Nutrient resorption in two dominant evergreen species in response to long-term fertilization at Mer Bleue, an ombrotrophic bog

Meng Wang, Meaghan T. Murphy and Tim R. Moore
Department of Geography and Global Environmental and Climate Change Centre, McGill University, Montreal, Quebec, Canada H3A 2K6 (meng.wang3@mail.mcgill.ca)

Introduction

❖ Nutrient resorption is considered to be predominantly important as an adaptive strategy to nutrient-deficiency (Aerts, 1996; Aerts & Chapin, 2000).
❖ Productivity in ombrotrophic bogs is undergoing the potential shift to P-limitation due to the increasing N deposition, depending on its stoichiometric balance with other nutrients, most importantly, phosphorus (P) and potassium (K) (Sterner & Elser, 2002).
❖ In these nutrient-poor bogs, the nutrient resorption is expected to be of great importance in regulating nutrient cycling and hence plant growth and C sequestration.
❖ In the present study, we investigated the effect of external N, P and K supply on their resorption in our long-term fertilization experiment in an ombrotrophic bog located in the boreal regions of Canada.

Materials and methods

❖ Study site: Mer Bleue bog, Ottawa, southern Ontario, Canada (45.40°N, 75.50°W)
❖ Species: *Chamaedaphne calyculata* and *Ledum groenlandicum*; two evergreen shrubs, widely spread in the boreal bogs of North America (Glaser, 1992).
❖ Mature and senesced leaves were sampled in July and October 2011, respectively.
❖ Nutrient resorption efficiency (NuRE) was calculated as:

$$\text{NuRE} = 1 - \frac{[\text{nutrient}]_{\text{senesced}}}{[\text{nutrient}]_{\text{mature}}} \times 100\%$$

where the $[\text{nutrient}]_{\text{senesced}}$ and $[\text{nutrient}]_{\text{mature}}$ were the leaf area based nutrient content (g cm^{-2}) of recently senesced or mature leaves respectively.
❖ Resorption proficiency: the level to which the nutrients are reduced in the senesced leaves.
❖ Statistics: when the interaction effect of N × (P+K) is insignificant ($P > 0.05$), corresponding treatments are combined for clarity as: Co, O + X; N0, Co + PK; N5, 5N + 5NPK; N10, 10N + 10NPK; N20, 20N + 20NPK; With P+K, PK + 5NPK + 10NPK + 20NPK; Without P+K, Co + 5N + 10N + 20N.

