Methane and CO_2 fluxes from an Indonesian peatland used for sago palm (Metroxylon sagu Rottb.) cultivation: Effects of fertilizer and groundwater level management

Abstract

Tropical peatland is a vast potential land source for biological production, but peatland is a major natural source of greenhouse gases, especially methane (CH_4). It is important to evaluate the changes in greenhouse gas emissions induced by cultivation practices for sustainable agricultural use of tropical peatland. We investigated the effects of fertilizer application and the groundwater level on CH_4 and carbon dioxide (CO_2) fluxes in an Indonesian peat soil. The crop cultivated was sago palm (Metroxylon sagu Rottb.), which can grow on tropical peat soil without drainage and yield great amounts of starch. CH_4 emission through sago palm plants was first estimated by collecting gas samples immediately after cutting sago suckers using the closed chamber method. The CH_4 fluxes ranged from negative values to 1.0 mg C m^{-2} h^{-1}. The mean CH_4 flux from treatment with macro elements (N, P, and K) and microelements (B, Cu, Fe, and Zn) applied at normal rates did not differ significantly from that of the No fertilizer treatment, although increasing the application rates of macro elements or microelements by 10-fold increased the CH_4 flux by a factor of two or three. The relationship between CH_4 flux and the groundwater table was regressed to a logarithmic equation, which indicated that to maintain a small CH_4 flux, the groundwater table should be maintained at <45 cm. The CO_2 fluxes ranged between 24 and 150 mg C $m^{-2}h^{-1}$, and were not significantly affected by either fertilizer treatments or the groundwater level. The inclusion of sago palm suckers in a chamber increased CH_4 emission from the peat soil significantly. Thus, gas emissions mediated by certain kinds of palm plants should not be disregarded.