FARMING PRACTICE
SOIL AMENDMENT WITH BIOCHAR

IMPACT: SOIL BIOLOGICAL QUALITY

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 microbial 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%). The largest increases in SOC content in biochar-amended treatments were found in rice paddies (mean: 68%; CI: 75% to 128%).

Factors influencing effect sizes

- Land use type : NA
- Experimental conditions : Field studies showed significant positive responses of MBC to biochar amendment, while soil MBC content was decreased by biochar amendment in incubation and pot studies
- Soil texture : Biochar amendment significantly increased MBC content in soils with coarse texture, while biochar effects on MBC were not significant in soils with medium and fine textures.
- Soil pH : Biochar amendment had no effect on MBC in neutral or alkaline soils, while it significantly increased soil MBC content by 49% in acid soils (CI: 42% to 85%).
- Fertilisation practice : The response of MBC to biochar amendment was not pronounced in N-unfertilized soils, while biochar amendment significantly increased MBC by 42% (CI: 26% to 58%) when N fertilizer was applied. The greatest positive combined effects on MBC were found when biochar amendment was coupled with waste compost N fertilizer.

Conclusion

When averaged across all studies, biochar amendment significantly enhanced soil microbial biomass carbon by 18%.