Results

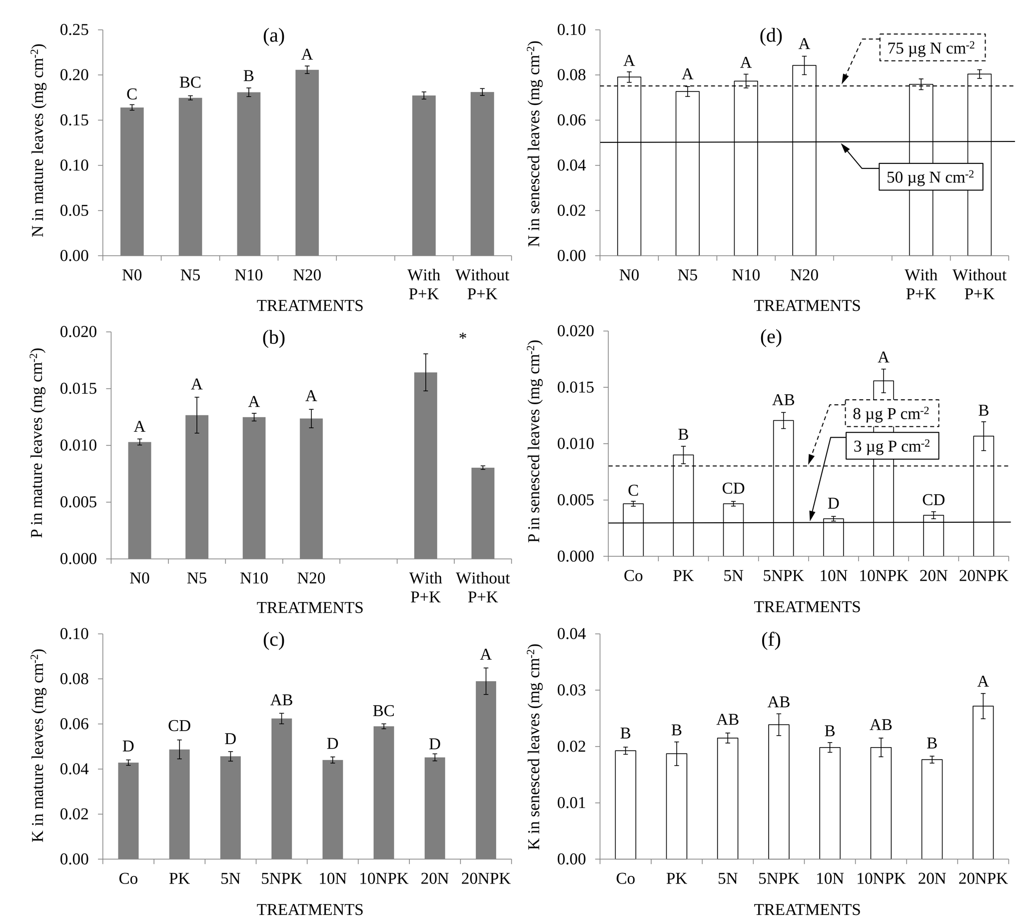

Fig. 1 N, P and K content in mature (a-c) and senesced (d-f) leaves of *C. calyculata* in response to long-term N, P and K fertilization. The dash and solid lines indicate the benchmark values from Killingbeck (1996). Values are mean ± standard error. Different letters indicate significant difference among treatments ($P < 0.05$). Significant differences between treatments with and without P+K fertilizer are indicated by * ($P < 0.05$).

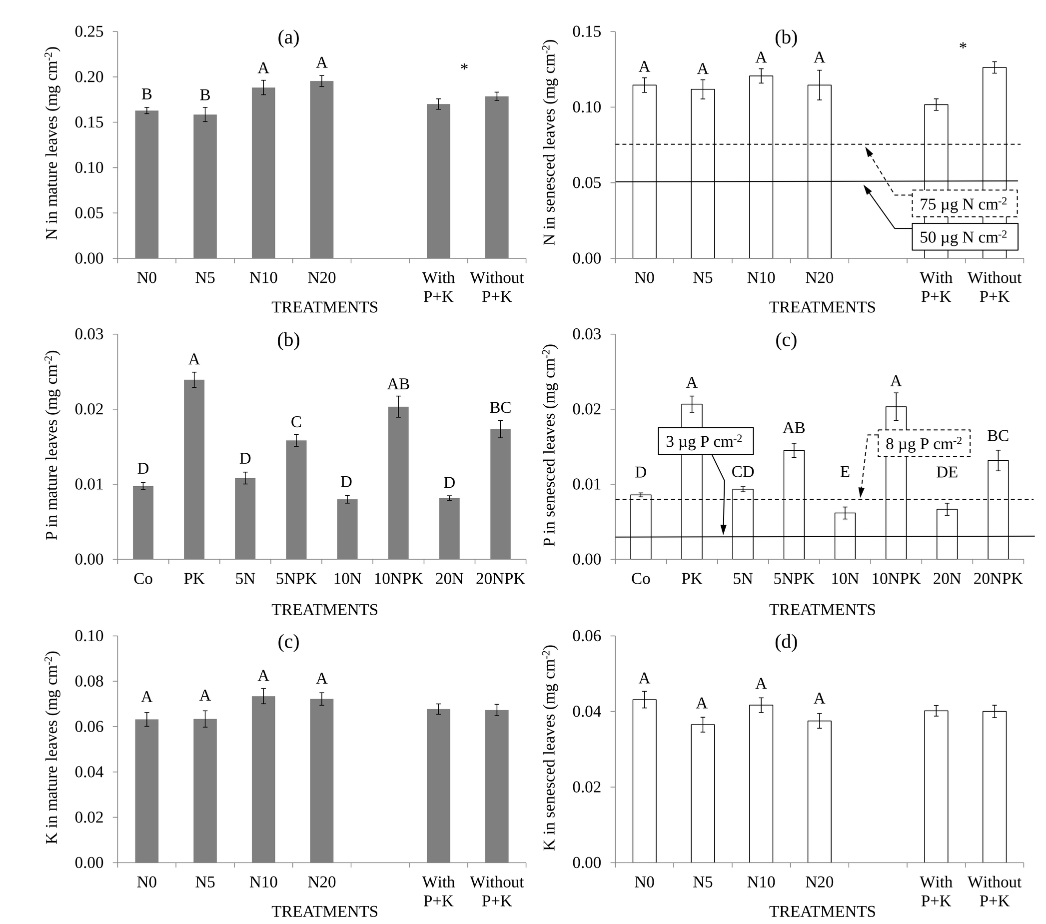

Fig. 2 N, P and K content in mature (a-c) and senesced (d-f) leaves of *L. groenlandicum* in response to long-term N, P and K fertilization. The dash and solid lines indicate the benchmark values from Killingbeck (1996). Values are mean ± standard error. Different letters indicate significant difference among treatments ($P < 0.05$). Significant differences between treatments with and without P+K fertilizer are indicated by * ($P < 0.05$).

