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Nitrogen availability and natural abundance of 15N of soil microbial biomass

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Nitrogen (N) availability in forest is a strong driver controlling net primary production of plant. Soil microbes regulate the N availability since they are responsible for the production of available N (inorganic and some organic N) for plants and soil microbes. Thus, balance of N and carbon (C) availability to soil microbes is quite important for the understanding of N cycle in terrestrial ecosystems and soil C/N ratio has been used as a parameter for that. However, C/N ratio of bacteria and fungi differs greatly and relative importance of them to the total soil microbes can differ among different soils, simple C/N ratio cannot determine the actual balance of C and N availability.

Recently, natural abundance of ^{15}N ($d^{15}N$) of the soil microbe has been proposed as a new parameter that can provide the information on relative C and N availability to the soil microbes (Dijkstra et al. 2006, 2008). Enrichment in $d^{15}N$ ($Dd^{15}N_{MB-Soil}$) of the soil microbes from the substrate (bulk soil N or extractable soil N) should be high when N availability is high because the soil microbes would extrete the excess N with low $d^{15}N$ due to the isotopic discrimination during the N metabolism. Even this new parameter r of $Dd^{15}N_{MB-Soil}$is expected to provide new insights into the actual C and N availability of the soil to the soil microbes, the measurement of $Dd^{15}N_{MB-Soil}$ is tedious due to the low concentration of soil microbial N. We explored the potential of $Dd^{15}N_{MB-Soil}$ in a temperate forest in Japan with denitrifier method that can allow us to measure $d^{15}N$ with small sample size (20-50nmol-N).

We collected the soil samples (Ao, 0-10 and 10-20cm depth) from Kamigamo Experimental Forest, Kyoto Univ, Japan from two plots located in upper part and lower part of a mountain slope. We measured $d^{15}N$ the extractable N (NH_4^+, NO_3^-, TDN and DON) in 0.5M K_2SO_4 soil extract. We also used the fumigation-extraction method to measure C and N content, and the $d^{15}N$ of soil microbial biomass. DOC concentration in the 0.5M K_2SO_4 soil extract and $d^{15}N$ of bulk soil N were also measured for the reference.

$d^{15}N$ of soil microbial biomass was significantly correlated with that of bulk N ($P<0.001$) but always higher than that of bulk N. Actually, $d^{15}N$ of soil microbial biomass was quite similar with $d^{15}N$ of DON, suggesting that the soil microbial biomass N is the source of soil DON as previously suggested (Koba et al. 2010). $Dd^{15}N_{MB-Soil}$ significantly correlated with soil C/N ($P<0.01$), which suggested that $Dd^{15}N_{MB-Soil}$ should reflect the C and N balance for soil microbes. However, the intercept of the regression lines obtained from two sites differed greatly. This difference in the relationship between $Dd^{15}N_{MB-Soil}$ and soil C/N strongly suggested that the same soil C/N does not indicate the same balance of C and N availability to the soil microbes. We discuss the usefulness of the new parameter of $Dd^{15}N_{MB-Soil}$ in the presentation together with other parameters such as DOC/DON and $d^{15}N$ of inorganic N.