

IMPACT: WATER USE

Data extracted in February 2021
Fiche created in May 2024

Note to the reader: This fiche summarises the effects of Soil amendment with biochar on WATER USE. It is based on 2 synthesis papers¹, including 43 and 74 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effects of soil amendment with biochar, as compared to no-amendment, on water use are reported in **Table 1**.

The table below shows the number of synthesis papers with statistical tests reporting i) a significant difference between the Intervention and the Comparator, that is to say, a significant statistical effect, which can be positive or negative; or ii) a non-statistically significant difference between the Intervention and the Comparator. In addition, we include, if any, the number of synthesis papers reporting relevant results but without statistical test of the effects. Details on the quality assessment of the synthesis papers can be found in the methodology section of this WIKI.

- Soil amendment with biochar, compared to no-amendment, shows significant positive effect (increase in Water use efficiency), consistently in the 2 reviewed synthesis papers.

Out of the 2 selected synthesis papers, one included studies conducted in Europe (see **Table 2**).

Table 1: Summary of effects. Number of synthesis papers reporting positive, negative or non-statistically significant effects on environmental and climate impacts. The number of synthesis papers reporting relevant results but without statistical test of the effects are also provided. When not all the synthesis papers reporting an effect are of high quality, the number of synthesis papers with a quality score of at least 50% is indicated in parentheses. The reference numbers of the synthesis papers reporting each of the effects are provided in **Table 3**.

Impact	Metric	Intervention	Comparator	Statistically tested			Non-statistically tested
				Significantly positive	Significantly negative	Non-significant	
Decrease water use	Water use efficiency	Soil amendment with biochar	No amendment	2	0	0	0

QUALITY OF THE SYNTHESIS PAPERS

The quality of each synthesis paper was assessed based on 16 criteria regarding three main aspects: 1) the literature search strategy and primary studies selection; 2) the statistical analysis conducted; and 3) the evaluation of potential bias. We assessed whether authors addressed and reported these criteria. Then, a quality score was calculated as the percentage of these 16 criteria properly addressed and reported in each synthesis paper. Details on quality criteria can be found in the methodology section of this WIKI.

2. IMPACTS

The main characteristics and results of the 2 synthesis papers are reported in **Table 2** with the terminology used in those papers, while **Table 3** shows the reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**. Comprehensive information about the results reported in each synthesis paper, in particular about the modulation of effects by factors related to soil, climate and management practices, are provided in the **summaries of the synthesis papers** available in this WIKI.

Table 2: Main characteristics of the synthesis papers reporting effects on water use. The references are ordered chronologically with the most recent publication date first.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref8	Not specified	Global	43	Soil amendment with biochar	No amendment	Plant water use efficiency; Leaf water use efficiency	This analysis showed a statistically significant 18.8 % and 20.0 % increase in plant water use efficiency and leaf water use efficiency, respectively, following biochar application, indicating the potential benefits of biochar application in adapting to climate change.	81%
Ref10	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%.	81%

Table 3: Reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**.

¹ Synthesis research papers include either meta-analysis or systematic reviews with quantitative results. Details can be found in the methodology section of the WIKI.

Impact	Metric	Intervention	Comparator	Statistically tested			Non-statistically tested
				Significantly positive	Significantly negative	Non-significant	
Decrease water use	Water use efficiency	Soil amendment with biochar	No amendment	Ref8 and Ref10			

3. FACTORS INFLUENCING THE EFFECTS ON WATER USE

Table 4: List of factors reported to significantly affect the size and/or direction of the effects on water use, according to the synthesis papers reviewed.

Factor	Reference number
Biochar application rate	Ref8
Biochar C content	Ref8
Biochar C/N	Ref10
Biochar K content	Ref8
Biochar pH	Ref8
Biomass precursor	Ref8
Crop type	Ref10
Experimental conditions	Ref8
NA	Ref8, Ref10, Ref10, Ref10, Ref10, Ref10 and Ref10
Soil pH	Ref8

4. KNOWLEDGE GAPS

Table 5: Knowledge gap(s) reported by the authors of the synthesis papers included in this review.

Ref Num	Gap
Ref10	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.

5. SYNTHESIS PAPERS INCLUDED IN THE REVIEW

Table 6: List of synthesis papers included in this review. More details can be found in the summaries of the meta-analyses.

Ref Num	Author(s)	Year	Title	Journal	DOI
Ref8	Gao, Y; Shao, GC; Lu, J; Zhang, K; Wu, SQ; Wang, ZY	2020	Effects of biochar application on crop water use efficiency depend on experimental conditions: A meta-analysis	F Crop Res. 249:107763	10.1016/j.fcr.2020.107763
Ref10	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

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