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Critical P concentration of forage grasses

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Introduction

- Critical nutrient concentrations are required for plant-based diagnostic methods.
- Concomitant dilution of P and N in increasing shoot biomass has led to a model of critical P concentration (Duru and Ducrocq 1997; Bélanger and Richards 1999).
- Critical P concentration is predicted as a function of N concentration.
- The existing model for timothy (Bélanger and Ziadi 2008) was developed in eastern Canada but it has not been validated under a wide range of conditions.

Objective

- To validate an existing model of critical P concentration (P_c = 1.07 + 0.063N) established for timothy (*Phleum pratense* L.) in eastern Canada.

Materials and Methods

- Five locations in four countries with varying rates of P fertilization.
  - Québec, Canada (CA): Timothy.
    - Seeding in 2009; 0, 10, 20, 40 kg P ha^{-1}
  - Normandin, Canada (CA): Timothy.
    - Seeding in 2009; 0, 10, 20, 40 kg P ha^{-1}
  - Maaninka, Finland (FI): Timothy.
    - Seeding in 2009; 0, 10, 20, 40 kg P ha^{-1}
  - Changins, Switzerland (CH): Multi-species.
    - Long-term (> 18 years); 0, 8, 17 kg P ha^{-1}
  - Ercé, France (FR): Multi-species.
    - Long-term (> 11 years); 0, 50 kg P ha^{-1}
- Soils with a low available P content (Mehlich-3 P) in spring 2010.
  - Québec (17 mg kg^{-1}), Normandin (23 mg kg^{-1}), Maaninka (67 mg kg^{-1}).
  - Changins: 8, 13, 22 mg kg^{-1} for the three P rates, respectively.
  - Ercé: 7, 75 mg kg^{-1} for the two P rates, respectively.
- Three or four replications.
- Measurements in 2010, 2011, and 2012.
  - Four sampling dates, one week apart, in spring growth.
  - From vegetative to late heading.
  - Dry matter (DM) yield by cutting at a 5-cm height.
  - Plant samples were analyzed for P and N concentrations.

