FARMING PRACTICE
SOIL AMENDMENT WITH BIOCHAR

IMPACT: WATER USE

Reference 10

He, YH; Yao, YX; Ji, YH; Deng, J; Zhou, GY; Liu, RQ; Shao, JJ; Zhou, LY; Li, N; Zhou, XH; Bai, SH 2020 Biochar amendment boosts photosynthesis and biomass in C(3)but not C(4)plants: A global synthesis GCB Bioenergy 12:605–17 10.1111/gcbb.12720

Background and objective

How biochar amendment affects plant photosynthesis and growth remains unclear, especially on a global scale. 1) obtaining a central tendency of plant photosynthesis and growth in response to biochar amendment and 2) investigating the key driving factors that affect the response of plant photosynthesis and growth following biochar amendment. Here we report only results regarding water use efficiency.

Search strategy and selection criteria

Research literatures were searched in Web of Science, Google Scholar and China National Knowledge Infrastructure (1900–2019) with the keywords "biochar OR char OR charcoal AND photosynthesis OR photosynthetic activity OR photosynthetic rate". 1) observations had one pair of data at lowest (comparing a control and biochar-amended treatment) and measured photosynthesis in plants; 2) the plots for all treatments had the same environmental conditions and dominant vegetation composition as the control at the beginning of the experiments; 3) the methods for biochar amendment were explicitly described, including biochar application rate and experimental duration; and 4) the mean and its standard deviation or error of variables in each treatment could be extracted from contexts or supplemental materials directly.

Data and analysis

The mean effect size was quantified by the weighted response ratio (RR++) using the random effects model. The 95% bootstrap confidence intervals (CIs) were calculated by using a bootstrapping (999 iterations) method. To examine the heterogeneity among subgrouping categories, the between-group heterogeneity (Qb) was calculated by using the MetaWin 2.1 software. We also used a random effect model to identify these biochar, soil physicochemical characteristics, and other explanatory factors which influence the response of photosynthesis to biochar amendment. Meta-regression was performed to explore the relationships between RR (photosynthesis and biomass) and continuous variables. The effects of plant type (C_3 and C_4) on physiological variables–photosynthesis and photosynthesis–biomass relationships were examined using analysis of covariance (ANCOVA).

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
74	Not specified	Soil amendment with biochar	No amendment	Metric: Water use efficiency; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	0.8125

Results

- On average, biochar amendment to soils significantly increased WUE (RR++ = 0.24), when compared with the corresponding controls. However, no significant effects were found for C_4 plants.

Factors influencing effect sizes

- Crop type : Biochar amendment led to increases of 30.6% in WUE for C_3 plants, while no significant effects were found for C_4 plants.
- Biochar C/N : WUE significantly decreased with biochar C/N.

Conclusion

Overall, we found that biochar amendment significantly increased water use efficiency by 26.8%.