Soil respiration and soil organic matter pools in soils amended for 7 years with biochar combined with mineral and organic fertilizers

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OBJECTIVE

The focus on this work was to investigate soil respiration and changes in SOM pools (mineral-free, intra-aggregate, and mineral-associated SOM) as affected by the application of 20 t ha^{-1} per year of biochar alone or combined with mineral fertilizer, municipal solid waste compost, or sewage sludge.

FIELD EXPERIMENT

The research project was carried out at the research station of the Spanish National Research Council (CSIC) "La Poveda" located in central Spain, Arganda del Rey (40°19'N 3°29'W, 534 m above sea level).

The field experiment (Figure 1) was set up in October 2012 as a randomized complete block design with one factor and four replicates, each block being annually cropped with cereal.

Unamended plots were used as control treatment and biochar application at a rate of 20 t ha^{-1} was combined with no organic fertilization, municipal solid waste compost at a rate equivalent to 75 kg potentially available N (PAN) ha^{-1}, and sewage sludge at a rate equivalent to 75 kg PAN ha^{-1}.

Soil sampling was performed after harvesting (July 2018).

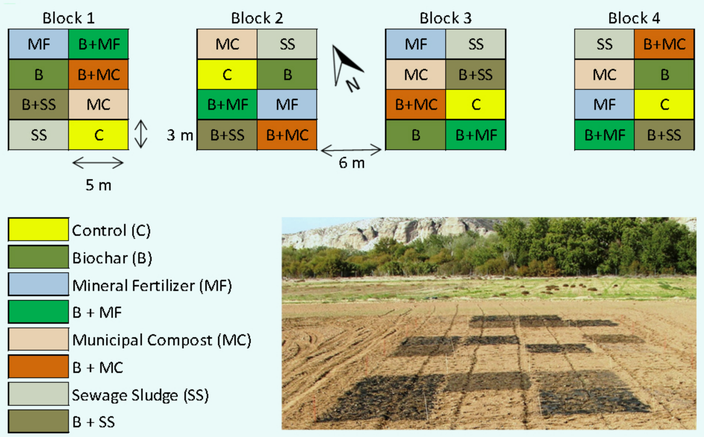

Figure 1. Field experiment

METHOD

Free, intra-aggregate, and mineral-associated SOM were separated using the method described by Golchin et al. (1994).

Total organic C and N contents of the whole soil samples and corresponding organic matter fractions were determined by dry combustion with a Thermo Flash 2000 NC Soil Analyzer.

Soil CO_2 emissions were measured with an EGM-4 infrared gas analyzer (IRGA) after 24 h of soil incubation at 25°C (Figure 4).

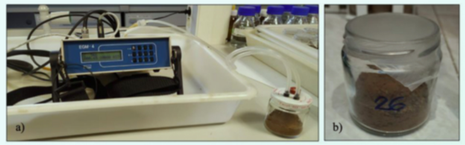

Figure 4. CO_2 analyzer, IRGA (a) and b) incubated soil sample (b)

RESULTS

Soil CO_2 emissions increased with the application of biochar, mineral fertilizer and municipal compost while the application of biochar combined either with municipal compost or sewage sludge decreased CO_2 emissions (Figure 2).

Biochar application increased organic C content in all SOM fractions with respect to the control while N content increased only in the free SOM fraction (Figure 3).

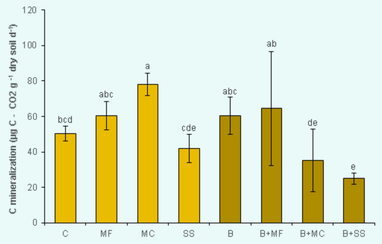

Figure 2. Soil CO_2 emissions

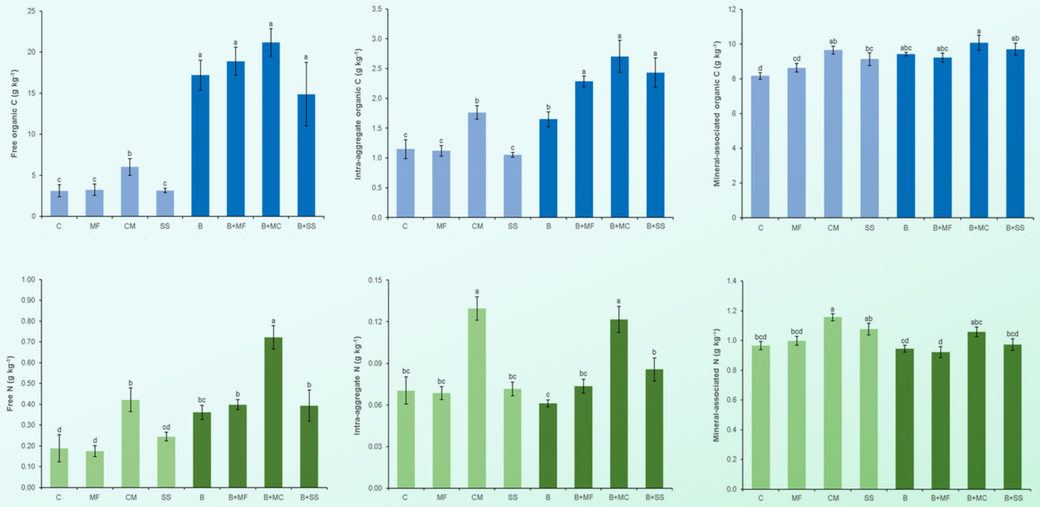

Figure 3. Free, intra-aggregate, and mineral-associated C and N of soil samples

CONCLUSIONS

- Biochar had no effect on soil respiration with respect to mineral fertilization and no amendment (control), and tended to decrease CO_2 emissions from soils amended with municipal solid waste compost and sewage sludge.
- Biochar accumulated mainly in the mineral-free SOM fraction and its addition, especially in combination with municipal solid waste compost, promoted the amount of SOM occluded with aggregates and associated to mineral surfaces.

Acknowledgements

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Reference

Golchin, A., Oades, J. M., Skjemstad, J. O. & Clarke, P. Soil structure and carbon cycling. Aust. J. Soil Res. 32, 1043–1068 (1994).