Results and Discussion

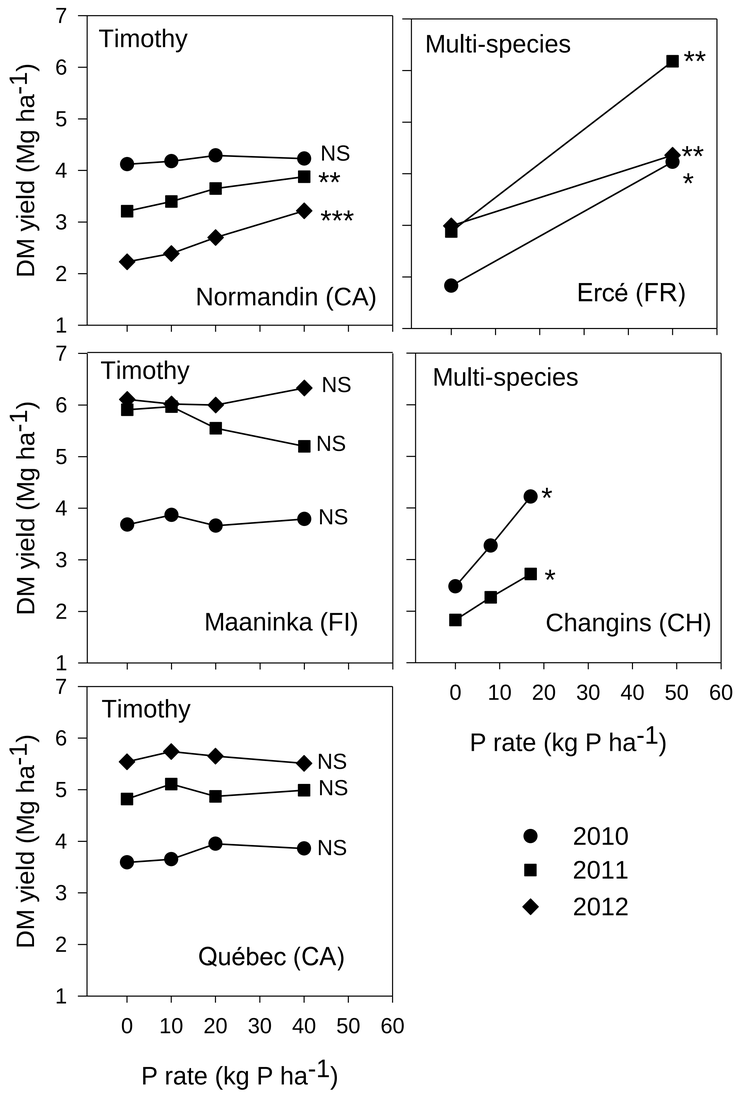

Figure 1. Effect of P fertilization on DM yield of timothy and multi-species swards on the third sampling date of the spring growth (NS: not significant at $P < 0.05$; *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.001$).

- Increasing P fertilization increased DM yield at seven of the 14 site-years, with increases occurring mostly at long-term multi-species swards (Fig. 1).
- Non-limiting P conditions: Data points with no further DM yield increase with a higher P rate.

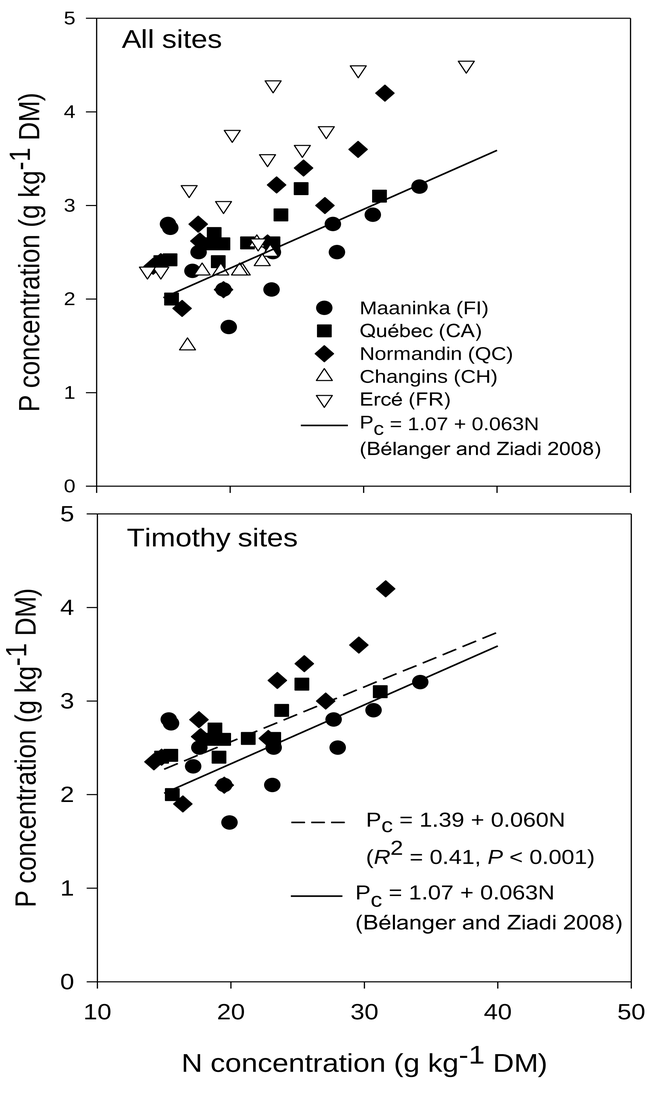

Figure 2. Relationship between P and N concentrations under non-limiting P conditions and the model of critical P concentration published by Bélanger and Ziadi (2008).

- Concentrations of N and P under non-limiting P conditions confirmed the validity of the model of critical P concentration for timothy but not for multi-species swards (Fig. 2).
- In Ercé (FR), high P concentrations might be due to the high P rate, preventing the estimation of critical P concentration.

Conclusions

- **The model of critical P concentration proposed by Bélanger and Ziadi (2008) was confirmed for timothy but not for long-term multi-species swards.**
- **The model of critical P concentration provides an essential tool for calculating an index of P nutrition as the ratio of P concentration to the critical P concentration.**

References

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© Scientific poster presented at the ASA, CSSA, & SSSA International Annual Meeting, 2-5 Nov. 2014, Long Beach, CA.

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