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Response of Timothy Se Concentration to Increasing Rates of a Slow-Release Se Fertilizer in Eastern Canada

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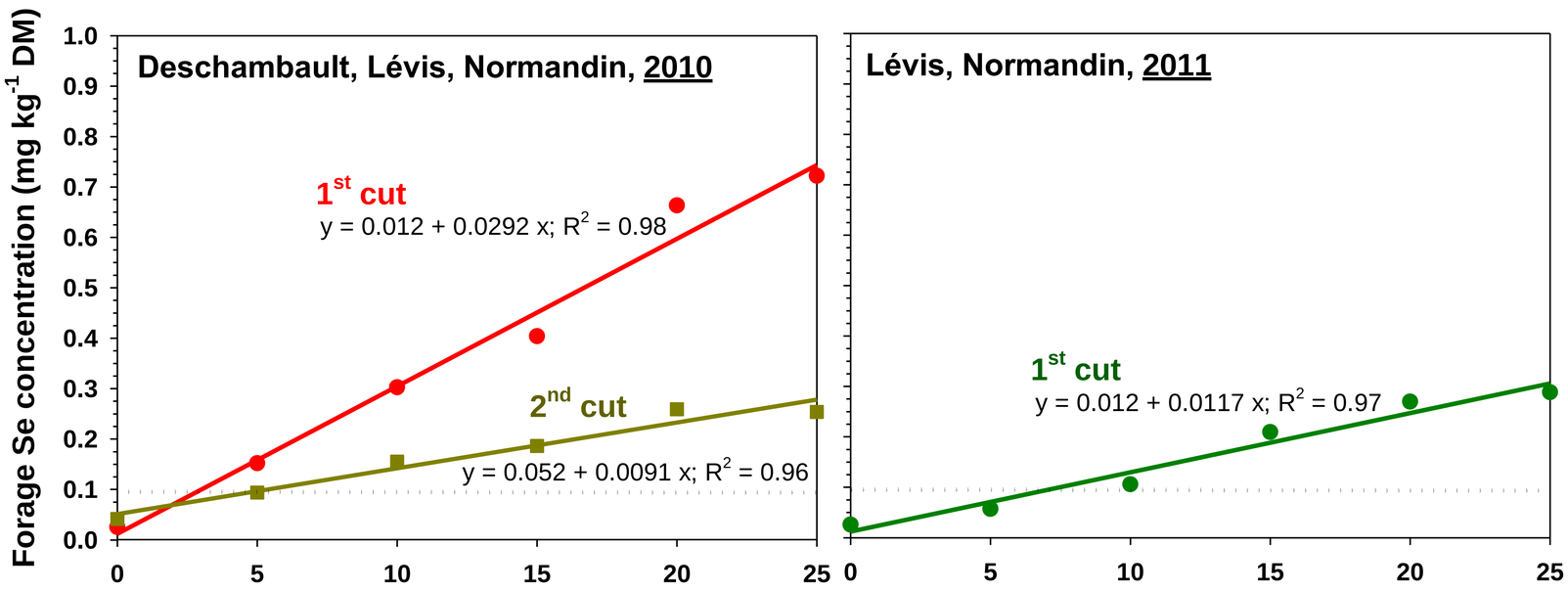
Introduction

- Selenium (**Se**) is an essential micronutrient given to ruminants by injection or orally, or applied as an additive to fertilizers to raise crop Se concentration in areas with low-Se soils.
- **Objectives: 1)** To determine the response of timothy (*Phleum pratense* L.) Se concentration to increasing rates of a slow-release Se fertilizer applied in spring;
  2) To investigate the possibility of predicting forage Se concentration by near infrared reflectance spectroscopy (**NIRS**).

