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Carbon Mineralization in Tropical Montane Forests Soils in Sri Lanka

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Abstract

The change of soil carbon (C) mineralization of tropical montane forests (TMFs) across elevation remains unclear. The objective of the present study was to determine the variation of soil C mineralization along an elevation gradient in TMFs in Sri Lanka. Soil samples were collected from four permanent sampling plots (PSPs): 1042 (Sinharaja-Enasalwatte-1/ENS_1), 1065 (Sinharaja-Enasalwatte-2/ENS_2), 2080 (Pidurutalagala/PTG) and 2132 m asl (Horton Plains/HNP). Each sampling plot was 1 ha in size and 17 near-surface representative soil samples were collected up to 0.25 m depth. Four replicates from each PSP were used for the study. Evolution of CO_2 was measured in a 60-day soil laboratory incubation study by trapping in 1 N NaOH and titrating a 20 mL aliquot with a standardized 1 N HCl. An average temperature of ~25° C was maintained throughout experiment. Basic soil physico-chemical properties (pH, electrical conductivity (EC), redox potential (Eh), cation exchange capacity (CEC), organic carbon (OC) content, volumetric water content (VWC), bulk density and porosity) were determined. All data were subjected to analysis of variance (one way ANOVA) at 95% confident level and mean separation was conducted following Tukey's Test. Results showed a significant (P<0.05) effect of elevation on the CO_2 emission rate, cumulative CO_2 emission and, above mentioned soil properties. The highest and the lowest average CO_2 emission rates; 67.6±9.7 and 28.8±2.2 mg C kg^{-1} soil day^{-1}, respectively, were determined in PTG and ENS_1. PTG showed the highest cumulative CO_2 emission (4,071 mg C kg^{-1} soil), followed by HNP, ENS_2 and ENS_1: 3,799, 2,091 and 1,733 mg C kg^{-1} soil, respectively. In mean comparison between cumulative CO_2 emission and elevation, upper montane (above 2080 m) forests (PTG, HNP) and lower montane (1042–1668 m) forests (ENS_1, ENS_2) were distinctly separated into two different groups. We found a significant (P<0.05) positive correlation between cumulative CO_2 emission and pH, EC, soil porosity, CEC and soil OC content. The cumulative CO_2 emission had a significant (P<0.05) negative correlation with bulk density. In conclusion, the soil physicochemical properties of selected PSPs also showed variation across the elevational gradient. The present findings suggested that the attitudinal variation of CO_2 evolution is partially supported by the variation of physicochemical properties of selected TMFs. But further studies are required to confirm the relationship between CO_2 evolution and soil physicochemical properties of the TMFs studied.

Keywords: Incubation, Elevation, CO_2 emission, Horton Plains, Sinharaja, Enasalwatte, Piduruthalagala