Solid Earth Discuss., 6, C434–C443, 2014
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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.

gabriel.gasco@upm.es

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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. It is better to see the modification of tables and Figures in the paper (suplemental documentation)due to in the answers to referee are too small (they are fit automatically.)

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.

Referee #2.

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.

The manuscript describes the effect of amended on soil properties. The manuscript need major revision before to be accepted. See the comments in attached file.

Page 852, Line 24: delete "in the case of pH " and" in the case of EC" and add "respectively" at the end of the sentence.

The sentence has been changed.

Page 852, Line 26: or total organic carbon?

Thank you very much for your comment.

It is TOM. TOM is determined by combustion at 540°C. The weight loss includes C and also H, O, N, S present in organic matter. This fact has been corrected on table 1.

Page 855, Line 10: see comment in table 1

Table 1: Could you add standard deviation? which is the number of samples?

Thank you for your comment. All analysis were performed by triplicate, except surface properties, proximate analysis and elemental analysis due to the cost of these analysis.

We add the sentence "These analysis were performed by triplicate (line 140)" and standard deviation has been added in pH, EC, TOM, CEC, Cd, Cr, Cu, Ni, Pb, Zn, phenolic substances, FC, WP and AW (see table 1). Also, we modified Table 1

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Page 855, Line 12: add (SOM) and use it the next time in the manuscript.

We have corrected this mistake adding (SOM) in the introduction, in the first place where we used "soil organic matter" and we used its initials in the rest of the manuscript.

Page 855, Line 14: significant?

Thank you for the comment. It can be seem clearly that there are differences between biochars in the proximate analysis. Nevertheless, we did not make any statistical test due we only have a replicate of the proximate analysis and for this reason we did not write that the differences were significant.

Page 856, Line 1: how many days?

After 45 days.

The sentence has been rewritten as follows: "Table 2 shows the changes of pH, EC and CEC after the 45 days of incubation experiment"

Page 856, Line 3: other studies? Add more citations.

Thank you for the comment. We have improved the discussion adding more references. The text has been rewritten as follows:

Table 2 shows the changes of pH, EC and CEC after the 45 days of incubation experiment. Instead, biochar pHs were different (Table 1), pH did not change after biochar application though BI and BII presented pH 2 units higher than soil. Conversely, other studies have shown pH increments after biochar application. For example, Méndez et al (2012) observed an pH increment on an Haplic Cambisol after the addition of sewage sludge-derived biochar, Kloss et al. (2014) described a slightly increment of soil pH (0.3 units) in an acid soils after application of woodchip-derived biochar or Jien and Wang (2013) observed a significant increased in Ultisol pH from 3.9 to 5.1 after addition of biochar made from the waste wood of white lead trees. So, both biochar

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and soil composition influences the pH changes.

We added the following references:

Kloss, S., Zehetner, F., Oburger, E, Buecker, J., Kitzler, B., Wenzel, W., Wimmer, B., Soja, G. Trace element concentrations in leachates and mustard plant tissue (Sinapis alba L.) after biochar application to temperate soil. Sci. Total Environ. 481, 498-508, 2014.

Jien, S.H., Wang, C.S. Effects of biochar on soil properties and erosion potential in a highly weathered soil. Catena 110, 225-233, 2012.

Page 856, Line 5: improve this sentence

The sentence “However, the electrical conductivity increased slightly depending on biochar electrical conductivity (Table 1)” has been changed as follows: However, “Biochar addition slightly increased soil EC (Table 1)”

Page 856, Line 12:

Soil organic matter has been replaced by soil OM.

Page 857, Line 2: did Zavalloni et al . find a similar or different result in comparison with your findings? Not clear in this sentence

Thank you for your comment. It was not clear. Zavalloni et al. (2011) did not find differences in CO2 emissions between control soil and soil amended with biochar.

