

SINGLE-IMPACT FICHE

SOIL AMENDMENT WITH BIOCHAR



IMPACT: PLANT WATER USE EFFICIENCY

Data extracted in February 2021

Note to the reader: This fiche summarises the impact of soil amendment with biochar on WATER USE EFFICIENCY (the crop biomass yield per unit of water consumption). It is based on two peer-reviewed synthesis research papers¹, including 43 and 74 individual studies, respectively.

1. WEIGHT OF THE EVIDENCE

- **CONSISTENCY OF THE IMPACT:**

Soil amendment with biochar, compared to no-biochar-amendment, has a consistent positive effect (increase in Water use efficiency), according to the 2 reviewed synthesis papers (see **Table 1**).

Among the two reviewed synthesis papers, one includes data collected in Europe and the other does not specify geographical location of experiments (see **Table 2**).

Table 1. Summary of effects. The effect with the higher score is marked in bold and the cell coloured. The numbers between parenthesis indicate the number of synthesis papers with a quality score of at least 50%. Details on quality criteria can be found in the next section.

Impact	Metric	Positive	Negative	No effect	Uncertain
Increase plant water use efficiency		2 (2)	0	0	0

- **QUALITY OF THE SYNTHESIS PAPERS:** *The quality score summarises 16 criteria assessing the quality of three main aspects of the synthesis papers: 1) the literature search strategy and studies selection; 2) the statistical analysis; 3) the potential bias. Details on quality criteria can be found in this document [→](#).*

As shown in the "Quality score" in **Table 2**, the quality level was of 81% for the two synthesis papers. The least frequently satisfied quality criteria were "Number of studies at each step", "Individual effect sizes", "Dataset available" and "Publication bias analysed".

2. IMPACTS


The main characteristics and results of the synthesis papers are summarized in **Table 2**. Detailed results of each synthesis study are reported in the summary reports .

Table 2. Main characteristics of the synthesis papers reporting impacts of soil amendment with biochar Water use efficiency. The references are ordered chronologically with the most recent publication date first.

¹ Research synthesis papers include a formal meta-analysis or systematic reviews with some quantitative results

Reference	Population	Geographical scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Gao, Y; Shao, GC; Lu, J; Zhang, K; Wu, SQ; Wang, ZY 2020	Not specified	Global	43	Soil amendment with biochar	No amendment	Plant water use efficiency (PWUE); Leaf water use efficiency (LWUE)	This analysis showed a statistically significant 18.8 % and 20.0 % increase in PWUE and LWUE, respectively, following biochar application, indicating the potential benefits of biochar application in adapting to climate change.	81%
He, YH; Yao, YX; Ji, YH; Deng, J; Zhou, GY; Liu, RQ; Shao, JJ; Zhou, LY; Li, N; Zhou, XH; Bai, SH 2020	Not specified	Global	74	Soil amendment with biochar	No amendment	Water use efficiency	Overall, we found that biochar amendment significantly increased water use efficiency by 26.8%. However, no significant effects were found for C ₄ plants.	81%

3. KNOWLEDGE GAPS

He et al., 2020

A lack of long-term field experiments, especially those conducted in the Southern Hemisphere, may hamper the evaluation of ecosystem structure and functioning, including photosynthesis and plant productivity, in response to biochar amendment over a larger timescale.

4. SYSTEMATIC REVIEW SEARCH STRATEGY

Keywords	TOPIC: (biochar OR charcoal OR "black carbon") AND TOPIC: (soil OR agriculture OR farming) AND TOPIC: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis") or TITLE-ABS-KEY: (biochar OR charcoal OR "black carbon") AND TITLE-ABS-KEY: (soil OR agriculture OR farming) AND TITLE-ABS-KEY: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis")
Search dates	No time restrictions
Databases	Web of Science and Scopus, run in February 2021

<p>Selection criteria</p>	<p>The main criteria that led to the exclusion of a synthesis paper were if the paper: 1) does not deal with agronomic application of biochar; 2) does not synthesize pairwise comparisons on the agronomic effect of biochar; 3) the control of the pairwise comparison is not no-biochar; 4) deals with soil application of mineral- or organic-enriched biochar; 5) does not report results with the same fertilisation conditions between intervention and control; 6) is either a simple review, a non-quantitative systematic review, a meta-regressions looking only at factors influences, without mean effect sizes; 7) deals with other than agricultural soils in cropping systems, e.g. forest restoration; 8) is not written in English. Synthesis papers that passed the relevance criteria were subject to critical appraisal carried out on paper-by-paper basis.</p> <p>The search returned 130 synthesis papers potentially relevant for the practice object of our fiche. Searches for other farming practices added another 2 potentially relevant synthesis papers. From the 132 potentially relevant synthesis papers, 57 were excluded after reading the title and abstract, and 34 after reading the full text according to the above-mentioned criteria. Finally, 41 synthesis papers were selected for soil amendment with biochar, from which 2 were relevant for this impact.</p>
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