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# Temporal changes in the soil microbial biomass and N dynamics in eastern Hokkaido

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1. Introduction

In arctic and alpine regions having seasonal snow cover, it has reported that the microbial activity in winter had impact on the annual nitrogen (N) cycling and the soil N availability in the growing season. However, the study focused on the soil microbial biomass and N dynamics from winter to spring in temperate region with seasonal snow cover is limited. In eastern Hokkaido in northern Japan, the soil often experiences soil freezing and freeze-thaw cycle due to the less snowpack in winter. Previous study in this region has reported that the ammonium production rate in soil increased in the late-winter compared to the much snowpack region. However, the pattern of soil microbial biomass and N dynamics from winter to spring is not clear. The objective of this study was to clear the pattern of soil microbial biomass and N dynamics and the relationship between their patter and the environmental factor.

2. Methods

This study was conducted on the Shibecha Experimental Forest, Kyoto University located in eastern Hokkaido, northern Japan. The main vegetation are Mongolian oak (*Quercus crispula*) and Sasa (*Sasa niponica*) that is understory vegetation. The study plots (5m×15m) were established in the slope of east and west. The plot number in each slope was six. The study period was from October 2013 to September 2014. In each plot, the soil moisture and temperature were measured using moisture sensor and temperature probe at 5 cm depth and 0， 5， 25 cm depth, respectively. The soil sampling from 0 to 10 cm was conducted in almost monthly. In same period, the exchange (collecting and setting) of resin was also conducted. The soil incubation from 0 to 10 cm and 10 to 20 cm was conducted by cylinder method. Collected interval of the incubated soil was from 1 to 2 month. We also measured snowpack and soil freezing depth in winter.

3.Results and discussion

The soil temperature at 0 and 5cm depth showed constantly 0 degree as snowpack increased. Microbial biomass C and N and inorganic N amount in the soil from 0 to 10 cm depth peaked in mid-winter. The inorganic N amount decreased from mid-winter to late-winter. On the other hand, both net N mineralization and nitrification rates showed higher trend in the growing-season than in the winter-season. These results indicated that the soil N utilization by living matter was significantly difference between winter- and growing-season. Although the microbial activity was inhibited by the low soil temperature in winter, the microbes would function as N sink because there is not competition for soil N resource between microbe and plant. The $NH_4^+$-N and $NO_3^-$-N peaked in October and December, respectively. Then both inorganic N amounts, especially in $NO_3^-$-N decreased rapidly, although the $NO_3^-$-N leaching at 20 and 30 cm depth was not found in same period. Furthermore, the values of ratio of fungi to bacteria and net nitrification rate decreased from October to March. These results suggested that the change of microbial flora might be important for the N sink in winter. However, the microbial biomass C significantly decreased at end of the April that the critical disappearance of snowpack was measured. These results suggested that the microbe could not tolerate to the freeze-thaw cycle and dramatic rise of soil temperature in the winter-spring transition.

Keywords: nitrogen cycling, soil freezing, freeze-thaw cycle, nitrogen mineralization, nitrogen leaching