

EGU2020-5384

<https://doi.org/10.5194/egusphere-egu2020-5384>

EGU General Assembly 2020

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The chemical interaction of biochar with iron and phosphate might explain the effects of biochar in alkaline and calcareous soils

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Due to the low consistency of the results obtained in field, the use of biochar as soil amendment is controversial. Thus, in general in acidic soils results are positive while in alkaline soils they are non-significant or even negative. The results regarding biochar action in acidic soils have been related to a lime-like effect due to its alkaline pH and the high doses normally used. However, the causes of biochar effects in alkaline soils remain unknown. We have used a well characterized biochar as a component of two complex N and PK granulated fertilizers at two different doses (1 and 5%). These fertilizers have been applied to wheat cultivated in pots containing an alkaline and calcareous soil and grown for 60 days. No effect was shown for the N-biochar fertilizer application. However, the PK-biochar fertilizer application caused a decrease in crop yield. Complementary, the absorption isotherms of Iron (Fe), Molybdenum (Mo), Manganese (Mn) and Phosphate (Pi) in biochar were also studied. The results showed that Fe was rapidly adsorbed in biochar, while Pi was only absorbed on the Fe-Biochar complex. Desorption experiments showed that P and Fe were not desorbed from the P-Fe-biochar complex by water or the Olsen reactant, while a partial desorption was observed when HCl 0.1 M was used. This blockage of Fe and P through Fe bridges in biochar could partially explain the negative effects in alkaline soils.