FARMING PRACTICE
SOIL AMENDMENT WITH BIOCHAR

IMPACT: PLANT NUTRIENT UPTAKE

Reference 27

Liu, Q; Zhang, YH; Liu, BJ; Amonette, JE; Lin, ZB; Liu, G; Ambus, P; Xie, ZB 2018 How does biochar influence soil N cycle? A meta-analysis Plant Soil 426:211–25 10.1007/s11104-018-3619-4

Background and objective

The amendment of soils with biochar has been suggested as a promising solution to regulate the soil N cycle and reduce N effluxes. However, a comprehensive and quantitative understanding of biochar impacts on soil N cycle remains elusive. 1) identify how and why the response of soil N cycle to biochar application varies across different biochar and soil properties; and 2) explore whether biochar production process entails hidden risk of extra pollutant N emissions. The study is expected to develop constructive biochar management for decreasing soil N losses without incurring negative side effects.

Search strategy and selection criteria

A literature search was performed through Web of Science, Google Scholar, Springer Link, Wiley Blackwell, and China Knowledge Resource Integrated (CNKI) databases using the keywords 'biochar', 'black carbon', 'soil', 'nitrogen'. 1) the research was on soil N cycle in response to biochar addition; 2) biochar was produced by pyrolyzing organic materials anaerobically (technology levels range from highly advanced facilities to simply equipped stoves); and 3) control and biochar treatments were subjected to the same management (e.g. same tillage, watering, fertilization, or residue addition).

Data and analysis

Mean effect sizes and the 95% bootstrapped confidence intervals (CIs) based on 9999 iterations for each grouping categories were generated based on a random-effect model. The total heterogeneity of effect sizes among studies (QT) was partitioned into within-group (QW) and between-group (QB) heterogeneity. A QB larger than a critical value suggests a significant difference between subgroups.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
208	Not specified	Soil amendment with biochar	No amendment	Metric: Plant nitrogen uptake; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	0.6875

Results

- On average, biochar leads to an increase of 11% ($P < 0.001$) in plant N uptake.
- Manure biochar induces a higher N uptake than wood biochar or straw biochar.

Factors influencing effect sizes

- Soil pH : Biochar generally increases N uptake in acidic soils ($pH \leq 6.5$), but it shows little effect in neutral or alkaline soils.
- Soil texture : The increasing impacts of biochar on N uptake are usually maximized in soils with poor structure (rich in either sand or clay).
- Soil cation exchange capacity : The increasing impacts of biochar on N uptake are usually maximized in soils with low CEC.
- Biochar application rate : The relationship of biochar application rate with the response of N uptake follows a convex curve, and over application of biochar (>80 t ha−1) will significantly inhibit N uptake.

Conclusion

Biochar leads to a significant increase in plant N uptake.