SINGLE-IMPACT FICHE
ORGANIC FARMING SYSTEMS

IMPACT: SOIL BIOLOGICAL QUALITY

Data extracted in October 2021
Fiche created in March 2024

Note to the reader: This fiche summarises the effects of Organic farming systems on SOIL BIOLOGICAL QUALITY. It is based on 2 synthesis papers[1], including 7 and 12 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effect of organic farming systems on soil biological 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.

- Organic systems (as broad category without distiction on different types) have positive effect on nematode abundance.
- Non-significant effect was found for other metrics, such as abundance of plant feeders, taxonomy richness, shannon diversity index, plant parasite index, nematode channel ratio, enrichment index and structure index.
- Negative effect was found for maturity index.
- Another synthesis paper reported non-statistically tested results on metrics regarding soil microbial biomass.

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**. Some synthesis papers may report effects for more than one impact or more than one effect for the same impact.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Increase soil biological quality	Soil biological quality	Organic systems	Conventional	1	1	1	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 soil biological 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
Ref3	Not specified	Global	12	Organic systems	Conventional	Soil nematodes: 1) Total density; 2) Abundance of bacterial feeders; 3) Abundance of fungal feeders; 4) Abundance of omnivore-predators; 5) Abundance of plant feeders; 6) Taxonomy richness; 7) Shannon diversity index; 8) Maturity index; 9) Plant parasite index; 10) Nematode channel ratio; 11) Enrichment index;	Organic agricultural systems improved nematode abundance, irrespective of trophic groups.	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
						12) Structure index		
Ref29	Studies conducted in Brazil assessing the performance of organic systems in comparison to conventional systems.	Brazil	7	Organic systems	Conventional systems	1) Soil microbial biomass-C (MB-C); 2) microbial quotient (MB-C/TSOC, total soil organic carbon); 3) metabolic quotient (qCO2).	The majority of these studies indicated that organic agriculture improved soil quality. However, the results are rated as uncertain, due to the lack of statistical analysis.	38%

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 soil biological quality	Soil biological quality	Organic systems	Conventional	Ref3	Ref3	Ref3	Ref29

3. FACTORS INFLUENCING THE EFFECTS ON SOIL BIOLOGICAL QUALITY

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

Factor	Reference number
Diversification strategies	Ref3
Fertilisation	Ref3
Pesticides use	Ref3
Tillage	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	These findings are dependent on the current limits of soil nematology, in particular (i) the possible lack of consideration of rare taxa due to the low number of individuals identified per soil sample, (ii) the low resolution of the taxonomic assignment (genus or family) which can lead to underestimating taxonomic richness, or (iii) the low consideration of the functional traits that may better capture the ecological strategies of nematodes. Our global pattern was mainly influenced by the three geological areas (Asia, Europe and America) and thus may not represent fully the worldwide pattern.
Ref29	Direct relationships between soil microbial biomass -C and nutrient-cycling dynamics, microbial diversity and functionality are still unclear. Further studies are needed to develop strategies to maximize beneficial effects of microbial communities on soil fertility and crop productivity.

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	Puissant, J; Villenave, C; Chauvin, C; Plassard, C; Blanchart, E; Trap, J	2021	Quantification of the global impact of agricultural practices on soil nematodes: A meta-analysis	SOIL BIOLOGY & BIOCHEMISTRY, 161, 108383	10.1016/j.soilbio.2021.108383
Ref29	Kaschuk, G; Alberton, O; Hungria, M.	2010	Three decades of soil microbial biomass studies in Brazilian ecosystems: Lessons learned about soil quality and indications for improving sustainability.	Soil Biology & Biochemistry 42: 1–13.	10.1016/j.soilbio.2009.08.020

Disclaimer: These fiches present a large amount of scientific knowledge synthesised to assess farming practices impacts on the environment, climate and productivity. The European Commission maintains this WIKI to enhance public access to information about its initiatives. Our goal is to keep this information timely and accurate. If errors are brought to our attention, we will try to correct them. However, the Commission accepts no responsibility or liability whatsoever with regard to the information on these fiches and WIKI.