SINGLE-IMPACT FICHE
SOIL AMENDMENT WITH BIOCHAR

IMPACT: PLANT NUTRIENT-UPTAKE

Data extracted in February 2021

Note to the reader: This fiche summarises the impact of soil amendment with biochar on PLANT NUTRIENT-UPTAKE (including in particular nitrogen, phosphorous and silicon). It is based on 3 peer-reviewed synthesis research papers[1], each of them including from 5 to 208 individual studies.

1.WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT:
  Soil amendment with biochar, compared to no-biochar-amendment, led to a positive effect (increase in plant nutrient-uptake) in 2 out of the 3 reviewed synthesis papers, while the other synthesis paper reported no effect (for greenhouse vegetables cultivations) (see **Table 1**).

  Among the 3 reviewed synthesis papers, 1 did not report data collected in Europe and 2 did not specify geographical locations of the 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 nutrient-uptake		**2 (2)**	0	1 (1)	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 ranges from 62% to 75%. 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 Plant nutrient-uptake. 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
Gu, JX; Wu, YY; Tian, ZY; Xu, HH 2020	Greenhouse vegetables	China	5	Soil amendment with biochar	No amendment	Nitrogen use efficiency	Biochar application to greenhouse vegetables tends to increase, but non-significantly, nitrogen utilisation efficiency.	75%
Li Z, Song Z, Singh BP, Wang H 2019	Not specified (for N and P), Rice (for Silicon)	Global	171	Soil amendment with biochar	No amendment	Plant nutrients uptake (Si, P, N)	Higher amount of silicon and nutrients input through addition of biochars significantly improved crop silicon (in rice) and nutrients (N,P) uptake (crops not specified).	62%
Liu, Q; Zhang, YH; Liu, BJ; Amonette, JE; Lin, ZB; Liu, G; Ambus, P; Xie, ZB 2018	Not specified	Global	208	Soil amendment with biochar	No amendment	Plant nitrogen uptake	Biochar leads to a significant increase in plant N uptake.	69%

3. KNOWLEDGE GAPS

Liu et al., 2018	The biochar effects synthesized in the current paper are mainly derived from experiments characterized by single-dose designs and relatively short-term time scales (months to a few years). Biochar effects with respect to longer-term and repetitive additions require further evaluation with future more relevant experimental data.

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
Selection criteria	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 synthetize 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. 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 3 were relevant for this impact.