Materials & methods

- **Six Se application rates**: 0, 5, 10, 15, 20, and 25 g ha^{-1} as Selcote Ultra® in the spring of 2010.
- In a **randomized complete block design** with 4 replications for a total of 24 plots (2 × 4 m) / site.
- **Three sites** in the province of Québec, Canada:
  1) Deschambault (46°40'N 71°55'W, silt loam);
  2) Lévis (46°48'N 71°23'W, clay soil);
  3) Normandin (48°51'N 72°32'W, silty clay fine).
- Soil analyses for P and K, and local recommendations were used for establishing P, K, and N fertilization.
- Timothy was harvested at the early heading stage twice in 2010 at all sites and once in 2011 at two of the sites.
- Forage analyses: Se by HG-ICP-OES, N by colorimetry, ADF, NDF, ADL, and ruminal *in vitro* digestibilities of DM and NDF (standard procedures).
- Forage samples were scanned using a NIRS DS2500 monochromator instrument (Foss NIRSystems Inc., Silver Spring, MD).
- ANOVAs with Se fertilization rates assigned as main plots and harvests within years as repeated measurements were performed using the Mixed procedure of SAS.
- Soil Se content was considered deficient at the three sites (0.1 to 0.6 mg kg^{-1}).

Results & discussion



- The response of timothy Se concentration to increasing Se rates was similar at the three sites (data not shown); it was averaged across sites.
- Without any Se fertilization, the timothy Se concentration at all sites was lower than the dietary optimum level for beef (0.1 mg kg^{-1} DM) and dairy cattle (0.3 mg kg^{-1} DM).
- Timothy Se concentration (y) averaged across the three sites increased linearly with increasing Se rates (x) at the first and second harvest in the year of the spring Se application.
- On the year following the Se application, timothy Se concentration (y) averaged across two of the three sites also increased linearly with increasing Se rates (x).
- The application of the slow-release Se fertilizer did not significantly affect timothy DM yield and any of the nutritive attributes (data not shown).
- This study confirms the difficulty in estimating timothy Se concentration using NIRS. Its prediction was classified as less reliable with a coefficient of determination of validation (R_V^2) < 0.70 and a ratio of prediction to deviation [RPD=SD/SEP(C)] < 1.75. The NIRS predictions of timothy N concentration, a control attribute, was found to be moderately successful (Table 1).

Table 1. Statistics† on the performance of NIRS to predict Se and N concentrations in timothy forage samples.

	Se	N
	mg kg^{-1} DM	g kg^{-1} DM
Calibration		
N_C	145	148
SEC	0.140	0.55
R_C^2	0.30	0.93
Validation		
N_V	38	38
Mean	0.226	20.7
Minimum	0.013	16.8
Maximum	1.179	25.7
SD	0.223	2.0
SEP(C)	0.218	0.70
Slope	0.63	0.96
R_V^2	0.07	0.88
RPD	1.02	2.84
Prediction‡	LR	MS

† N_C = number of samples in the calibration set; Mean, chemical average value; Minimum, minimum chemical value; Maximum, maximum chemical value; SEC, standard error of calibration; R_C^2, coefficient of determination of calibration; N_V, number of samples used for validation; SD, standard deviation; SEP(C), standard error of prediction corrected for the bias; R_V^2 = coefficient of determination of validation; RPD = ratio of prediction to deviation (SD/SEP(C)).

‡ Classification of the NIRS prediction performance: EX, excellent, $R_V^2 > 0.95$ and RPD > 4.00; SC, successful, $0.90 \le R_V^2 \le 0.95$ and $3.00 \le$ RPD ≤ 4.00; MS, moderately successful, $0.80 \le R_V^2 < 0.90$ and $2.25 \le$ RPD < 3.00; MU, moderately useful, $0.70 \le R_V^2 < 0.80$ and $1.75 \le$ RPD < 2.25; and LR, less reliable, $R_V^2 < 0.70$ and RPD < 1.75.

Conclusions

- Our results confirm that the Se concentration of timothy spring growth and summer regrowth responds linearly to a spring application of up to 25 g Se ha^{-1} as slow-release fertilizer granules, and that this application also has a linear carry-over effect on the spring growth of the subsequent year.
- A spring application of 10 g Se ha^{-1} as Selcote Ultra® and the residual effect of this application are sufficient to produce, during the entire growing season, timothy forage with a Se concentration greater than 0.1 mg kg^{-1} DM, allowing diet formulation to meet optimal Se levels.
- Timothy Se concentration could not be successfully predicted by NIRS.

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