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CO_2 Measurement in Palm Oil Plant in Peatland

Pengukuran CO_2 pada Pertanaman Kelapa Sawit di Lahan Gambut

Lukas Sebayang* and Imelda S Marpaung

Research Center for Horticulture and Estate Crops, Research Organization for Agriculture and Food, National Research and Innovation Agency of the Republic of Indonesia, Cibinong Science Center, Jl. Raya Jakarta - Bogor, Km 46 Cibinong-Bogor, West Java 16911, Indonesia

*Corresponding author: lukas.sebayang@gmail.com

ABSTRACT

Peatlands are one of the contributors to greenhouse gas emissions because it is estimated that the carbon stock stored in them is around 528 Giga tons (Gt) or equivalent to 75% of the total carbon (C) in the atmosphere, so that if peat is oxidized it will cause carbon to be released into the air. The conversion of forest land to agricultural land can be one of the causes, including the activity of making drainage channels. The construction of drainage channels causes a decrease in the water table so that the volume of peat under aerobic conditions increases while increasing the activity of microorganisms in decomposing peat. Peat decomposition and root respiration contribute to carbon emissions. This study aims to determine the CO_2 concentration in several conditions of oil palm roots. CO_2 measurement by survey method on oil palm plantations, using the IRGA (Infra Red Gas Analyzer). Measurements are carried out once per month from January to May 2020 for 3 minutes. The point of observation was determined by 2 factors with 3 treatments and 3 replications. Factor 1 is the observation point in the area of accumulation of midrib pieces and other litter (B1) and factor 2 is the observation point in the road area around the tree (B2). While thetreatments were (A1) natural roots, (A2) roots were cut when the measurements were going to be taken and (A3) roots were cut and permanently restricted. The results of the measurement of the highest average concentration of CO_2 changes from 0 minutes to 3 minutes in January were in treatment B1A3 (140.4 ppm), February in treatment B2A3 (103.9 ppm), March B1A3 (124.6 ppm) ppm), April B1A3 (143.8 ppm) and May B1A3 (110.7 ppm). Meanwhile, the lowest concentration of CO_2 changes from 0 minutes to 3 minutes in January was in treatment B1A1 (71.5 ppm), February in treatment B1A1 (25.7 ppm), March B2A3 (40.2 ppm), and March B2A3 (40.2 ppm). April B2A1 (30.6 ppm) and May B1A1 (43.2 ppm). From the measurement results, it can be concluded that the highest concentration of CO_2 and its changes was in treatment B1A3, namely in the treatment of cutting roots with permanent blocks, while the concentration of CO_2 and its reduced changes was in thetreatment of natural roots (A1) both in Blocks B1 and B2.

Keywords: *CO_2, Palm Oil, Peat.*

ABSTRAK

Lahan gambut merupakan salah satu penyumbang emisi gas rumah kaca karena diperkirakan cadangan karbon yang tersimpan di dalamnya sekitar 528 Giga ton (Gt) atau setara dengan 75% dari total karbon (C) di atmosfer, sehingga apabila gambut teroksidasi akan menyebabkan karbon terlepas ke udara. Alih guna lahan hutan menjadi lahan pertanian dapatmenjadi salah satu penyebabnya, termasuk aktivitas pembuatan saluran drainase. Pembuatan saluran drainase menyebabkan penurunan muka air tanah sehingga volume gambut dalam kondisi aerob meningkat sekaligus meningkatkan aktivitas mikroorganisme dalam mendekomposisi gambut. Dekomposisi gambut dan respirasi akar berkontribusi terhadap emisi karbon. Pengkajian ini bertujuan untuk mengetahui kosentrasi CO_2 pada beberapakeadaan akar kelapa sawit. Pengukuran CO_2 dengan metode survey pada pertanaman kelapa sawit, menggunakan alat IRGA (*Infra Red Gas Analyzer*). Pengkuran dilakukan satu kali per bulan dari Bulan Januari sampai Mei 2020 selama3 menit. Titik pengamatan ditentukan dengan 2 faktor dengan 3 perlakuan dan 3 ulangan. Faktor 1 yaitu titik pengamatan di daerahpenumpukan potongan pelepah dan serasah lainnya (B1) dan faktor 2 yaitu titik pengamatan di daerah jalan sekitar pohon (B2). Sedangkan perlakuannya adalah (A1) akar alami, (A2) akar dipotong saat akandilakukan pengukuran dan (A3) akar dipotong dan di dibatasi permanen. Hasil pengukuran rata-rata konsentrasi perubahan CO_2 tertinggi dari 0 menit sampai ke menit ke 3 pada Bulan Januari adalah pada perlakuan B1A3 (140,4 ppm), Bulan Pebruari pada perlakkuan B2A3 (103,9 ppm), Bulan Maret B1A3 (124,6 ppm), Bulan April B1A3 (143,8 ppm) dan Bulan Mei B1A3 (110,7 ppm). Sedangkan konsentrasi perubahan CO_2 terendah dari 0 menit sampai ke menit ke 3 pada Bulan Januari adalah pada perlakuan B1A1 (71,5 ppm), Bulan Pebruari pada perlakkuan B1A1 (25,7 ppm), Bulan Maret B2A3 (40,2 ppm), Bulan April B2A1 (30,6 ppm) dan Bulan Mei B1A1 (43,2 ppm). Dari hasil pengukuran dapat disimpukan bahwa konsentrasi CO_2 dan perubahannya yang tertinggi adalah pada perlakuan B1A3 yaitu pada perlakuan pemotongan akar dengan blok permanen sedangkan konsentrasi CO_2 dan perubahannya yang terendan adalah pada perlakuan akar alami (A1) baik di Blok B1 maupun B2.

