

IMPACT: SOIL PHYSICO-CHEMICAL QUALITY

Data extracted in January 2022
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Note to the reader: This fiche summarises the effects of Cover and catch crops on SOIL PHYSICO-CHEMICAL QUALITY. It is based on 4 synthesis papers¹, including from 6 to 269 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effect of cover/catch crops, as compared to bare soil, on SOIL PHYSICO-CHEMICAL QUALITY is 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.

- The effect of cover/catch crops, as compared to bare soil, on SOIL PHYSICO-CHEMICAL QUALITY is generally positive, with 2 results out of 2 indicating a significant improvement in soil physico-chemical quality parameters (including e.g. cation exchange capacity, soil penetration resistance, soil structural stability).

Out of the 4 selected synthesis papers, 3 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	
Increase soil physico-chemical quality	Soil physico-chemical quality	Cover crops	Bare soil	3	0	0	1

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 4 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 soil physico-chemical quality. The references are ordered chronologically with the most recent publication date first.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref10	Data from North America, Europe, Africa, and Asia, specifically eastern China; Cash crop type: corn, soybean, wheat, vegetable, corn-soybean rotation, corn-soybean-wheat rotation, and other	Global	269	Cover and catch crops (legume, grass, multi-species mixture, and other)	No cover/catch crop	Cation exchange capacity	Soil cation exchange capacity showed significant increase in cover crop treatments compared to controls.	62%
Ref17	Annual crops	Global	23	Cover crops	no cover crop (fallow)	Soil water infiltration rate	The mean increase in infiltration rates for cover crop experiments (n = 81, 23 studies) was significantly above zero (34.8%, confidence interval 19.8–50.0%)	94%

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.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref30	In all the experiments the commercial crops were soybean or corn and always sowed after the cover crop.	Pampas	62	Cover crops	No cover crops	1) Soil penetration resistance; 2) Soil structural stability; 3) Soil water infiltration	Soil penetration resistance was greatly reduced (15-20%) by the adoption of cover crops. There was a 12% average positive and significant effect of cover crops on soil structural stability. Infiltration was enhanced by cover crop use.	81%
Ref31	Annual crops	Global	6	Cover crops	No cover crop	Soil porosity	There was evidence of improvements in both hydrologic properties analyzed (however, no statistical analysis is provided).	56%

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	
Increase soil physico-chemical quality	Soil physico-chemical quality	Cover crops	Bare soil	Ref10, Ref17 and Ref30			Ref31

3. FACTORS INFLUENCING THE EFFECTS ON SOIL PHYSICO-CHEMICAL QUALITY

Table 4: List of factors reported to significantly affect the size and/or direction of the effects on soil physico-chemical quality, according to the synthesis papers reviewed.

Factor	Reference number
Associated practices	Ref17
Soil depth	Ref30
Soil texture	Ref17
Years of treatment	Ref17

4. KNOWLEDGE GAPS

The authors did not report knowledge gaps in the reviewed synthesis papers.

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
Ref10	Jian, Jinshi; Lester, Brandon J.; Du, Xuan; Reiter, Mark S.; Stewart, Ryan D.	2020	A calculator to quantify cover crop effects on soil health and productivity	Soil and Tillage Research 199, 104575	10.1016/j.still.2020.104575
Ref17	Basche, AD; DeLonge, MS	2019	Comparing infiltration rates in soils managed with conventional and alternative farming methods: A meta-analysis	PloS one, 14 (9): e0215702.	10.1371/journal.pone.0215702
Ref30	Alvarez, Roberto; Steinbach, Haydee S.; De Paepe, Josefina L.	2017	Cover crop effects on soils and subsequent crops in the pampas: A meta-analysis	Soil and Tillage Research 170, 53-65	10.1016/j.still.2017.03.005
Ref31	Basche, AD; DeLonge, MS	2017	The Impact of Continuous Living Cover on Soil Hydrologic Properties: A Meta-Analysis	SOIL SCI SOC AM J, 81, 5, 1179-1190	10.2136/sssaj2017.03.0077

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