FARMING PRACTICE
SOIL AMENDMENT WITH BIOCHAR

IMPACT: GHG EMISSIONS

Reference 9

Gu, JX; Wu, YY; Tian, ZY; Xu, HH 2020 Nitrogen use efficiency, crop water productivity and nitrous oxide emissions from Chinese greenhouse vegetables: A meta-analysis Sci Total Environ. 743:140696. 10.1016/j.scitotenv.2020.140696

Background and objective

Greenhouse vegetable cultivation is a substantial source of nitrous oxide (N_2O) emissions in China due to intensive managements with nitrogen (N) fertilizers and irrigation water. 1) quantify the variations in vegetable yields, N_2O emissions, nitrogen use efficiency (NUE) and crop water productivity (CWP) under greenhouse cultivation conditions; 2) determine the major regulating factors of vegetable yields, N_2O emissions, emission factors (EFs), yield-scaled N_2O emissions, NUEs and CWPs; and 3) evaluate the effectiveness of fertilization and irrigation strategies for N_2O mitigation. Here, we report only the results regarding biochar amendment.

Search strategy and selection criteria

Peer-reviewed publications were compiled by searching the Web of Science (http://apps.webofknowledge.com) and China National Knowledge Infrastructure database (https://www.cnki.net/) by using various keyword combinations, namely, "vegetables" or "greenhouse vegetables," and "nitrous oxide," "N_2O" or "greenhouse gases." 1) only field experimental data were included and laboratory or pot experimental data and modeling results were not considered, 2) measurements obtained under green soybean crops were not considered, and 3) N_2O emissions and related input rates of N fertilizers and irrigation water were recorded over a whole growing season. Authors excluded a few measurements that were only reported on an annual basis. Authors did not use the measurements from unfertilized treatments in further data processing, statistical analysis and meta-analysis except when specifically mentioned.

Data and analysis

Statistical analysis was performed using the R Statistical Package (version 3.63, https://www.r-project.org/). The variations in vegetable yields, N_2O emissions, yield-scaled emissions, EFs, NUEs and CWPs are presented as the means, medians and coefficients of variance (CV). Kolmogorov-Smirnov tests were applied to test if these data series followed normal or log-normal distributions ($p < 0.05$) and to evaluate the differences between vegetable types ($p < 0.05$). A linear mixed-effects model (nlme package) was applied to determine the fixed-effects (e.g., vegetable types, N input rates, water input rates and interactions of N-by-water) and random effects (publication) on vegetable yields, N_2O emissions, EFs, yield-scaled emissions, NUEs and CWPs.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
5	Greenhouse vegetables	Soil amendment with biochar	No amendment	Metric: 1) Area-scaled N_2O emission (kgN /ha); 2) N_2O emission factor (% of total N); 3) Yield-scaled N_2O emission (kgN /ton crop harvested); Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	0.75

Results

- Biochar's effects on agricultural-area-scaled N_2O emissions were non-significant.
- Application of biochar significantly decreased emission factors (EFs) and yield-scaled N_2O emissions by 34% (95% CIs: −50% to −13%) and 35% (95% CIs: −50% to −14%), respectively.

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Applying biochar was capable of decreasing N_2O emission factor (per unit of N-input) and yield-scaled N_2O emissions from greenhouse vegetables. Area-scaled N_2O emission was not significantly changed.