The sentence has been rewritten as follow: “On the other hand, Zavalloni et al. (2011) found that respiration rate in soil with coppiced woodlands derived biochar were not significantly different from control soil”

Page 858, Line 12: Highlight the novelty of this study

Page 858, Line 13: the study is not only about the effect of biochar on CO2, therefore I suggest to also add the other main conclusion

Thank you for your comments. Conclusions have been rewritten as follows:

The effect of biochar on soil carbon mineralization priming effect depends on the characteristics of the raw materials, production method and pyrolysis conditions. Indeed, results shown a negative priming effect in the soil after addition of BI (prepared at 620°C from a mixed wood sieving's from wood chip production) and a positive priming effect in the case of soil amended with BII (prepared at 500°C from a mixture of paper sludge and wheat husks) and BIII (prepared at 600°C from sewage sludge). These facts can be related with different biochar properties such as carbon content, carbon aromaticity, volatile matter, fixed carbon, easily oxidised organic carbon, metal and phenolic substances content and surface biochar properties. In addition, experimental results show that cumulative CO2 emissions were well fit to a simple first-order kinetic model for the different biochar and amended soil. Also, biochars addition improved water soil retention. Finally, further research is required to determine the importance of the different biochar properties involved in soil CO2 emissions.

Thanks, we have improved the conclusion in order to answer your suggestions and observations.

Table 2: number of samples? Table 3: number of samples?

There are 4 samples (S, S+BI, S+BII, S+BIII), in the experiments, we did 3 replicates of each sample.

We add the next sentences in material and methods: "These analysis were performed by triplicate" and we add the next footnote on tables "The number of replicates were 3 for each determination".

Table 4: explain the meaning of high, normal, low

High, normal and low refers to a value of each property, in this way, this table summarizes the qualitative influence of high, normal and low values on CO2 emissions, for example according to the table 4 a soil with a high or a low pH value has a negative

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effect on CO2 emissions while a soil with pH normal value has a positive effect and therefore an increment of the emissions is expected.

We have modified the table 4 (see Table 4) and also add some comments in the text as follows :

Table 4 summarizes the qualitative influence of different factors on CO2 emissions and it shows an orientation about the influence of different biochar properties on the increment of soil CO2 emissions after biochar application. pH limits have been fixed following the classes of soil pH of USDA (1998) and the guidelines to biochar production according (Schmidt et al, 2012). It must be pointed that pH of 6.6 to 7.3 is favorable for microbial activities that contribute to the availability of nitrogen, sulfur, and phosphorus in soils (USDA, 1998) and pH value exceeding 10 can have negative effects on soil pH but it must note that only the application of larger amounts of biochar will lead to changes in a soil's pH value (Schmidt et al, 2012). With respect to electrical conductivity, limits have been fixed according to the limits fixed by Richards (1954) where the high value (4 dS m-1, 25 °C) is the limit between normal and saline soils. The organic carbon limits have been fixed according to International Biochar Initiative (2012) and the recommendations of Schmidt et al (2012) who described that organic carbon content of pyrolysed chars fluctuates between 10% and 95% of the dry mass dependent on the feedstock and process temperature used. With respect to volatile matter (VM) and fixed carbon (FC), values over 20% and 40% of VM and FC can be considered high according biochar prepared from different fedstocks as sewage sludge (Gascó et al, 2012; Méndez et al, 2012), rice husk (Kalderis et al, 2014), eucalyptus wood or poultry litter (Paz-Ferreiro, 2012; Lu et al, 2014). Finally, BET surface area values shuold be preferably higher than 150 m2 g-1 (Schmidt et al, 2012) being values over 750 m2 g-1 very high and of the same order that montmorillonite. It must stand out that the negative effects are usually due to a combination of different factors and not can be attributed to a unique factor.

References:

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International Biochar Initiative: Standardized product definition and product testing guidelines for biochar that is used in soil, International Biochar Initiative, Westerville, United States of America, 2012.

