EM 013

Soil Organic Carbon Stabilization on Forested and Deforested Red-yellow Soil under Different Temperature Condition

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Introduction

Soil organic carbon (SOC) has an important role as a key indicator for soil health due to its contributions on mitigation and adaptation to climate change. Tropical areas cover with Red-yellow soil (Udults) such as Amazon represents the highest amount of soil carbon sources in the earth. Although it is affected by human impacts due to deforestation, it is important to maintain and increase SOC of tropical Red-yellow soil toward an optimal level for meeting challenges such as mitigating climate change effects.

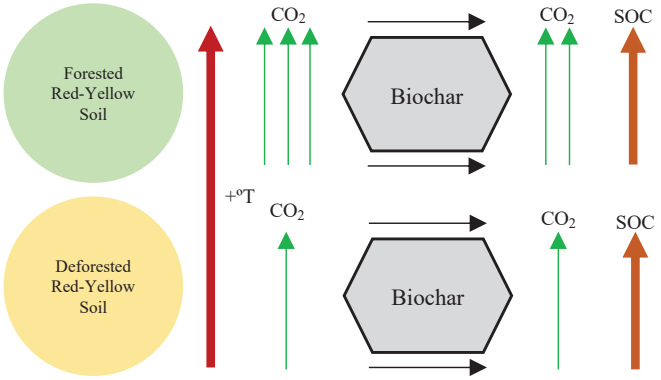

Fig. 1 Diagram of the effects of temperature on soil.

Objetives

The present study aimed to analyze the quantity and stabilization of soil organic carbon from Red-yellow soil, under different temperatures (25ºC and 35ºC) and conditions (forested and deforested). Such study is important to provide information about potential carbon emissions and climate change effects.

Methodology

Soil sample source and preparation

The soil was collected from deforested and forested areas (Carter and Gregorich, 2008). Air-dried soil were sieve and weighed. Each treatment was divided at ambient (25ºC) and warm (35ºC), and biochar rate (0% and 5%).

Fig. 2 Soil sample preparations of the treatments.

Soil Organic Carbon (SOC) determination

SOC were analyzed by Spectrophotometric method (Wallinga et al., 1992). Standards worked as 0, 5, 10, 15 and 20 mmol Cr^{+3} per litter. The absorbance was measured in a 1 cm cuvette at a wavelength of 590 nm.

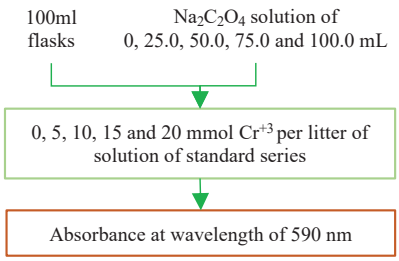

Fig. 3 diagram of spectrophotometric method

Soil Respiration Rate (SRR) determination

The SRR was determined by using the infrared gas analyzer at time zero and measure again at the end of 1-h incubation (Sparda, Miller, Anderson and Hsieh, 2016). The soil respiration rate (SRR, µL CO_2/h/g air-dried soil) was calculated as:

$$SRR = (CO_{2f} - CO_{2i}) * V * \frac{1000}{S}$$

CO_{2i} & CO_{2f} : CO_2 ppm.
V: space volume (450 mL).
S: amount of soil (10.0 g).

Results & Discussion

Table 1 Soil Organic Carbon (SOC) content and Soil Respiration Rate (SRR) of different conditions, biochar rate and temperature.

Condition	Biochar	T°	SOC (mg/g)	SRR (µL CO2/h/g)
Forested	0%	25°	7.24 ± 0.04 a	8.87 ± 0.20 a
		35°	7.61 ± 0.43 a	12.14 ± 0.20 b
	5%	25°	10.27 ± 0.39 b	8.53 ± 0.04 a
		35°	10.97 ± 0.37 b	11.9 ± 0.13 c
Deforested	0%	25°	5.68 ± 0.46 c	6.57 ± 0.02 d
		35°	6.6 ± 0.44 ab	4.93 ± 0.13 e
	5%	25°	4.99 ± 0.09 ab	5.51 ± 0.09 e
		35°	5.52 ± 0.53 c	4.88 ± 0.24 e

The amount of organic carbon obtained in this study indicated significant differences (P<0.05) between treatments (Forested vs Deforested). Temperature changes did not show significant difference between treatments in short term. Liu et al. (2021) describe the degradation of organic carbon in long-term by microbes at warm conditions as a reduction in the amount of SOC, this explain the non-significant change in the values of SOC by temperature in short-term.

Deforested conditions showed values of SRR lower in comparison with Forested. It is clear due to the low amount of carbon in the Red-yellow soil and the relation with microbial activity. Biochar application has affected the SOC but the effects on SRR stabilization in the short-term is depending by temperature and the microbial activity (Xu et al., 2019).

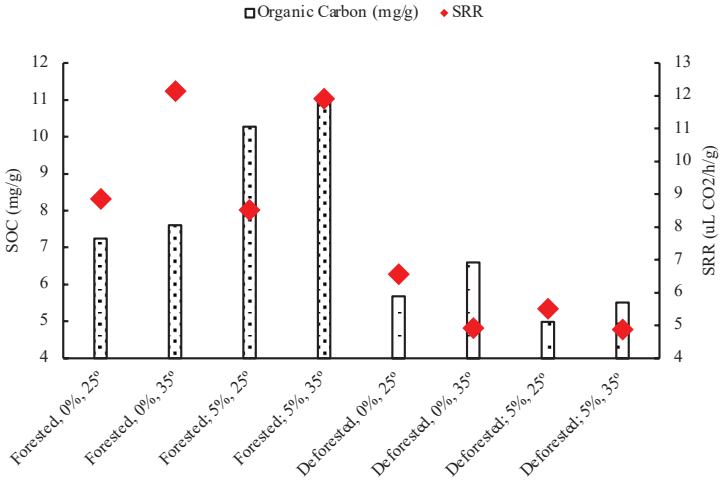

Fig. 4 Soil Organic Carbon content and Soil Respiration Rate of each treatment.

Conclusions

Although Red-yellow soil has a low organic carbon content, this reduction can be recovered by biochar addition. The loss of carbon by microbial activity increases by the effect of temperature which has an important role through Soil Respiration Rate. The Forested conditions of Red-yellow soil showed an increase of microbial activity due to the high carbon content, thus, the changes on respiration are easily affected by weather such as temperature conditions. This process of organic carbon degradation is not stabilized by biochar addition in the short-term. Finally, biochar works as carbon sources to maintain and increase SOC content, but stabilization effect on Soil Respiration Ratio (SRR) should be observed in long term under warm and ambient conditions as part of the stabilization process.