

Carbon dioxide and methane emission from compacted tropical peat soil

Drainage, compaction and groundwater table control are pre-requisite for cultivation of oil palm on peat. To understand effect of compaction on soil C emission from tropical peatland, a laboratory soil column incubation experiment was conducted. Peat soil collected from Mixed Peat Swamp forest in Sarawak, Malaysia were packed and compacted in polyvinyl chloride pipes to three soil bulk densities (BD); 0.14, 0.18 and 0.22 g cm⁻³. Soil CO₂ flux, CH₄ flux, DOC concentration and redox potential (E_h) from soil columns were measured weekly for 12 weeks. Field measurement of soil CO₂ and CH₄ flux at oil palm plantation were monitored one year for validation against soil column approach. Soil porosity and moisture retention of each soil BD at field capacity were also determined using another set of peat sample packed into 100 cm³ soil core ring. Soil porosity decreased while soil moisture retention increased proportionally with increasing soil BD. High moisture content at higher soil BD was expected to reduce soil C emission through the restriction of soil aeration and microbial activity. However, results from incubation experiment showed that only soil CH₄ flux were reduced approximately by 22% with compaction. On contrary, soil CO₂ fluxes were greater at the compacted soil (BD 0.18 and 0.22) when infiltration and percolation of rainwater become slower with time, until soil moisture becomes limiting factor. Faster water infiltration at uncompacted soil (BD 0.14) also resulted in higher DOC concentration that was about two times compared to soil BD 0.18 and 0.22. Meanwhile, soil E_h shows no significant correlations with both CO₂ and CH₄ flux. This study showed that compaction affects water movement and gaseous transport in the soil profile, thus influences C emission from peat soil. However, the set-up of present soil column did not reflect the real condition in the field and therefore further improvement on the experimental set-up are required.