The evaluation of soil nutrient status based on the microbial substrate utilization characteristics in tropical rainforest in Cameroon

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1. INTRODUCTION

In eastern Cameroon, located on the north edge of Congo Basin, it is essential to understand the soil nutrient status for sustainable land use as highly weathered and poor-nutrient Oxisols is a dominant soil. Currently, shifting cultivation on the plateau, typical reddish soil has been the main occupation and forest area with yellow soil at the edge of the plateau has not been opened yet. With increasing human pressure, shifting cultivators are likely to open new forests at the edge of the plateau but the nutrient status has not been studied. Also rapid decrease in lands may force them to reduce their fallow periods and eventually to conduct continuous cultivation. Previous research[1)] indicated there was a temporary increase in available pool of N and P and the original characteristic from forest vegetation lasted at least two years. However, it is not clear how long it will last. Thus, the objective of this research was to identify the limiting nutrient on microbial growth by using microorganisms as an indicator to evaluate the effect of topography and cultivation period on soil nutrient status.

2. MATERIALS AND METHODS

Samples were collected from typical clay forest soil on the plateau (FRup), lower forest soil (FRedge) and 5-year-cropland (CRup5) in Andom village and the laboratory incubation experiments were conducted. Added substrates were Carbon(C), Nitrogen (N) and Phosphorus (P) and four treatments(C, CN, CP and CNP) were applied. Exponential increase in the respiration rate after the addition of a particular substrate is considered to demonstrate that the nutrient added is the limiting factor on microbial growth. The respiration rate was measured two hourly until 120h. The data in 2-year-cropland (CRup2) from the previous study was also used in discussion.

3. RESULTS AND DISCUSSIONS

All plots showed higher specific respiration rate (SRI) of CP than that of C and significantly higher maximum respiration rate (CO_2 max) of CNP than that of CP and CN. It indicated P limited the initial microbial growth rate and N or P did the maximum respiration rate if there is ample C and P or C and N. In FRedge, the addition of C did not induce the microbial exponential growth and SRI and CO_2 max of all treatments were smaller than those in FRup. Thus, in FRedge, there was a strong N and/or P limitation beyond C limitation. And available and total pools of N and P were smaller in FRedge than in FRup. In CRup2, SRI of CN, CP and CNP was higher than that in FRuo and only that of CP in CRup5 was significantly smaller than in FRup. This indicated after a temporary increase in available pool of N and P during two years, they decreased to the original size but only available pool of N further decreased in CRup5. And CO_2 max of C and CN was significantly smaller after five-year cultivation than that in FRup indicating the decrease in total pool of P.

Thus, limiting nutrient on microbial growth did not change while continuous cultivation decreased available pool of N and total pool of P. As total pool of P significantly decreased from the original forest vegetation as the effect of five-year cultivation, it is ideal to have fallow-period every less than 5 years. Although FRedge has poorer nutrient status than FRup, cassava plantation on FRedge could contribute the crop production in this forest area as it is good at taking up nutrient even under the low soil fertility. Therefore, it is indicated that shifting cultivation on both forest on the plateau and at the edge of the plateau could be one of the approaches for sustainable land use in this forest.

1) Fujimori (2014). Evaluation of soil nutrient status using substrate utilization characteristics of soil microbes: Application to Oxisols in eastern Cameroon.