FARMING PRACTICE
SOIL AMENDMENT WITH BIOCHAR

IMPACT: SOIL BIOLOGICAL QUALITY

Reference 12

Li, XN; Wang, T; Chang, SX; Jiang, X; Song, Y 2020 Biochar increases soil microbial biomass but has variable effects on microbial diversity: A meta-analysis Sci Total Environ. 643:926–35. 10.1016/j.scitotenv.2020.141593

Background and objective

Biochar has been extensively studied as a soil amendment for carbon sequestration and for improving soil quality; however, a systematic understanding of the responses of soil microbial biomass and diversity to biochar addition is lacking. Assess the responses of both soil microbial biomass and microbial diversity to biochar application.

Search strategy and selection criteria

Peer-reviewed publications investigating the effect of biochar addition on soil microbial biomass and microbial community composition were located using the Web of Science database (http://apps.webofknowledge.com) including publications from January 2009 to July 2019. The paired observations including a control treatment and a biochar amendment treatment and data points from studies with any additional input (e.g., fertilizers) to influence microbial communities were excluded from this meta-analysis. The microbial community data in the top 1–20 cm soil were used in this analysis.

Data and analysis

The overall effect of biochar on microbial biomass or diversity was estimated by a random-effects model because the various studies included in this meta-analysis were not expected to have a common effect size due to the various experimental conditions and procedures used. In addition, sampling error was not assumed to be the only source of variation to influence the effect size among various studies based on a random-effects model.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
194	Laboratory and field studies	Soil amendment with biochar	No amendment	Metric: Soil total microbial biomass and microbial diversity; Effect size: Hedge g (standardized difference) comparing the considered metrics between intervention and control	0.875

Results

- Biochar application generally increased both the total soil microbial biomass and bacterial and fungal biomass (however, no grand mean was computed by the authors). The degree of increases depends on the feedstock type and pyrolysis temperature used for biochar production and the measurement method used.
- The effects of biochar on soil microbial diversity, especially fungal diversity, were negative in some studies.
- The responses of bacterial biomass to biochar application were significantly influenced by biochar properties, soil pH and SOC, and the experimental condition. The mean effect sizes for total microbial biomass, bacterial and fungal biomass decreased with increasing pyrolysis temperature used for biochar production, showing significant increases by biochars pyrolyzed lower than 700 °C.

Factors influencing effect sizes

- Soil pH : The increase in fungal biomass was only significant in soils with pH ≤ 7.5, with the largest mean effect size in soils with pH ≤ 4.5
- Soil organic carbon : Total total microbial biomass, bacterial and fungal biomass were more affected in soils with 15–30 g kg−1 SOC.
- Biochar particle size : The different particle sizes of biochar affected responses of microbial biomass to biochar application; the small size biochar (≤ 1 mm) significantly increased bacterial biomass. The small size biochar (≤ 1 mm) was more suitable for bacterial community growth while the large size biochar (> 2 mm) was more suitable for fungal community growth.

Conclusion

The application of biochar, particularly that produced under low temperature and from nutrient-rich feedstocks, could better increase soil microbial biomass (based on phospholipid fatty acid analysis (MBCPLFA)) and diversity.