

IMPACT: AIR POLLUTANTS EMISSIONS

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 AIR POLLUTANTS EMISSIONS. It is based on 2 synthesis papers¹, including 41 and 208 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effects of soil amendment with biochar, as compared to no amendment, on air pollutants emission 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-biochar-amendment, led either to a significant negative effect (increase in ammonia emission) in one synthesis paper or to non-significant effect in the other synthesis paper.

None of the selected synthesis papers 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 air pollutants emissions	NH ₃ emissions	Soil amendment with biochar	No amendment	0	1	1 (2)	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 air pollutants emissions. The references are ordered chronologically with the most recent publication date first.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref20	Not specified	Global	41	Soil amendment with biochar	No amendment	Ammonia emission	Biochar addition did not impact on ammonia volatilization, but this varied under different soil, biochar and experimental conditions.	88%
Ref27	Global dataset of 208 studies, 340 pairwise comparisons. Different types of soils, pedo-climate conditions, different types of biochars.	Global	208	Soil amendment with biochar	No amendment	Ammonia emission	Biochar significantly enhances soil ammonia volatilization. However, wood biochar tends to decrease soil NH ₃ volatilization.	69%

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.

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

Impact	Metric	Intervention	Comparator	Statistically tested			Non-statistically tested
				Significantly positive	Significantly negative	Non-significant	
Decrease air pollutants emissions	NH ₃ emissions	Soil amendment with biochar	No amendment		Ref27	Ref20	

3. FACTORS INFLUENCING THE EFFECTS ON AIR POLLUTANTS EMISSIONS

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

Factor	Reference number
Biochar application rate	Ref27
Biochar BET surface area	Ref20
Biochar carbon content	Ref20
Biochar pH	Ref20 and Ref27
Fertiliser-N application rate	Ref20
NA	Ref27, Ref27 and Ref27
Soil nitrogen	Ref20
Soil organic carbon	Ref20 and Ref27
Soil pH	Ref20 and Ref27
Soil texture	Ref20 and Ref27

4. KNOWLEDGE GAPS

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

Ref Num	Gap
Ref20	A significant publication bias was identified ($p < 0.05$), but use of the Fail-safe N. technique indicated that results were reliable.
Ref27	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.

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
Ref20	Sha, ZP; Li, QQ; Lv, TT; Misselbrook, T; Liu, XJ	2019	Response of ammonia volatilization to biochar addition: A meta-analysis	Sci Total Environ. 655:1387–96.	10.1016/j.scitotenv.2018.11.316
Ref27	Liu, Q; Zhang, YH; Liu, BJ; Amonette, JE; Lin, ZB; Liu, G; Ambus, P; Xie, ZB	2018	How does biochar influence soil N cycle? A meta-analysis	Plant Soil 426:211–25	10.1007/s11104-018-3619-4

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