Kata kunci: CO_2, Kelapa Sawit, Gambut

INTRODUCTION

Climate change is a global phenomenon caused by human activities such as the use of fossil fuels and land use change, theprocess produces gases such as CO_2, CH4 and N2O. These gases are increasing innumber in the atmosphere and have theability to absorb and reflect long-wave radiation emitted by the earth, resulting in an increase in the earth's temperature by 0.6oC during the 20th century (IPCC, 2007). The gases that play a role in global warming are known as greenhouse gases. One of the contributors to greenhouse gas emissions is peatland and it is estimated that the total world carbon content stored in the soil is 550 Giga tons or equivalent to 75% of all carbon in the atmosphere (Joosten, 2009; Ansari, 2011).

This is because peat soil is formed from the accumulation of organic matter with a slow rate of decomposition so that the entire peat is a stored carbon source that plays a significant role in the global carbon cycle. When peat soil is oxidized, it will release carbon into the air not only in the form of CO_2 but also CH4 which is produced from anaerobic breakdown of organic matter. Peatlands require good water management for several reasons. First, for nature conservation and restoring hydrological conditions, such as reducing the vulnerability of peatlands to fire. Second, water management is needed so that peatlands can be used for agriculture such as rice, oil palm, vegetables, pineapple, and others. Annual crops (food and vegetables) generally require shallow drainage ranging from 20-30 cm. For oil palm plantations the ideal drainage depth is around 50-70 cm (Melling et al., 2005) and for rubber plants around 20-40 cm (Agus and Subiksa, 2008).

Maintaining a water level of no more than 40 cm fromthe soil surface will result in a balancebetween reducing CO_2 emissions andwater for plant growth (Sabiham et al., 2012). The purpose of this study was to determine the concentration of CO_2 in oil palm plantations on peatlands.

MATERIAL AND METHOD

The measurement location is in Teluk Panji Village, Kampung Rakyat District, South Labuhanbatu Regency. Implementation time starts from January – May 2020. The observation point was determined by 2 factors with 3 treatments and 3 replications. Factor 1 is the observation point in the area of accumulation of midrib pieces and other litter (B1) and factor 2 is the

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observation point in the road area around the tree (B2). While the treatments were (A1) natural roots, (A2) the cut roots are 50 tertiary roots and 50 quaternary roots when measurements were going to be taken and (A3) roots were cut and permanently restricted (Figure 1). CO_2 measurements were carried out using a survey method on oil palm plantations, using an IRGA (Infra Red Gas Analyzer) for 3 minutes.Determination of the measurement location area is carried out using the purposive sampling method, namely the determination of the location intentionally which is considered representative.

RESULTS AND DISCUSSION

The data on the average CO_2 concentration measured in January, February, March, April and May are shown in Fig. 1 – 5.

