FARMING PRACTICE
SOIL AMENDMENT WITH BIOCHAR

IMPACT: CARBON SEQUESTRATION

Reference 33

Liu, SW; Zhang, YJ; Zong, YJ; Hu, ZQ; Wu, S; Zhou, J; Jin, YG; Zou, JW 2016 Response of soil carbon dioxide fluxes, soil organic carbon and microbial biomass carbon to biochar amendment: a meta-analysis GCB Bioenergy 8:392–406. 10.1111/gcbb.12265

Background and objective

Biochar as a carbon-rich coproduct of pyrolyzing biomass, its amendment has been advocated as a potential strategy to soil carbon (C) sequestration. 1) quantitatively examine the effect size of biochar amendment on soil CO_2 fluxes, SOC, and MBC contents. 2) identify the key factors that influence the response of soil CO_2 fluxes, SOC, and MBC to biochar amendment.

Search strategy and selection criteria

The authors conducted a detailed review of literature published in peer-reviewed journals through the year 2014 (cutoff date on July 10, 2014). Studies under controlled conditions (laboratory incubation or greenhouse pot studies) were also included to better quantitatively understand the integrative effect of biochar on soil CO_2 fluxes, SOC, and MBC content across soils. Studies with no replication or no reported number of replications were excluded. Moreover, grouping categories with fewer than two data pairs were excluded from the analyses.

Data and analysis

The authors conducted weighted meta-analyses using RRs, where mean effect size for each category was calculated using a categorical random effects model. Groups with fewer than two treatments were excluded from the analyses. The overall mean effect size and 95% confidential interval (CI) of each grouping category generated by bootstrapping (9999 iterations) were calculated with MetaWin version 2.0 statistical software.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
50	Lab incubations, Pot trials, field trials	Soil amendment with biochar	No amendment	Metric: Soil organic carbon content; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	0.75

Results

- Biochar amendment significantly increased SOC content by 40% across all ecosystem types (CI: 32% to 51%).

Factors influencing effect sizes

- Land use type : The largest increases in SOC content in biochar-amended treatments were found in rice paddies (mean: 68%; CI: 75% to 128%).
- Experimental conditions : Among the laboratory incubation, greenhouse pot, and field studies, pot studies showed the greatest increases in SOC response to biochar amendment.
- Soil pH : The smallest and greatest effects of biochar on SOC were found in acid soils (mean: 25%; CI: 18% to 23%) and alkaline soils (mean: 53%; CI: 32% to 96%), respectively.
- Biochar application rate : The significant positive response of SOC increased with biochar application rate, ranging from 23% (CI: 17% to 30%) to 59% (CI: 37% to 80%).
- Biochar feedstock : Among all biochar feedstock sources, wood source had the largest enhancement of SOC content (mean: 48%; CI: 32% to 51%). MBC was significantly increased by biochar with a crop residue source (mean: 48%; CI: 32% to 51%).

Conclusion

When averaged across all studies, biochar amendment significantly enhanced SOC content by 40%.