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## Long-term cattle grazing effects on soil chemistry in the Rough Fescue grassland

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**Key word:** Rough Fescue grassland, soil OC, soil nitrogen, soil phosphorus, soil pH, soil soluble ions

**Introduction** The Rough Fescue grasslands in western Canada are highly productive but sensitive to summer grazing. This can lead to overgrazing and subsequently soil degradation, which includes increased soil crusting, reduced soil infiltration, and enhanced soil erosion susceptibility (Manzano and N avar, 2000), which results in the loss of soil nutrients. Therefore, an experiment was conducted to investigate the effects of 58-yr of cattle grazing on soil properties in a Rough Fescue grassland.

**Materials and methods** The study site was at the Department of Agriculture Research Substation, Stavely, Alberta Canada with a semiarid climate. Annual mean precipitation was 494mm (from 1997 to 2007). The vegetation is classified as the Fescue Grassland (*Festuca campestris* (Rydb.) Association). Soil is Orthic Black Chernozemic and has a clay-loam to loam texture. Three treatments were established in 1949 consisting of fields representing a (i) non-grazed exclusive (CK), (ii) moderate grazing (MG), and (iii) heavy grazing (HG). The fields (MG and HG) were grazed by cattle from about May 15 to November 15 at 2.4 and 4.8 animal unit month ha<sup>-1</sup>, respectively. In May 2007, Soil C, N, P, pH, electrical conductivity (EC) and water soluble ions were determined to the 60 cm depth for each treatment. The MIXED procedure from SAS (SAS Institute Inc. 2005) was used to analyze the data as a randomized complete block design with grazing effects. Tukey's test was used for all mean comparisons.

**Results** Soil organic carbon (OC), total P (TP) concentrations and Cl<sup>-</sup> at all depths were higher ( $p < 0.05$ ) in the CK than in the grazing treatments whereas the total N (TN) concentration at all depths was lower ( $p < 0.05$ ) in the CK than in the grazing treatments (Tables 1 and 2). Soil soluble K<sup>+</sup> at all depths was higher ( $p < 0.05$ ) in HG treatment than CK and LG treatments. Soil pH values were higher ( $p < 0.05$ ) in grazing treatments than in the CK (Table 1). There was no grazing effect ( $p > 0.05$ ) on soil EC, available N (NO<sub>3</sub>-N and NH<sub>4</sub>-N) and available P (AP) concentrations, soluble Mg<sup>2+</sup>, Na<sup>+</sup> and SO<sub>4</sub><sup>2-</sup> at all depths (Tables 1 and 2).

**Table 1** The effect of long-term cattle grazing on soil pH, EC, C, N and P concentrations in the Rough Fescue grassland.

Indicators	P	CK	MG	HG
pH	0.00	6.45b <sup>1</sup>	7.10a	7.30a
EC(dS m <sup>-1</sup> )	0.20	0.12a	0.17a	0.19a
OC(%)	0.01	5.57a	4.58b	4.29b
TN(%)	0.04	0.52b	0.60a	0.59a
TP(g kg <sup>-1</sup> )	0.10	0.85a	0.74b	0.77ab
NO <sub>3</sub> -N (mg kg <sup>-1</sup> )	0.22	3.62a	5.47a	5.86a
NH <sub>4</sub> -N (mg kg <sup>-1</sup> )	0.52	7.85a	8.61a	8.30a
AP(mg kg <sup>-1</sup> )	0.44	3.08a	4.19a	3.73a

**Table 2** The effect of long-term cattle grazing on soil soluble ions (mg kg<sup>-1</sup>) in the Rough Fescue grassland.

Indicators	P	CK	MG	HG
Ca <sup>2+</sup>	0.10	28.26a <sup>2</sup>	82.93a	59.26a
Mg <sup>2+</sup>	0.29	5.69a	9.31a	8.42a
Na <sup>+</sup>	0.13	19.31a	12.27a	12.95a
K <sup>+</sup>	0.02	21.98b	25.23b	38.71a
Cl <sup>-</sup>	0.02	27.25a	19.53b	16.79b
SO <sub>4</sub> <sup>2-</sup>	0.34	13.23a	9.77a	11.04a

<sup>1,2</sup> Means within row having different lower case letters are different at  $P < 0.05$  probability levels.

**Conclusions** Fifty-eight years of cattle grazing had a major impact on the concentration of soil nutrients in the Rough Fescue grassland. Soil C and P significantly decreased ( $p < 0.05$ ) both in the MG and HG treatments compare to CK. Loss of C and P in soil is indicative of soil deterioration and suggests that HG is not sustainable.

### References

- Manzano, M.G., N avar, J., 2000. Processes of desertification by goats overgrazing in the Tamaulipan thrscrib (matorral) in north-eastern Mexico. *J. Arid Environ.* 44, 1-17.  
 SAS Institute Inc. 2005. SAS OnlineDoc<sup>®</sup> 9. 1. 3. Cary, NC: SAS Institute Inc.