Kalderis, D, Kotti, M.S., Méndez, A., Gascó, G.: Characterization of hydrochars produced by hydrothermal carbonization of rice husk, Solid Earth Discuss. 6, 657-677, 2014.

Kuiters, A.T., Sarink, H.M.: Leaching of phenolic compounds from leaf and needle litter of several deciduous and coniferous trees, Soil Biol. Biochem., 18(5), 475-480, 1986.

Lu, H, Li, Z., Fu, S., Méndez, A., Gascó, G., Paz-Ferreiro, J.: Can biochar and phytoextractors be jointly used for cadmium remediation? Plos One, 9 (4), 1-7, 2014.

Richards, L.A.: Diagnosis and improvement of saline and alkali soils. Handbook no. 60, USDA,Washington, United States of America, 1954.

Schmidt, H.P., Abiven, S., Kammann, C, Glaser, B, Bucheli, T., Leifeld, J.: Guidelines for biochar production. Delinat Institute und Biochar Science Network, Arbaz, Switzerland, 2012.

USDA: Soil Quality Information Sheet: pH. Washington, United States of America, 1998.

Table 5: explain all terms

Thank you for your comment. The meaning of CO2-C evolved, RMSD, r2, R2 and C and m are now explained in the table caption and the meaning of C10 in a footnote.

Figure 1: which is the unit of measurement? Figure 1: improve the caption. Explain the letters

Thank you for your comments. The unit of measurement is percentage.

We have modified the Figure 1 (new Figure 2) adding the unit of measurement and we

have improved the caption explaining the meaning of letters. Now is the figure 2 due to we have added other with the dTG (1.a) and DTA curves (1.b) of soil and soil amended with biochar 1.a) after incubation period according to Referee #1′s comments.

Figure 2: not clear. it's difficult to read.

Thank you for your comment. We have done bigger the Figure 2 (new Figure 3).

Please also note the supplement to this comment:
http://www.solid-earth-discuss.net/6/C434/2014/sed-6-C434-2014-supplement.pdf

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

Figure 2. Evolution of organic carbon oxidised with dichromate. Values in column followed by the same letter are not significantly different (P = 0.05) using Duncan test

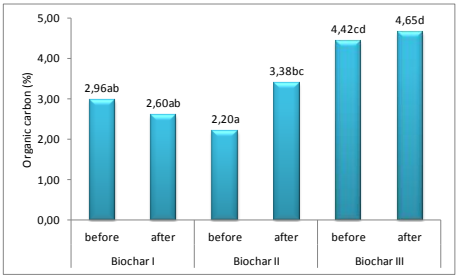

Fig. 1.

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Figure 3. Exponential model of measured C mineralized (as CO_2) and that calculated by addition of soil and BI, BII and BIII effects.

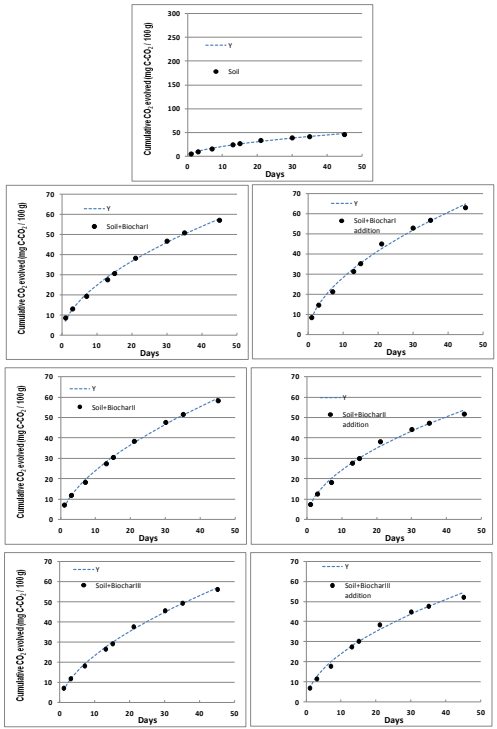

Fig. 2.

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