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Biochar effects on microbial community profiling of a tropical sandy loam

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1A. Introduction

- Tropical soils experience subsistence agricultural management practices under high temperatures, humidity and intense rainfall.
- Consequent leaching and runoff of basic nutrients
- Reactive iron and aluminum with low pH (acidity problem)
- Low organic matter content is expected to affect microbial community structure and bio-diversity.
- Poor soil fertility and low crop productivity

Economically feasible and sound environmental strategy?

Biochar proposed as one of the amendments to improve soil biology, enzyme activities and microbial community structure.

Soil microbes play critical roles in
- ❖SOM decomposition
- ❖Nutrient recycling

Microbial diversity has paramount importance in maintaining soil health and crop productivity with enhanced agroecosystem services.

1B. The Game

Economically viable and environmentally compatible management strategy?

Crop residues

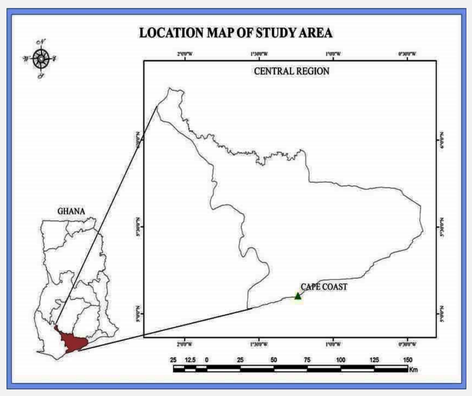
Pyrolysed

Biochar

2. Objective

To study the response of microbial activity and community structures, and enzyme activity at different rates of biochar application in soil under humid tropical condition.

3. Materials and methods



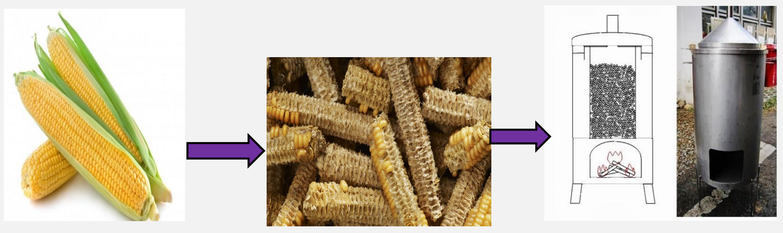
Location map

Field layout

- Randomized complete block design.
- 4 treatments with 4 four replications each.
- 16 plots (3-m × 6-m each)

Biochar preparation

- Feed stock: Corn cob at pyrolytic temperature: 550^{o}C



Biochar dose

- 0, 15, 30, and 30 t ha^{-1} (with P) biochar, respectively

- The treatments were denoted by CT, BC-15, BC-30, and BC-30+P for the 0, 15, 30, and 30 t ha^{-1} with P, respectively.

Soil sampling

- Biochar was applied on 7th November 2015. On 16th January, 2017, soil samples from 20-cm depth were randomly collected by an auger (5-cm diameter) from the sixteen plots.

Acknowledgments

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Microbiological properties

Basal respiration, microbial biomass, enzyme activities and phospholipid fatty acids (PLFA), and metabolic quotients.

FAME detection and quantification

4. Results and discussion

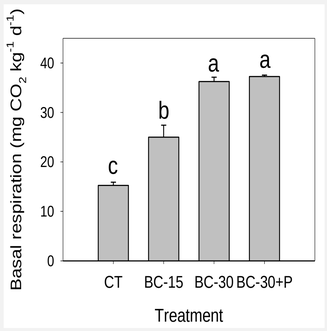

Fig. 1: Biochar effects on soil microbial basal respiration

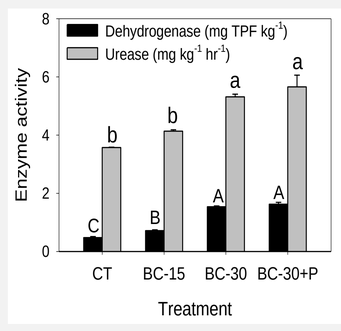

Fig. 2: Biochar effects on enzyme activity

Table 1: Biochar effects on soil microbial biomass carbon (MBC) and nitrogen (MBN), specific maintenance respiration rates (qCO_2), and potentially mineralizable carbon (PMC)

Treatment	MBC (mg kg^{-1})	MBN (mg kg^{-1})	qCO_2 (mg mg d^{-1})	PMC (mg kg^{-1})
CT	39.7 ± 5.98c	20.5 ± 3.5b	0.4 ± 0.07a	5.4 ± 0.53c
BC-15	177.4 ± 7.6b	29.1 ± 2b	0.1 ± 0.01b	6.6 ± 0.95bc
BC-30	324.6 ± 27.5a	55.1 ± 4a	0.1 ± 0.01b	8.1 ± 0.60ab
BC-30+P	328.50 ± 34.5a	55.68 ± 2.1a	0.12 ± 0.02b	9.1 ± 0.81a

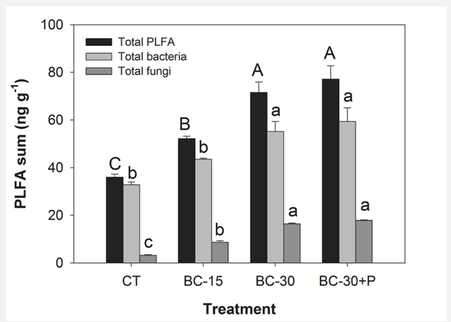

Fig. 3: Biochar effects on total PLFA and bacterial and fungal PLFAs concentration.

5. Conclusion

- Soil microbial biomass and enzyme activities increased with high rates of biochar.
- Biochar application at 30 t ha^{-1} significantly improved basal respiration with an associated decrease in specific maintenance respiration.
- Higher rates of biochar application had a significant positive effect on soil microbial community profiling and PLFA contents.