SINGLE-IMPACT FICHE
ORGANIC FARMING SYSTEMS

IMPACT: PESTS AND DISEASES

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Note to the reader: This fiche summarises the effects of Organic farming systems on PESTS AND DISEASES. It is based on 4 synthesis papers[1], including from 53 to 134 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effect of organic farming systems on pest and disease control 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.

- Compared to conventional systems, 3 synthesis papers reported positive effect of organic cropping systems on the abundance of natural enemies (i.e. increased abundance of natural enemies), and 1 reported non-significant effect on natural enemy species richness.
- 2 synthesis papers reported negative effect on pest and disease abundance (i.e. an increased incidence and/or severity level of pests and diseases).
- All results are expressed per unit of area (e.g., per ha). No results were reported per unit of product.

All 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**. 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	
Decrease pests and diseases	Natural enemies of pests per unit of area	Organic cropping systems	Conventional	3	0	1	0
Decrease pests and diseases	Pests per unit of area	Organic cropping systems	Conventional	0	2	0	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 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 pests and diseases. The references are ordered chronologically with the most recent publication date first.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref4	Studies assessing the performance of organic	Global	59	Organic systems (Cereals, Fruits,	Conventional	Biotic abundance, biotic richness of	Organic sites had greater biodiversity (34%) than conventional sites. Biodiversity gains increased as average	88%

[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
	systems in comparison to conventional systems.			Oil crops, Pulses, Root, Vegetables)	systems	functional groups (Pollinators)	crop field size in the landscape increased, suggesting organic farms provide a "refuge" in intensive landscapes.	
Ref6	Studies assessing the performance of organic in comparison to conventional perennial orchards and vineyards.	Global	53	Organic orchards and vineyards	Conventional systems	Natural enemies taxon richness	Organic farming significantly restored both biotic richness and abundance in orchards and vineyards, including a variety of (dis)service-providing organisms.	94%
Ref10	Studies assessing the performance of organic systems in comparison to conventional systems.	Global	134	Organic cropping systems	conventional cropping systems	1) Biological control potential (predation rate, parasitism rate and soil-suppressiveness, that is, soil ability to suppress pathogens following their inoculation); 2) pest infestation (disease severity or incidence, pest abundance or pest density, weed soil cover, weed biomass or weed density)	Results show that, compared to conventional cropping systems, 1) organic farming promotes overall biological pest control potential, 2) organic farming has higher levels of overall pest infestations but 3) this effect strongly depends on the pest type. The meta analyses show that there are lower levels of pathogen infestation, similar levels of animal pest infestation and much higher levels of weed infestation in organic than in conventional systems.	94%
Ref28	Studies assessing the performance of organic systems in comparison to conventional systems.	Global	71	Organic systems	Conventional systems	Abundance, fecundity, development rate, size and damage. Pests and natural enemies of pests.	Pest responses suggest that controlling pests in organic systems may be a limitation. Nonetheless, natural enemy abundance is higher in organic systems than in conventional systems	56%

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	
Decrease pests and diseases	Natural enemies of pests per unit of area	Organic cropping systems	Conventional	Ref4, Ref10 and Ref28		Ref6	
Decrease pests and diseases	Pests per unit of area	Organic cropping systems	Conventional		Ref10 and Ref28		

3. FACTORS INFLUENCING THE EFFECTS ON PESTS AND DISEASES

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

Factor	Reference number
Crop field size	Ref4
Crop type	Ref28 and Ref10
Experiment scale	Ref28
Pests type	Ref28
Presence of pest management	Ref28
Study type	Ref10

4. KNOWLEDGE GAPS

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

Ref Num	Gap
Ref6	Future meta-analytic studies should focus on the role of large-scale factors on biodiversity and ecosystem services in orchards/vineyards.
Ref10	There is a need for more studies about the effect of landscape composition (especially considering organic farming in the landscape) on pest infestation levels.
Ref28	This review also serves to highlight the potential importance fertilisers play within a farming context in determining pest and natural enemy populations, although it does emphasise a gap in the research, predominantly with regards to natural enemies and the impact of organic and conventional fertilisers.

5. SYNTHESIS PAPERS INCLUDED IN THE REVIEW

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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
Ref4	Smith, OM; Cohen, AL; Reganold, JP; Jones, MS; Orpet, RJ; Taylor, JM; Thurman, JH; Cornell, KA; Olsson, RL; Ge, Y; Kennedy, CM; Crowder, DW	2020	Landscape context affects the sustainability of organic farming systems.	Proceedings of the National Academy of Sciences of the United States of America 117: 2870-2878.	10.1073/pnas.1906909117
Ref6	Katayama, N; Bouam, I; Koshida, C; Baba, YG	2019	Biodiversity and yield under different land-use types in orchard/vineyard landscapes: A meta-analysis.	Biological Conservation 229: 125-133.	10.1016/j.biocon.2018.11.020
Ref10	Muneret, L; Mitchell, M; Seufert, V; Aviron, S; Djoudi, E; Petillon, J; Plantegenest, M; Thiery, D; Rusch, A.	2018	Evidence that organic farming promotes pest control	Nature Sustainability 1, 361-368	10.1038/s41893-018-0102-4
Ref28	Garratt, MPD; Wright, DJ; Leather, SR.	2011	The effects of farming system and fertilisers on pests and natural enemies: A synthesis of current research	AGRICULTURE ECOSYSTEMS & ENVIRONMENT 141, 261-270.	10.1016/j.agee.2011.03.014

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