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Waldernährungsstrategien und deren Wechselwirkung mit bodenchemischen und bodenbiologischen Eigenschaften

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Titel
Phosphorus and nitrogen cycling in forest soils depending on long-term nitrogen inputs

Abstract
Foliar phosphorus (P) contents have been decreasing in a range of temperate forests in Europe and North America during the last decades, and one reason for this might be atmospheric nitrogen (N) deposition (1,2,3). Therefore, we studied the effect of N inputs on P and N cycling in long-term N fertilization experiments in temperate forests. The aim of the study was to test how increased N inputs affect P and N cycling in forest soils. We sampled the organic layer of three N fertilization experiments in the USA (Harvard Forest, Cary Institute and Bear Brook), that are between 17 and 25 years old. Net N and P mineralization rates were determined along with microbial biomass, enzyme activities and soil C, N and P stoichiometry. Total C and N concentrations in the organic layer (Oe+Oa horizon) increased significantly due to long-term fertilization in Harvard Forest and the same trend was observed in the two other experiments that are based on lower N fertilization rates. Contrariwise, total P concentrations in the organic layer decreased on average by 15% due to N fertilization, while C:P ratios increased by 60%. Phosphatase activity was elevated in the N fertilized soils in all experiments by a factor of 2 to 5, and the ratio of chitinase:phosphatase activity was on average decreased by 30%, indicating that specifically phosphatase production was upregulated. The results imply that trees and/or microorganisms invested more N in the production of phosphatases in the N fertilized soils than in the non-fertilized controls. Net P mineralization did not change consistently with N inputs, indicating that mineralized P was quickly taken up by the plants in most of the N fertilized soils. In contrast, net N mineralization increased in all experiments in response to N fertilization, while microbial biomass C was only little affected by N fertilization In conclusion, the experiments indicate that high inputs of N in temperate forest ecosystems lead to increased P demand and hence to increased phosphatase activity. Moreover, the decreased P concentration and the elevated C:P ratio of the organic layer indicate that P is preferentially mineralized and taken up by plants. Our results support the hypothesis that increased atmospheric N inputs are the reason for an emerging P limitation in temperate forests.

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