Solid Earth Discuss., 6, C428–C433, 2014
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Solid Earth Discussions

Interactive comment on "Factors driving carbon mineralization priming effect in a soil amended with different types of biochar" *by* P. Cely et al.

P. Cely et al.

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We thank the reviewers for the many insights provided about our work. We have carried out a major revision of our article which we expect will be more satisfactory towards publication. Following, we provide the comments of the reviewers and our answers. Also, we included as supplemental documentation the paper with the changes highlighted.

General comments:

Title: We have changed the title to "Factors driving carbon mineralization priming effect in a sandy-loam soil amended with different types of biochar" due to biochar effects depending on the type of soil.

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Discussion Paper

Referee #1.

We thank the reviewer for the many insights provided about our work. We have carried out a major revision of our article which we expect will be more satisfactory towards publication. Following, we provide the comments of the reviewers (in black) and our answers (in red).

Also, we have marked in the manuscript the changes that we have done.

It is a simple laboratory experiment, with limited conclusions. The experimental design is based on previous studies. It would be better if the incubation had included the biochar samples, without soil. My only suggestion is that discussion might include the possible repercussions of biochar addition on SOM cycling and quality.

The study already had included the biochar samples without soil (see table 5), in this way we evaluated the soil (S), the amendment soil (S+BI, S+BII, S+BIII) and the biochar samples (BI, BII, BIII). This fact allowed us to quantify the priming effect of the three biochars, comparing the experimental data with the results of the addition of soil emissions with biochar emission. However, we have included a new figure (Figure 4) where the fit of the exponential model of measured C (as CO2) for each biochar can be observed to complete the paper.

In order to evaluate the possible repercussions of biochar addition on SOM cycling and quality as referee 1 suggests we have included thermogravimetric analysis thermal analysis (TG, dTG and DTA) of soil after the different treatments (Figure 1) that complete the data of evolution of organic carbon oxidized with dichromate (Figure 2). Also, we have included the elemental analysis of the different biochar to improve the discussion. About this topic, we have added the following information in the manuscript:

Lines 157-159: The content in C, H, N and S was analysed by an elemental microanalyzer LECO CHNS-932 and the oxygen content was determined by difference.

Lines 183-185: In addition, thermal analysis (TG, dTG and DTA) of soil was performed in a thermogravimetric equipment Labsys Setaram. About 50 mg of each sample were heated at 15 °Cmin-1 until 850 °C in air atmosphere using a ïňĆow rate of 40 mL min-1.

Lines 223-229: The molar H/C ratio was used as an indicator of the degree of aromatization. This ratio shows the sequence BI<BII<BIII. The O/C ratio was indicative of the degree of carbonization following the same trend that H/C ratio, BI<BII<BIII. According to previous studies on biochars (Kuhbusch and Crutzen, 1995; Hammes et al., 2006) the H/C ratio of ≤ 0.3 (like BI) indicates a highly condensed aromatic ring system whereas H/C ratio of ≥ 0.7 (like BIII) represents a non-condensed structure.

Lines 253-273: In the last years, thermal analysis has been proposed as an interesting technique in the characterization of organic matter stabilization processes. Additionally, it has been applied to soil characterization to assess proportions of labile and recalcitrant organic matter (Plante et al., 2009) and to study the evolution of organic matter in amended soils (Barriga et al., 2010; Gascó et al., 2012). Thermal analysis has the advantage to provide information about the chemical characteristics of soil organic matter without any extraction step as all sample was analyzed. Figure 1 shows dTG (Figure 1.a) and DTA (Figure 1.b) of S, S+BI, S+BII and S+BIII samples after incubation period. Different peaks were observed in Figure 1, at temperatures lower than 150°C, water releases was observed, then at temperatures from 200 to 650°C, oxidation of organic matter takes place. Initially, weight loss corresponds to less humified matter (from 200 to 400°C) whereas the peak observed at temperatures highest than 400°C correspond to more humified organic matter. At temperatures higher than 550 °C weight loss could be attributed to refractory carbon from biochars and clays decomposition (Gascó et al., 2012).