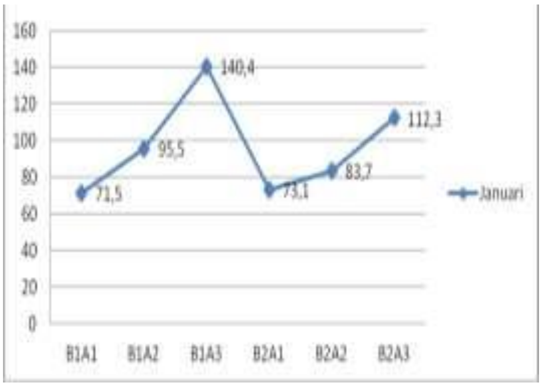

Figure 1. CO2 concentration in January 2019

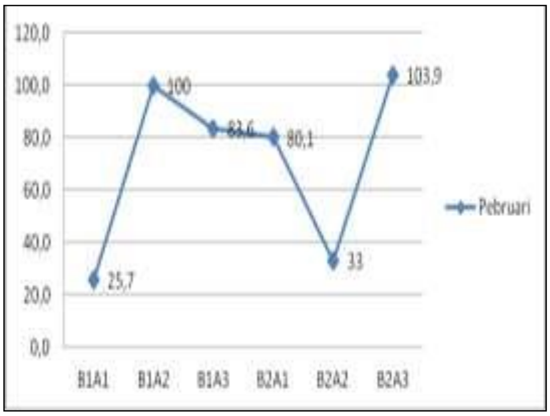

Figure2. CO2 concentration in February 2019.

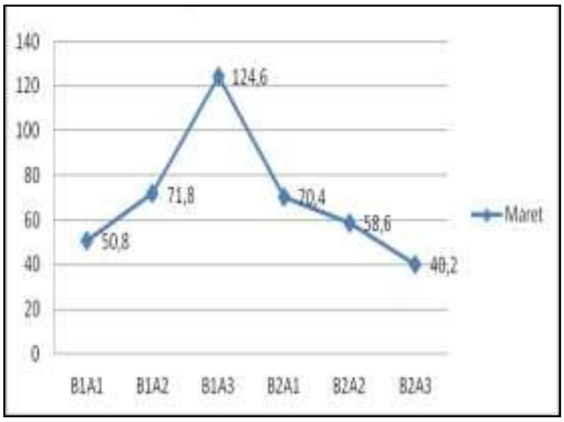

Figure 3. CO2 concentration in March 2019.

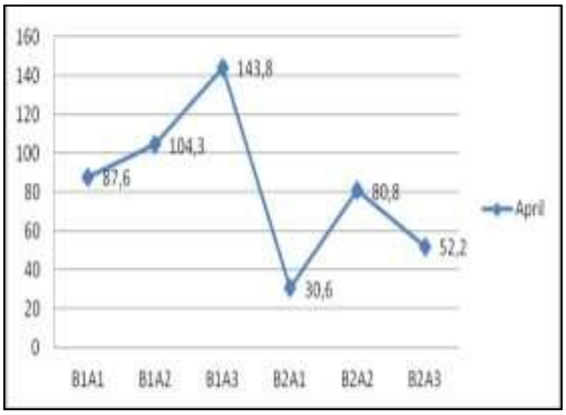

Figure 4. CO2 concentration in April 2019.

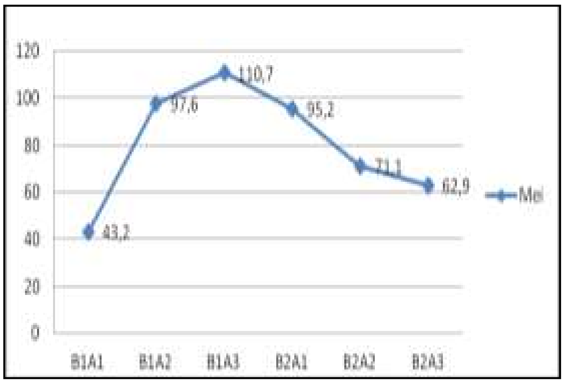

Figure 5. CO2 concentration in May 2019.

Information:
B1A1 : Litter area with natural roots
B1A2 : Litter area with roots cut during measurement
B1A3 : Litter area with cut roots permanently restricted
B2A1 : Ordinary Road Area with naturalroots
B2A2 : Road area with root cut off during measurement

B2A3 : Road area with cut roots permanently restricted

From Figure 1-5 it can be seen that the highest concentration of CO2 changes in January was in treatment B1A3 (140.4 ppm), February in treatment B2A3 (103.9 ppm), March B1A3 (124.6 ppm), April B1A3 (143.8 ppm) and May B1A3 (110.7 ppm). While the lowest CO2 concentration in January was in treatmentB1A1 (71.5 ppm), February was in treatment B1A1 (25.7 ppm), March B2A3 (40.2 ppm), April B2A1 (30.6 ppm) and May B1A1 (43.2 ppm). The change in CO2 occurs from the root respiration process, this is in accordance with the opinion of Berglund et al., 2011, that the contribution of root respiration to CO2 emissions is 27-63%. Changes in CO2 are alsocaused by the decomposition of peat by soil micro-organisms.

CONCLUSION

From the results of measurements for five months it can be concluded that the concentration of CO2 is in the B1A3 treatment, namely the root cutting treatment with a permanent block. Meanwhile, the lowest CO2 concentration was in the B1A1 treatment, which is a litter area with natural roots. Measurements should also be made on the types of plants and other peat land uses.

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