Reply to Editor Comments on Manuscript IJERPH-2243654

Title: Biochar blended with nitrogen fertilizer promote maize yield by altering soil enzyme activities and organic carbon content in Black soil

This paper describes the effects of biochar and mineral fertilizer applications on soil aggregation, aggregates associated C, and microbial community structure. Few studies have examined the limpact of biochar on soil aggregation and microbial community structure that related to soil C and N cycles under field conditions. Furthermore, the study considers the interactions between biochar and mineral fertilizer on these processes linking to SOC sequestration. This paper provides important new information that will be of value to many researchers and students and the data are worthy of publication.

However, some issues should be revised before further consideration.

◆ Author response: We appreciate the reviewer very much for the positive and constructive comments and suggestions concerning to our manuscript. We have carefully studied the reviewers' comments and have made some revisions in the modified manuscript.

1. For the introduction section, some statements should be cited the references (E.g., L49-50, L65-66;)

◆ Author response: Thank you for your suggestion. We have added some references to the statements as has been mentioned.

Replaced “The SOC can promote the formation of large aggregates in soil, while increased soil aggregate stability promotes soil SOC sequestration” with “The SOC can promote the formation of large aggregates in soil, in turn, the increased soil aggregate stability promotes soil SOC sequestration (Zhang et al., 2018).”

Zhang, Y., Li, X., Gregorich, E. G., Mclaughlin, N. B., Zhang, X., Guo, Y., et al.: No-tillage with continuous maize cropping enhances soil aggregation and organic carbon storage in northeast china. Geoderma 330, 204-211. https://doi.org/10.1016/j.geoderma.2018.05.037, 2018. **Line-45-46**

Replaced “Biochar can enhance SOC storage, soil granular structure, cation exchange capacity” with “Biochar can enhance SOC storage, soil granular structure, and cation exchange capacity (Mete et al., 2015; Hu et al., 2020).” **Line-64-66**

(Mete, F. Z., Mia, S., Dijkstra, F. A., Abuyusuf, M., Hossain, A., Agronomy, D. O.: Synergistic Effects of Biochar and NPK Fertilizer on Soybean Yield in an Alkaline Soil. Pedosphere 25(05),713-719. https://doi.org/10.1016/S1002-0160(15)30052-7, 2015.

Hu, L., Li, S., Li, K., Huang, H., Wan, W., Huang, Q.: Effects of Two Types of Straw Biochar on the Mineralization of Soil Organic Carbon in Farmland.

https://doi.org/10.3390/su122410586, 2020.)

2. For L86, A summary is needed to grasp the research gaps here and other palaces in the introduction.

◆ Author response: Thank you for your suggestion. Following your comments, we have added a summary at the end of the paragraph: "Despite these benefits, a quantitatively understanding is scare on how combined effects between biochar and nitrogen fertilizer contribute to soil fertility by modifying microbe-soil interactions in agroecosystems." **Line-85-87**`

3. For 322 to 328, these discussion should be mixed with your own data.

◆ Author response: Thank you for your helpful advice. We have freshened the discussions that were blend seamlessly with our data. The modified discussions are as follows:

"Our results demonstrated that soil bulk density of Mollisols had a negative correlation with biochar application rate. The C3 treatment reduced soil bulk density by up to 12.69% (Fig. 1). The bottom soil bulk density was on average 18.88% higher than surface soil by the biochar amendment, though the improvement in the bottom soil bulk density was not significant ($P > 0.05$), which are consistent with Xiu et al. (2019). This trend might be due to the unique properties of biochar, such as complex microporous structure, large specific surface area, and light texture, et al. (Zhang et al. 2015)." **Line-323-329**

"The soil water content gradually increased with increasing biochar application rate. This improvement was the largest during the single application of biochar, with an average increase of 18.07%. The two-factor ANOVA showed that the increase in soil water content was mainly attributed to biochar, though there was also a synergistic effect of biochar and nitrogen fertilizer on the increase in soil moisture content (Table. S1)." **Line-332-337**

4. L334-345, this statement should be supported by citation.

◆ Author response: Thank you for your suggestion. We have added references to the statement as suggested.

Replaced "The porosity, hydrophilic domains, and huge specific surface area of biochar may aid in water retention." with "The porosity, hydrophilic domains, and huge specific surface area of biochar may be favorable the improvement of water retention (Leonard et al. 2014)."

Line-343-344

Leonard, Githinji.: Effect of biochar application rate on soil physical and hydraulic properties of a sandy loam. Archives of Agronomy & Soil Science. https://10.1080/03650340.2013.821698, 2014.

5. L338, In the end of subsection, a summary is heavily needed to conclude what they get from the complete discussion.

◆ Author response: Thank you for your suggestion. As suggested, we have added an additional summary at the end of the discussion section: “The input of exogenous organic matter and nitrogen fertilizer actively participate in the formation of soil large aggregates, which enhances the soil water-holding capacity and repress soil erosion by enhancing the soil aggregate structure (Gaia et al. 2020; Islam et al. 2021).” **Line-347-350**

6. L447, The novelty and significance of these findings should be mentioned.

◆ Author response: Thank you for your useful advice. We have added the novelty and significance in the “conclusion” section: “This study highlighted that biochar blended with N fertilizer application could be a potential option for mitigating soil degradation, rational application of nitrogen fertilizer, and enhancing soil carbon storage, which would support sustainable use of Mollisols. In the future, we will further investigate the long-term effects of biochar application on soil C and N cycles in agroecosystem.” **Line-474-478**

attached file:

- label 1. please specify the meaning the C2N?
  - ◆ Author response: Thank you for your suggestion. The C2N represents the biochar application rate (19.6 Mg ha^{-1}) blended with the nitrogen fertilizer application rate (600 kg ha^{-1}), which is clearly mentioned in the Abstract: “The biochar input levels were C1, C2, and C3 (9.8, 19.6, and 29.4 Mg ha^{-1}, respectively), while the nitrogen fertilizer rates were N1/2 (300 kg ha^{-1}) and N (600 kg ha^{-1}).”

- label 2. please keep the integer.
  - ◆ Author response: Made the change as suggested. “56.9” has been changed to “56.9%” **Line-18**

- label 3. showed
  - ◆ Author response: “shows” has been changed to “showed” **Line-16**

- label 4. please check this citation
  - ◆ Author response: We are very sorry for our carelessness. “(E.-L. et al. 2014)” has been changed to “(Ng et al. 2014)” **Line-95**

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Does the chemical nature of soil carbon drive the structure and functioning of soil microbial communities?

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Ng, E. L., Patti, A. F., Rose, M. T., Schefe, C. R., Wilkinson, K., Smernik, R. J., et al.: Does the chemical nature of soil carbon drive the structure and functioning of soil microbial communities? Soil Biology and Biochemistry. 70 (2014) 54-61. http://dx.doi.org/10.1016/j.soilbio.2013.12.004, 2014.

- label 5. In the end of subsection, a summary is heavily needed to conclude what they get from the complete discussion. Line-409

  - Author response: As suggested, we have added a summary at the end of this discussion section: “Biochar in combination with nitrogen fertilizer as amendments effectively improves the soil aggregates and carbon sequestration.” **Line-427-428**