ABSTRACT

ETIK PUJI HANAYANI. Carbon dioxide (CO$_2$) and Methane (CH$_4$) emission on Oil Palm Peatland with various peat thickness and plant age. Under supervision of KOMARUDDIN IDRIS, SUPIANDI SABIHAM, SRI DJUNIWATI, MEINE VAN NOORDWIJK.

The total area of peatland in Indonesia is about 20 million ha and average oil palm yield on peatland can reach 23 tons Fresh Fruit Bunches (FFB)/(ha year). Therefore, peatlands have considerable potential for development of oil palm agribusinesses in Indonesia. However, peatlands contain one-third of global soil carbon and total stocks represent 70 years of current annual global emissions from fossil fuel burning. This carbon store is now being released to the earth’s atmosphere through fire and respiration, both increased by drainage. CO$_2$ and CH$_4$ gases are part of the greenhouse effect on global warming. CO$_2$ and CH$_4$ gas fluxes vary with stage of plant growth, depending on management practices for soil and plant (such as drainage and fertilization) and characteristics of peatland, including water level, and the thickness and maturity of peat deposit.

The research was conducted on Meulaboh (West Aceh) from May 2008 until May 2009. Measurements of CO$_2$ and CH$_4$ flux were carried out by applying a closed chamber method and subsequent laboratory analysis. The objectives of this study were (1) to characterize physicochemical conditions of peatland used for oil palm, (2) to study the effect of N application on peat soil with different levels of maturity to the CO$_2$ flux, (3) to evaluate CO$_2$ and CH$_4$ flux in rhizosphere and non rhizosphere soil in oil palm field in relation to drainage, peat thickness and plant age.

Peatlands around Meulaboh characteristically have pH H$_2$O 2.9 – 3.9, pH KCl 2.23 - 3.07. Water content per unit dry weight depends on peatland maturity level (fibric: 540 - 1187%, hemic: 268 - 480% and sapric: 106 - 242%). Ash content per unit dry weight varied from 1.8 – 5.9%, and C-organic content 53.4 – 57.6%. Peat total acidity is 4.2 – 6.4 me g$^{-1}$, COOH content 0.02 - 0.16 me g$^{-1}$ and phenolic-OH content 4.2 – 6.2 me g$^{-1}$.

In a laboratory study, application of nitrogen fertilizer on peat soil was found to increase CO$_2$ emission.

The rate of CO$_2$ emission was 10 - 40 t ha$^{-1}$ yr$^{-1}$. The CO$_2$ emission showed that: (1) there was a tendency in CO$_2$ flux to be higher in the rainy season than in the dry season, (2) measured flux in oil palm fields decreased with age (1-10 years), (3) CO$_2$ flux in rooted peat was on average 50% higher than non-rooted peat, (4) there was a tendency for the CO$_2$ flux to decrease with increasing peat thickness, (5) the type land used was one of factors affecting the CO$_2$ flux, (6) In general, CO$_2$ flux increased with increasing the depth of water table. However, reverse pattern was also found, and another pattern where CO$_2$ flux was independent on the depth of water table. The increasing depth of water table seemingly impacted on the decrease of CH$_4$ flux.

Keywords: CO$_2$ and CH$_4$ fluxs, depth of water table, peat thickness, oil palm, West Aceh.