

**EFFECTS OF POULTRY MANURE BIOCHAR
AMENDMENT ON TROPICAL SOIL CO₂
EMISSION AND MICROBIAL BIOMASS**

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ABSTRACT

Biochar is a type of charcoal product which is produced by pyrolysis of biomass under limited-oxygen conditions and it is a carbon-rich residue. Biochar applied to soil enhances soil respiration by increasing the CO₂ production. The objectives of this study are to evaluate the effects of poultry manure biochar amendment on soil CO₂ emission and soil microbial biomass, to determine the relationship between soil temperature, moisture content, pH and CO₂ emission as well as to evaluate the canopy effect on soil CO₂ emission. This study was done at Faculty of Sustainable Agriculture, Universiti Malaysia Sabah, Sandakan, Sabah, Malaysia (5° 55'47" N 118° 0'30" E). Twelve maize plots were randomly amended with poultry manure biochar at three rates of 0, 7.5, 15 t ha⁻¹, with each replicated four times. Soil respiration rate was measured in the morning (6 a.m.) and evening (5 p.m.), weekly, for thirty-six weeks during the two crop cycles of the maize crop. Soil respiration was significantly different between the three biochar application rates for both the morning and evening measurements. Generally, the 15 t ha⁻¹ biochar rate had the highest soil respiration rate compared to the others with a mean of 10.54 μmol m⁻²s⁻¹ (14.63 kg CO₂ m⁻² yr⁻¹) over the 36 weeks observations. The 7.5 and 15 t ha⁻¹ of biochar significantly increased the soil pH from 5.45 to 6.20 and 5.48 to 6.35 respectively. Soil microbial biomass and population were significantly affected by the 15 t ha⁻¹ biochar application rate with an increase of about 130% (575.98 mg kg⁻¹) during the second crop cycle. Further, 15 t ha⁻¹ of biochar application resulted in the highest microbial population for both fungi (41.88 CFU ml⁻¹) and bacteria (37.50 CFU ml⁻¹) for the soil incubation study.

Keywords: Poultry Manure Biochar, Soil CO₂ Emission, Soil pH, Soil Microbial Biomass

ABSTRAK

KESAN-KESAN PENAMBAHAN BIOCHAR SISA BUANGAN TERNAKAN KE ATAS RESPIRASI TANAH TROPIKAL DAN BIO-JISIM MIKROB

Biochar merupakan sejenis produk arang yang dihasilkan daripada bahan buangan secara proses pirolisis dalam keadaan bekalan gas oksigen yang terhad dan ia mengandungi unsur karbon yang banyak. Penambahan biochar ke dalam tanah dapat merangsangkan proses respirasi tanah dengan mengambilkira penghasilan karbon dioksida yang dikeluarkan daripada tanah. Tujuan kajian ini adalah untuk mengkaji kesan penambahan biochar ke atas respirasi tanah serta mengenalpasti impak penambahan biochar ke atas bio-jisim microb tanah. Kajian ini dijalankan di lokasi Fakulti Pertanian Lestari, Universiti Malaysia Sabah, Sandakan, Sabah, Malaysia (5°55'47" N 118°0'30" E). Kajian ini menggunakan dua belas plot tanah yang ditanam dengan pokok jagung dan setiap plot tanah dirawat dengan kuantiti biochar 0, 7.5 dan 15 t ha⁻¹ serta setiap rawatan biochar telah diulangi sebanyak 4 kali secara rawak. Kadar respirasi tanah telah direkod dan dibaca pada waktu pagi (jam 6 pagi) dan waktu petang (jam 5 petang) dan semua bacaan diukur sekali dalam seminggu selama tiga puluh enam minggu sepanjang dua kitaran penanaman jagung. Secara keseluruhannya, rawatan biochar 15 t ha⁻¹ merangsang kadar respirasi tanah yang lebih tinggi berbanding dengan rawatan kawalan dan 7.5 t ha⁻¹ biochar. Ia menghasilkan kadar respirasi tanah sebanyak 10.54 μmol m⁻²s⁻¹ (14.63 kg CO₂ m⁻² yr⁻¹) sepanjang 36 minggu tempoh kajian. Sementara itu, rawatan biochar 7.5 dan 15 t ha⁻¹ masing-masing dapat meningkatkan nilai pH tanah secara signifikasi daripada pH 5.45 kepada 6.20 dan 5.48 kepada 6.35. Bio-jisim dan populasi mikrob tanah turut menunjukkan peningkatan secara signifikasi setelah dirawat dengan biochar 15 t ha⁻¹. Sebanyak 130% peningkatan (575.98 mg kg⁻¹) dalam jumlah jisim dan populasi mikrob pada tanaman kitaran kedua. Penambahan biochar 15 t ha⁻¹ meningkat jumlah populasi mikrob antara kumpulan kulat (41.88 CFU ml⁻¹) dan bakteria (37.50 CFU ml⁻¹) dalam proses penggeraman sampel tanah.

Kata utama: Biochar sisa buangan ternakan, respirasi tanah, pH tanah, bio-jisim mikrob tanah