References

Aerts R. 1996. Nutrient resorption from senescing leaves of perennials: Are there general patterns? Journal of Ecology 84: 597-608.
Aerts R, Chapin FS. 2000. The mineral nutrition of wild plants revisited: A re-evaluation of processes and patterns. Advances in Ecological Research 30: 1-67.
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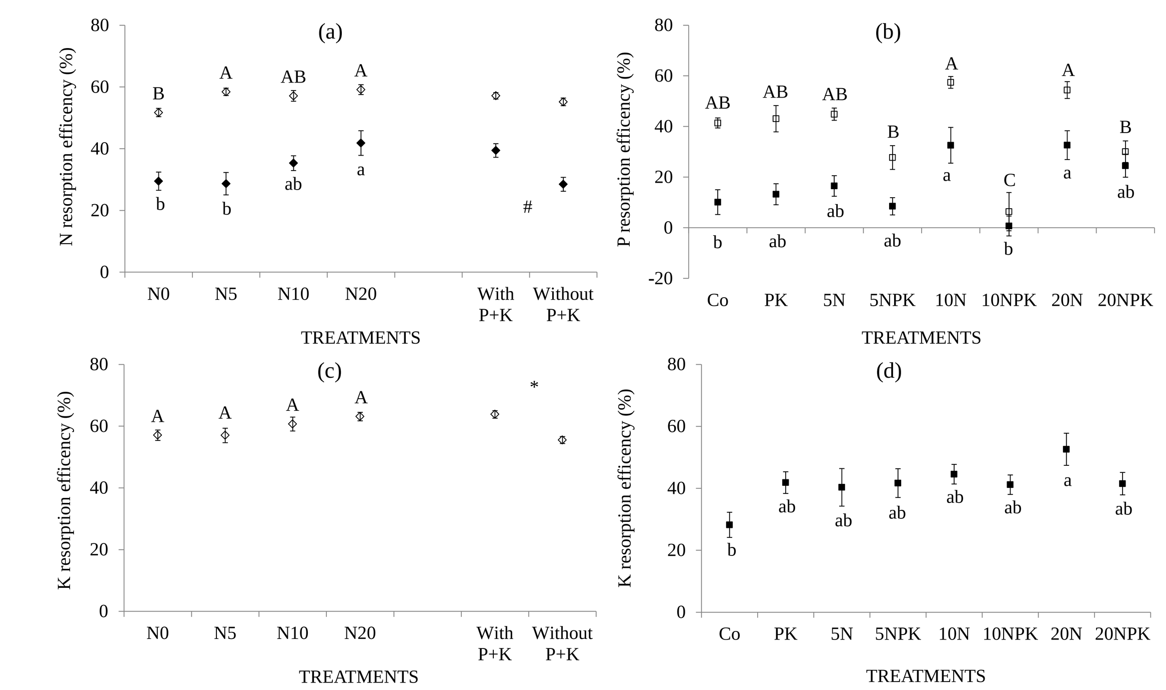
Sterner RW, Elser J. 2002. Ecological stoichiometry: the biology of elements from molecules to the biosphere. New Jersey, USA: Princeton University Press.

Fig. 3 Nutrient resorption efficiency of N, P and K of *C. calyculata* (open diamonds) and *L. groenlandicum* (filled diamonds) in response to long-term N, P and K fertilization. Values are mean ± standard error. Upper case letters indicate significant difference between treatments in *C. calyculata*; lower case letters indicate significant difference between treatments in *L. groenlandicum* ($P < 0.05$). Significant differences between treatments with and without P+K fertilizer are indicated by * and # for *C. calyculata* and *L. groenlandicum*, respectively ($P < 0.05$).



Discussion

❖ N resorption efficiency of both species were stimulated by N fertilization but its proficiency remained unchanged in response to N supply.
❖ The resorption efficiency and proficiency of N was only increased in *L. groenlandicum* in response to P and K fertilization.
❖ Only the relatively high levels of N supply (3.2 and 6.4 g N m^{-2} yr^{-1}) can increase the resorption efficiency and proficiency of P if N was added separately.
❖ In contrast, if added in combination with P and K, the increasing level of N supply can initially reduce and then increase the resorption efficiency and proficiency of P.
❖ P resorption efficiency and proficiency were generally reduced after fertilized with P and K, although this negative relationship can be altered with the presence of N.
❖N fertilization hardly affected K resorption. A strong species-specific response of K resorption to P and K fertilization was observed and no clear pattern was shown.