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Effects of nitrogen and phosphorus additions on soil organic matter mineralizing enzymes in eastern Chinese forests

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Global changes include increasing nitrogen (N) deposition and phosphorus (P) addition, which affect microbial nutrient demand and biogeochemical cycles. The responses of soil organic matter mineralizing enzymes to these global change components are poorly defined in forest soils. We tested the hypothesis that the catalytic efficiency (Vmax/Km) of N or P acquisition enzymes would be inhibited, and the Vmax/Km of C acquisition enzyme would be improved, by N or P additions, and vice versa, in line with the microbial economic theory. We chose one site in a P-rich and two sites in P-poor forests and established sixteen 20 $\times$ 20 m plots at each site. Control, either N only, P only, or combined N and P, were randomly distributed through each forest site with 4 replicates.
Without N and P additions, the catalytic efficiency for β-1,4-glucosidase (βG) and phosphatase (aP) were higher in the Changbai than in the Dinghu forest soils, in the contrast, the catalytic efficiency for β-1,4-N-acetylglucosaminidase (NAG) was lower in the Changbai than in the Dinghu forest soils. In agreement with our hypothesis in the Changbai forest soils, N and NP additions increased the Vmax/Km for βG and NAG. Though P additions caused no effect on the kinetic parameters for βG, P additions increased the catalytic efficiency for NAG in the Changbai forest soils. But partly in agreement with our hypothesis in the Dinghu forest soils, the N, P and NP additions had no effects on the kinetic parameters for βG. N additions increased the catalytic efficiency for NAG, but P additions had no effect on the kinetic parameters for NAG in the Dinghu forest soils. N additions had no effect on the Vmax/Km for aP in P-rich and P-poor soils because of the similar increases in the Vmax and Km. P additions to P-poor soils resulted in a decrease in the Vmax/Km for aP via the inhibitory effects of inorganic P on the Vmax. Phosphatase kinetic parameters were positively related to the availability of N and P in P-rich soils, but inorganic P inhibited phosphatase activity and caused a decrease in the catalytic efficiency in P-poor soils.
Our results suggest that future increasing N deposition combined with P additions would increase βG catalytic efficiency in temperate forest soils. While in the subtropical forest soils, βG and NAG catalytic efficiency were inert to P additions, but NAG catalytic efficiency was increased by N additions. There were contrast responses of phosphatase kinetics to P and N inputs in P-rich and P-poor forest soils, while long-term N deposition might mitigate P limitation by increasing phosphatase secretion.