ELS2014 –The Earth Living Skin: Soil, Life and Climate Changes
EGU – SSS Conference
Bari | Italy | 22 – 25 September 2014
ELS2014-82-1

Effect of biochar on soil rhizosphere respiration in a wheat pot experiment

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Biochar is a carbon (C) rich material, able to modify soil qualities and increase soil carbon sequestration.We investigated interactions and mechanisms observed when adding biochar (from Miscanthus feedstock) to soil in presence of plants. In a greenhouse experiment with wheat grown in pots under simulated natural conditions, biochars pyrolysed at 450°C were applied ata rate equivalent to 10 and 25 t ha-1. The effect of biochar addition on soil respiration was estimated by comparing CO_2 fluxes measured over 7 months in pots with and without biochar using an IRGA connected to small custom made soil respiration chambers. Biochar interaction with rhizospheric respiration was estimated using a root exclusion approach by comparing soil respiration measured in pots with and without wheat, with and without biochar addition. In order to trace the label in the plant organs and in the root derived respiration, a 13C label to the photosynthetic C flux in the plants was provided with a pulse labelling experiment, with 100 atom % 13C labelled CO_2. During the pulse the Gross Canopy Photosynthesis (GCP) of the wheat was measured in replicated pots under the same conditions. The soil CO_2 efflux and its isotopic composition were then monitored for six days after the pulse using a mobile lab equipped with a GC IRMS. The 13C label was quantified in the plant tissues and rhizosphere soil from samples taken over time following the pulse.
Biochar application did not affect soil CO_2 flux except at day 5 after the start of the experiment. The estimated rhizosphere respiration after day 169 increased in biochar treated pots compared to the untreated pots, however no significant effect of biochar in above- and below-ground biomass was found at the end of the experiment.
The δ13C of the soil CO_2 efflux showed a peak after 22 hours in all the treatments and the analysis of the isotopic signature of the samples collected after the pulse confirmed the allocation of the label through the plant to the roots and the surrounding environment. The cumulated pulse-derived $\delta 13CO_2$ fluxes corrected for the GCP were not affected by biochar addition. These results suggest that the observed increase in rhizosphere respiration in the presence of biochar is unlikely due to an increase in root activity (exudation), suggesting rather an increase in SOM/biochar decomposition as an effect of root activity.