SINGLE-IMPACT FICHE
IL AMENDMENT WITH LIME AND GYPSUM

IMPACT: CARBON SEQUESTRATION

Data extracted in February 2021
Fiche created in May 2024

Note to the reader: This fiche summarises the effects of Soil amendment with lime and gypsum on CARBON SEQUESTRATION. It is based on 2 synthesis papers[1], including 20 and 59 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effects of soil amendment with lime and gypsum, as compared to no-amendment, on carbon sequestration 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.

- Compared to no soil amendments, amendment with gypsum showed significant positive effect on soil organic carbon in one synthesis paper, while amendment with lime showed non-significant effect in the other synthesis paper.

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**.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Increase carbon sequestration	Soil organic carbon	Gypsum	No gypsum	1	0	0	0
		Lime	No lime	0	0	1	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 carbon sequestration. The references are ordered chronologically with the most recent publication date first.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref3	Saline-sodic soil types	China	59	Soil amendment using flue gas desulfurization gypsum (FGDG)	No-amendment control under identical experimental conditions	Soil organic carbon	Soil amendment using flue gas desulfurization gypsum (FGDG) significantly increased SOC content.	62%
Ref6	Grasslands	Global (including Europe)	20	Liming intensity categorised into three rates: low lime, < 3 t/ha lime; moderate lime, 3–5 t/ha lime; and high lime, > 5 t/ha lime.	No-liming under same ecosystem and simiar environmental characteristics.	Soil organic carbon stock	Liming results in a marginal non significant increase in soil C stocks of global grasslands.	100%

[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**.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Increase carbon sequestration	Soil organic carbon	Gypsum	No gypsum	Ref3			
		Lime	No lime			Ref6	

3. FACTORS INFLUENCING THE EFFECTS ON CARBON SEQUESTRATION

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

Factor	Reference number
Aplication season	Ref3
Climate	Ref6
Liming duration	Ref6
NA	Ref6, Ref6, Ref6, Ref6, Ref6, Ref6, Ref3, Ref3, Ref3, Ref3 and Ref3
Soil depth	Ref3
Soil salinity	Ref3

4. KNOWLEDGE GAPS

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

Ref Num	Gap
Ref3	In addition, a few studies have estimated soil C sequestration capacity in organic and inorganic forms induced by flue gas desulfurization gypsum application. The magnitude of soil C sequestration potential due to FGDG application at large spatial scales is largely unknown. Large temporal variations occur and it may take years to observe the impacts of FGDG application on them. Unfortunately, most studies of FGDG application measure these soil properties only once, which cannot inform the long-term impacts.
Ref6	The understanding of the mechanisms of interactions between climate change and management activities in temperate grasslands is still poor.

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
Ref3	Wang Y, Wang Z, Liang F, Jing X, Feng W	2021	Application of flue gas desulfurization gypsum improves multiple functions of saline-sodic soils across China.	Chemosphere. 277:130345	10.1016/j.chemosphere.2021.130345
Ref6	Eze, S; Palmer, SM; Chapman, PJ.	2018	Soil organic carbon stock in grasslands: Effects of inorganic fertilizers, liming and grazing in different climate settings	Journal of Environmental Management 223, 74-84	10.1016/j.jenvman.2018.06.013

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