From DTA curve, it could be observed the first endothermic peak at temperatures lower than 150 °C due to moisture release from soil sample. Then, two small exothermic peaks could be observed between 200 and 650°C due to combustion reactions of soil organic matter. It is established that the ïňĄrst peak was associated with combustion of less humiïňĄed organic matter, whilst the second one was related to the more hu-

SED

6, C428–C433, 2014

miïňĄed. Four samples show at 573 °C, the characteristic small endothermic peak due to the quartz α-β inversion. Comparison of four samples in Figures 1.a and 1.b shows the influence of different biochars in soil organic matter composition. Biochar addition increases the amount of more humified or thermally stable organic matter following the sequence S+BI>S+BII>S+BIII. It was interesting to note that S+BIII shows a thermal behavior similar to that of unamended soil (S) indicating a similar organic matter composition that original soil.

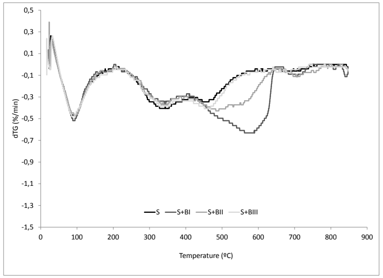
Lines 278-292 (rewritten and added new information): With respect to biochar CO2 emissions, these were higher in BI while significant differences between BII and BIII were not found. This fact can be attributed to the elevated carbon content of BI (82%) respect to BII (65.15%) and BIII (26.54%). In order to explain the similar CO2 emissions of BII and BIII other factors needs to be account (Jones et al, 2011). Calvelo Pereira et al. (2011) found that dichromate oxidation reflect the degree of biochar carbonization and could therefore be used to estimate the labile fraction of carbon in biochar. Figure 2 shows as BIII with highest ash content and lowest C content and consequently, expected lowest CO2 emissions, has the highest content of labile carbon. So, the H/C and O/C ratios have showed that BIII has non-condensed organic structures. After incubation, the labile carbon of BI decreases whereas that of BII and BIII slightly increases, indicating that some of the more stable organic structures were transformed into labile carbon. This result was according with that obtained previously by Gascó et al. (2012) using thermal analysis and biochar form sewage sludge. However, for BI the labile carbon slightly decreases after incubation.

Please also note the supplement to this comment:
http://www.solid-earth-discuss.net/6/C428/2014/sed-6-C428-2014-supplement.pdf

Interactive comment on Solid Earth Discuss., 6, 849, 2014.

Figure 1. dTG (1.a) and DTA curves (1.b) of soil and soil amended with biochar

1.a) after incubation period



1.b)

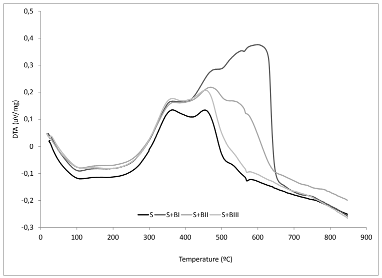


Fig. 1.

SED

6, C428–C433, 2014

Interactive Comment

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Discussion Paper

SED

6, C428–C433, 2014

Interactive Comment

Figure 4. Exponential model of measured C mineralized (as CO_2) in BI, BII and BIII biochars

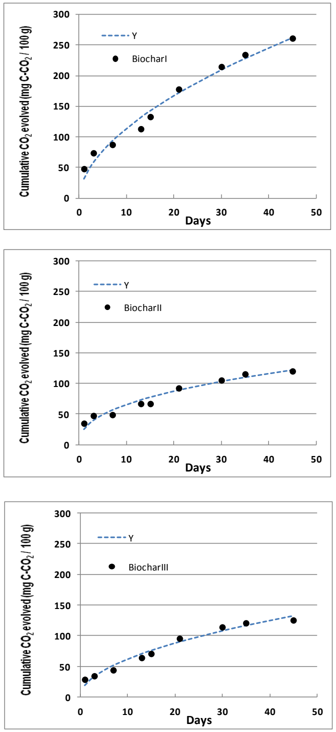

Fig. 2.

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