enteric greenhouse gas emissions (CH_4, CO_2) will be measured using two techniques: the SF6 tracer gas technique (CH_4) and the C-Lock Greenfeed Emission Monitoring (GEM) (CH_4, CO_2) system.

Soil cores of 0 to 15 cm and 15 to 30 cm depth increments will be taken as a transect across each paddock before trial. Soil cores will be taken in year one (2019) as the baseline and then in years three (2021) and four (2022) with 15-cm coring device. Soil cores collected in 2021 will be used for assessment of C and N dynamics and cycling through measurement of available (water soluble) C and N and microbial respiration. Supply rates of available N will be measured with plant root simulator probes placed in cores during incubation. Soil cores collected in years one (2019) and four (2022), representing beginning and end of the study, will be measured for concentrations of total C and N to calculate C and N sequestration over the study years as affected by treatment. In addition characterization of soil at the site will include texture, pH, electrical conductivity and available nutrients.

Soil moisture sensors will be installed in each paddock at 0.2 m, 0.4 m, 0.6 m, 0.8 m, 1.0 m and 1.5 m depths to continuously monitor soil moisture movement. Availability of soil water in the top one m of soil will be continuously measured using heat dissipation sensors. Rainfall acquisition, wind and incoming solar radiation will also be measured. Deeper water storage and transport will be measured with vibrating wire piezometers.

Forage establishment costs and returns for both the perennial and annual systems will be estimated. The forage establishment costs will include seed, fertilizer, herbicide and field passes using a combination of actual costs incurred and custom rates.

Implications:

This multi-year study will provide Saskatchewan producers utilizing perennial or annual forage systems the necessary detailed information on when to integrate an annual or perennial forage to extend the grazing season with adequate biomass and quality. The study will also provide information on grazing animal performance, GHG emissions, sequestered carbon while preserving soil nutrients and moisture, and the economic efficiencies of the system.

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