Fate of biochar applied to a Colombian savanna Oxisol during the first and second years

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Introduction

Biochar can conceivably be lost from soil by surface erosion, abiotic or biotic degradation and leaching of small particles, although abiotic degradation is extremely slow under normal field conditions. In field situations, irrigation and rain water would most likely be responsible for surface erosion and leaching of biochar particles of various sizes. Here, we used isotope signatures to assign sample C to its sources. We measured the amounts of C from biochar as well as resident organic matter that were mineralized to CO_2 and found in soil samples to 2m depth. *Hypotheses:*

(i) Applied biochar will be found in soil below the initial incorporation depth.

(ii) CO_2 evolution will be reduced by biochar applications, due to an increased C:N ratio.

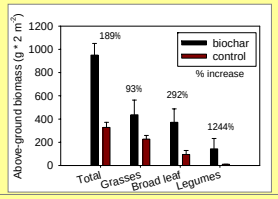
Materials and Methods

A field experiment was established in the Oriental Savanna of **Colombia** (N 04º10'15.2", W 072º36'12.9") on a Tropeptic Haplustox (**delta ^{13}C ~12‰**). Average annual temperature is 26°C, annual rainfall is 2200mm and 95% falls in the rainy season which extends from April to November. In December 2004, biochar (**delta ^{13}C = -29‰**) was produced by piling **mango tree prunings**. Savanna vegetation was mowed in December 2004, and a RCBD with 3 replicates was established with unamended plots and plots where **26 t * ha^{-1} biochar** was applied and disked in (2ND YEAR PLOT) to **10cm depth**. In April 2006 more biochar was made from mango and applied to an adjacent lot in the same fashion (1ST YEAR PLOT). **Soil** was **sampled** in the "2 year plot" to 2 m depth in May and December 2006, i.e. after the effects of 1 and 2 rainy seasons (years). Throughout the 2006 rainy season **soil respiration** was measured using **soda lime traps** (2 traps per plot). Chambers were 27.3 cm in diameter and soda lime was exposed for 24 h weekly for 19 weeks and then bi-weekly. Laboratory analyses consisted of determining respired CO_2 by **soda lime mass difference**, dissolving soda lime to capture and **analyze absorbed CO_2 for C isotopes** in a **C/N analyzer**, and grinding air-dried soil also for **soil C isotope analysis**.

Results and Discussion

Biochar increased biomass production by 189%

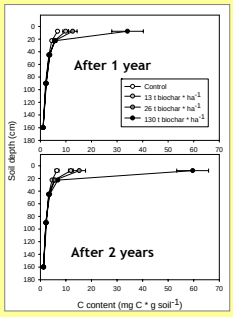
5 months after biochar application

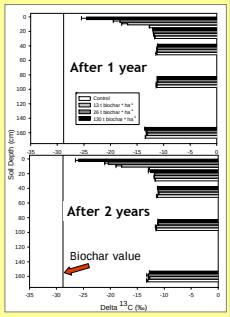


Biochar did NOT migrate down the soil profile

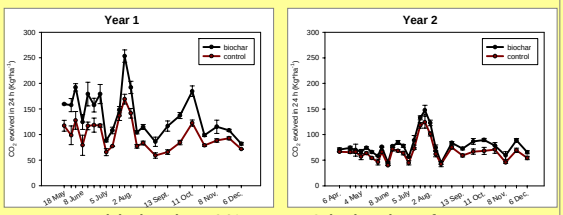
No significant increase in C content between the 1st and 2nd year was observed below the surface

No significant difference in Delta ^{13}C was observed between the 1st and 2nd year

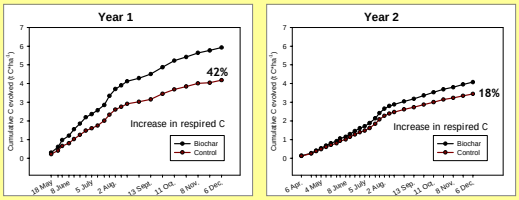




Biochar application increased soil respiration

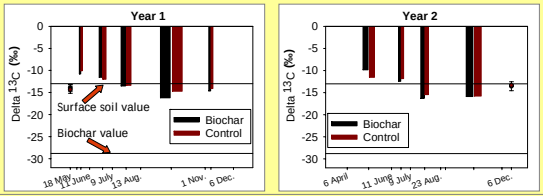


This lead to 60% more C being lost from biochar plots after 2 years



This C was most likely derived from resident OM and NOT biochar

Isotope signatures did not change between treatments



Conclusions

•As demonstrated by the C isotope data, biochar applied to the soil surface had not significantly (α=0.05) migrated downward, 2 years after application.

•While biochar application caused increases in soil respiration (60%) and thus greater loss of non-biochar C, simultaneous increases in above ground plant biomass (378% for 2 years) more than offset C losses and rather contributed a net C gain in the system.