SINGLE-IMPACT FICHE
SOIL AMENDMENT WITH LIME OR GYPSUM

IMPACT: CROP YIELD

Data extracted in April 2021

Note to the reader: This fiche summarises the impact of soil amendment with lime or gypsum on CROP YIELD. It is based on 5 peer-reviewed synthesis research papers[1]. Each synthesis paper includes a number of individual studies, which in this case ranges from 19 to 175.

1.WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT:

Both liming and gypsum amendments, compared to no amendments, showed a consistent positive effect on crop yield. From 5 synthesis papers, 4 showed a positive effect (increase of crop yield), while 1 paper reported an uncertain effect (see **Table 1**).

Among the 5 reviewed synthesis papers, only 1 includes data collected in Europe.

Table 1. Summary of effects. 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	Intervention	Control	Positive	Negative	No effect	Uncertain
Increase crop yield	Lime	No lime	2 (2)	0	0	0
	Gypsum	No gypsum	2 (2)	0	0	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 the methodology section of this WIKI.*

2. IMPACTS

The main characteristics and results of the synthesis papers are summarized in **Table 2**. Summaries of the meta-analyses provide fuller 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.

Table 2. Main characteristics of the synthesis papers reporting impacts of soil amendment with lime or gypsum on crop yield. The references are ordered chronologically with the most recent publication date first.

Reference	Population	Geographical scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
R.Hijbeek; M.P.van Loon; W.Ouaret; B.Boekelo; M.K.van Ittersum 2021	Maize	Kenya	19	Lime	No lime	Crop yield	Average observed increase in maize yields was 57% (with 2 t ha –1 lime).	56%

[1] Research synthesis papers include a formal meta-analysis or systematic reviews with some quantitative results. Details can be found in the methodology section of the WIKI.

Reference	Population	Geographical scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Wang Y, Wang Z, Liang F, Jing X, Feng W 2021	Saline-sodic soil types	China	59	Soil amendment using flue gas desulfurization gypsum (FGDG)	No-amendment control under identical experimental conditions	Crop yield, Plant seedling emergence	Soil amendment using flue gas desulfurization gypsum (FGDG) significantly increased crop yield (+91.2%) and plant seedling emergency (+63.2%).	62%
Pias, OHD; Tiecher, T; Cherubin, MR; Silva, AGB; Bayer, C 2020	Arable crops	Brazil and Paraguay	43	Gypsum application	No gypsum	Crop yield	Gypsum application decreases Al toxicity to plants and increases crop grain yields as a result in no-tillage soils with high Al saturation.	81%
Li Y.; Cui S.; Chang S.X., Zhang Q. 2019	Field-studies, laboratory incubation or greenhouse pot studies	Global (including Europe)	175	Liming treatment, including dolomite ($CaMg(CO_3)_2$), calcium hydroxide ($Ca(OH)_2$), calcium carbonate ($CaCO_3$), and calcium oxide (CaO)	No-liming control under identical experimental conditions	Yield	Averaged across different crop species, the application of CaO, $CaCO_3$, $Ca(OH)_2$, and $CaMg(CO_3)_2$ significantly increased yield by 13.2%, 34.3%, 29.2%, and 66.5%, respectively.	81%
Tiecher, T; Pias, OHD; Bayer, C; Martins, AP; Denardin, LGD; Anghinoni, I 2018	Grain yields in sub-tropical Brazil	Brazil	20	Gypsum application	Specific treatment without gypsum, that induced the highest yield	Crop yield	Irrespective of water deficiency, applying gypsum to soils with high subsurface acidity increased the average yield by 14 % in corn (85 % studied cases) and by 20 % in winter cereals (75 % of cases). Soybean only responded positively to gypsum in the simultaneous presence of high soil subsurface acidity and water deficiency (average increase 23 %, 100 % of cases). However, rigorous statistical analysis was not provided in this work.	44%

3. KNOWLEDGE GAPS

R.Hijbeek et al.	Further research could investigate liming effects for crops other than maize.
Wang Y et al.	Most studies of FGDG application focus on changes in plant productivity and a few soil properties such as soil salinity and pH. There are few studies that have investigated changes in soil physical properties that reflect water retention such as the distribution and stability of soil aggregates, and soil hydraulic conductivity, infiltration, and permeability. The lack of simultaneous measurements for multiple soil properties and plant productivity does not allow the determination of underlying mechanisms regarding how FGDG application can affect soil functions. This makes it difficult to offer practical suggestions to improve the amelioration by FGDG amendment.
Pias, OHD et al.	Long-term experiments under no-tillage are needed also because most existing studies are relatively new (<2yr) and only allow one to evaluate short-term effects of gypsum on soil properties and crop yields.
Li Y. et al.	The complexity of responses identified in this study emphasizes the need for adopting more advanced data-science algorithms coupled with high-dimensional data sets in the future that could enhance our understanding of the underlying mechanisms of liming on an agroecosystem basis.
Tiecher, T et al.	All existing studies involved Oxisols and most (80 %) examined the crop response of soybean or corn. Sixty-one (76 %) of the 73 growing seasons examined in this systematic review corresponded to a period shorter than three years after gypsum was applied.