Name	Counterpart	Title
Damris Muhammad, Yusrizal	A05	Effects of biochar amendment on CO_2 emission and DOC retention in soils of the transformed forest: a short-term laboratory study

Background

Biochar is a carbon rich material of high stability, absorbing capacity, aromatic in nature and a recalcitrant (Fidel *et al.* 2019). Biochar has therefore been used for a number of environmental applications such as soil amendment to reduce DOC losses (Liu *et al.* 2019, Dai et al. 2018, Eykelbosh *et al.* 2015) and to capture CO_2 emission (Creamer *et al.* 2018). Biochar contributes to the refractory soil organic carbon pool and can decrease atmospheric CO_2 concentrations by sequestering carbon when added to soil (Oliveira, *et.al.*, 2018).
Biochar amendment to soil in sugarcane plantations in Brazil was able to reduce C losses through leaching (Eykelbosh *et al.* 2015), reduce 18˘% of total DOC flux by surface runoff in cropland during natural rainfalls (Liu *et al.* 2019) and influence gas emission from easy mineralizable carbon amended with manure-based biochar (Dai *et al.* 2018). Biochar has higher CO_2 capture capacity than that of liquid amines (Creamer *et al.* 2018); a liquid for capturing CO_2.
Structural changes during pyrolysis processes contribute to the high capacity of biochar in stabilizing soil DOC (Oliveira *et al.* 2018). The decrease in the H/C and O/C ratios in the resulted materials results in a higher polarity, aromaticity and stability. The recalcitrant nature of biochar has brought it to center of studies for a number of applications. The aim of this research was to study the effects of biochar amendment to the soils impacted by tropical forest transformation systems in Jambi on GHG emission and DOC retention in the biochar amended soils through a short-term incubation study.

Materials and Methodology

Soil samples (0–30 cm) collected from small holders of palm plantation in the Batanghari district, Jambi Province, were air dried and grained to pass a 2 mm sieve. The sample's weight (approx. 750 g) was measured in a 1000-ml glass bottle and 5, 10, 15 and 20 % w/w of biochar were added. Litter (10%) was also added to the bottle as a source of organic material for soil microorganism. Water was then added up to 75 % of water holding capacity. For conditioning, the bottles were left open for 1 week.
The bottle was connected to a tube containing 40-ml NaOH 0.1 M solution and an air pump to ensure that oxygen was not as a limiting factor. Carbon dioxide gas generated in the bottle head space were then pumped to the NaOH solution and the solids were also collected. During the 8-week incubation period, the gas and the solids were collected 8 times with 7-day intervals. The solids were then treated with water for DOC extraction.

Results and Discussion

Concentrations of water extractable DOC from biochar amended soils had increased with the incubation time up to the 4th week and then decreased afterwards up to the 8th week. Figure 1 (A) shows variations of soil extractable DOC concentrations with varying biochar amendments (0–20% w/w). The water extractable DOC concentrations were low at the early stages of incubation and increased gradually at the 3rd week and peaked at the 4th week. Beyond the 4th week, the concentrations decreased until the end of the 8th week of incubation. At this point, the concentrations were slightly above their initial concentrations. Similar results were also observed for the soil samples without the addition of biochar. It appears that biochar amendment to the soils resulted in the improvement of DOC productions peaking at the 4th week.
Carbon dioxide emission also follows a similar trend as DOC, as shown in Figure 1 (B). At the early stage of incubation, the CO_2 emission was low and gradually increased with incubation time. The emission peaked at the 5th week for all five biochar variations and beyond this point the emissions gradually decreased. At the 8th week, the emission was about the same level as it was in the beginning of the incubation. However, a similar result was also observed for the samples without biochar.

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Funded by DFG Deutsche Forschungsgemeinschaft

It needs to be emphasized that the peak of CO_2 emission is a week behind the peak of DOC production as indicated in Figure 1 (A) and (B). It appears that the increase in DOC concentrations in the soil promotes the improvement of soil microbes' activity in mineralizing the soil's DOC and improves the production of CO_2 released into the atmosphere.

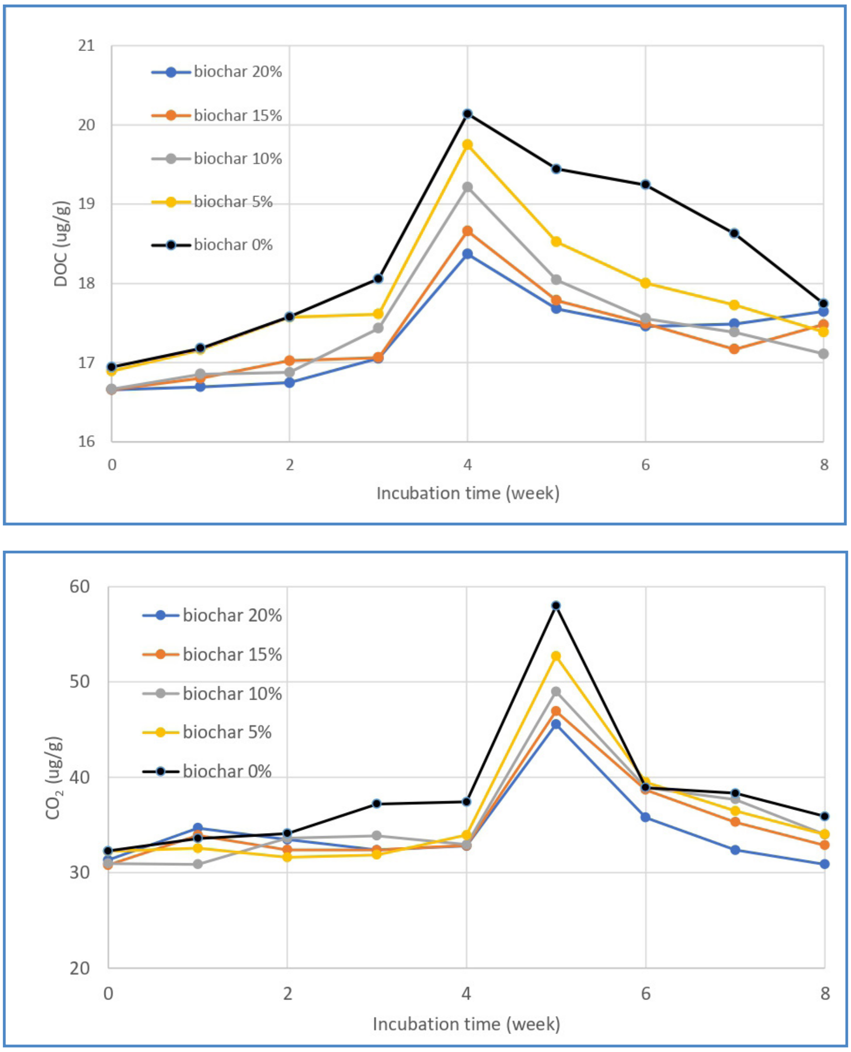

Figure 1A and 1 B.
The effect of biochar amendment and incubation time on (A) water extractable DOC and (B) CO_2 emission from the soil of palm oil plantation (constant 10% litter added to the bottle)

Conclusion

Biochar amendment to the palm oil soil suppresses the DOC production and CO_2 emission during an 8-week incubation period. DOC production peaks at the 4th week while CO_2 emission peaks a week behind the DOC.

Reference

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