SINGLE-IMPACT FICHE – ORGANIC SYSTEMS

IMPACT: CROP YIELD

Data extracted in September 2020

Note to the reader: This fiche summarises the impact of organic systems on CROP YIELD. It is based on a review of 10 peer-reviewed synthesis research papers[1]. Each synthesis paper includes a number of individual studies, which ranges in this case from 9 to 150.

1. WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT: All the 10 synthesis papers[1] reported crop yield losses in organic systems compared to conventional systems (see **Table 1**). All results are expressed per unit area (e.g., per ha). The reported average yield losses were in the range of 10-30%. A couple of synthesis papers also assessed the yield variability in organic farming systems compared to conventional systems and showed either no effect, or an increased level of variability in organic systems. The reported effects concerned a large range of crop species, like cereals, legume crops, horticulture, vineyards. All the synthesis papers[1] included results of experiments conducted in Europe.

Table 1. Summary of impacts. The effect with the higher score is marked in bold and the cell coloured. The numbers between parenthesis indicate the number of synthesis papers[1] with a quality score of at least 50%. Details on quality criteria can be found in the next section.

Impact	Positive	Negative	No effect	Uncertain
Increase cyield	0	**9+2***	1*	0

* In this impact, the effect size is reported not only based on mean value, but also based on variance. The objective was to check if organic farming leads to more variable yield than conventional. The same was done for carbon sequestration (see fiche).

- QUALITY OF THE SYNTHESIS PAPERS[1]: [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 this document →]

  As shown in the "Quality score" of the tables in section 2, the quality level ranges from 50% to 100%. The least frequently satisfied quality criteria were "Number of papers reported at each step", "Individual studies weighted", and "publication bias analysed" (only satisfied in 5 synthesis papers).

2. IMPACTS

The main characteristics and results of the 10 synthesis papers[1] are summarized in **Table 2**. The references are ordered chronologically with the most recent publication date first.

[1] Research synthesis papers include meta-analysis or systematic reviews

Table 2. Main characteristics of the synthesis papers reporting impacts on CROP YIELD. All detailed results of each synthesis study are reported in the summary reports.

Nr	Reference	Population	Geographical scale	Intervention	Comparator	Conclusion	Quality score	Global effect
1	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	Organic and conventional systems	Global	Organic systems	Conventional systems	Organic sites had lower yields (18%).	88%	Negative effect
2	Smith, OM; Cohen, AL; Rieser, CJ; Davis, AG; Taylor, JM; Adesanya, AW; Jones, MS; Meier, AR; Reganold, JP; Orpet, RJ; Northfield, TD; Crowder, DW 2019	Organic and conventional systems	Global	Organic systems	Conventional systems	Lower mean yield and higher yield variability in organic systems than in conventional systems.	56%	Negative effect (decrease mean yield, increase yield variability)
3	Doring, J; Collins, C; Frisch, M; Kauer, R 2019	Organic, biodynamic and conventional viticulture	Europe, South Africa, USA, Australia	Organic systems	Conventional systems	A yield decrease of 18 % in organic and biodynamic viticulture compared to conventional viticulture was observed when all available data from scientific field trials were assessed.	50%	Negative
4	Katayama, N; Bouam, I; Koshida, C; Baba, YG 2019	Four systems - organic (Org), conventional (Conv), integrated (Int), and abandoned (Aba) - of perennial orchards and vineyards + (semi) natural habitats (Nat)	Global	Organic systems	Conventional and integrated systems	Organic systems reduced yield compared to conventional and integrated systems.	94%	Negative
5	Knapp, S; van der Heijden, MGA. 2018	Organic and conventional systems (arable crops)	Global	Organic systems	Conventional systems	Although organic farming promotes biodiversity and is generally more environmentally friendly, future efforts should focus	100%	Negative effect on relative yield stability (CV). No effect on absolute

Nr	Reference	Population	Geographical scale	Intervention	Comparator	Conclusion	Quality score	Global effect
						on reducing its yield stability.		yield stability (variance).
6	Lesur-Dumoulin, C; Malezieux, E; Ben-Ari, T; Langlais, C; Makowski, D. 2017	Organic and conventional horticultural systems (37 fruits and vegetables species).	Global	Organic systems	Conventional systems	The meta-analysis, based on a global comprehensive experimental dataset, shows that yields in organic horticulture are on average 10 to 32% lower than those in conventional horticulture, but they exhibit large variation across experiments.	81%	Negative
7	Ponisio, LC; M'Gonigle, LK; Mace, KC; Palomino, J; de Valpine, P; Kremen, C 2015	Organic and conventional systems.	Global	Organic systems	Conventional systems	This meta-analysis found relatively small, and potentially overestimated, differences in yield between organic and conventional agriculture (i.e. between 15.5 and 22.9%), despite historically low rates of investment in organic cropping systems.	81%	Negative
8	Tuomisto HL; Hodge ID; Riordana P; Macdonald DW 2012	Organic and conventional systems	Europe	Organic systems	Conventional systems	This meta-analysis has showed that organic farming in Europe has generally lower yields (-25% in average).	69%	Negative
9	de Ponti T., Rijk B., van Ittersum M.K. 2012	Organic and conventional systems	Global	Organic systems	Conventional systems	This review and meta-analysis of yield data comparing organic and conventional agriculture showed that currently organic yields of individual crops are on average 80% of conventional yields.	75%	Negative

Nr	Reference	Population	Geographical scale	Intervention	Comparator	Conclusion	Quality score	Global effect
10	Seufert, V; Ramankutty, N; Foley, JA 2012	Organic and conventional systems.	Global	Organic systems	Conventional systems	Overall, organic yields are 25% lower than conventional. But these yield differences are highly contextual, depending on system and site characteristics.	94%	Negative

3. KNOWLEDGE GAPS

[They are extracted from each synthesis paper, synthesized and consolidated]

- Long-term performance of organic agriculture under different management regimes;
- Study organic systems under a wider range of biophysical conditions;
- Examine the relative yield performance of smallholder agricultural systems;
- Evaluate the performance of farming systems through more holistic system metrics;
- Conduct new experiments in Countries from the Southern Hemisphere;
- Collect standard data on crop management and environmental characteristics;
- More information about the influence of differing soil moisture content and physiological performance of the management systems on fruit set.

4. SYSTEMATIC REVIEW SEARCH STRATEGY

Keywords	TOPIC: ("organic farm*" OR "organic agriculture" OR "organic system*" OR "organic product*") AND TOPIC: ("meta-analy*" OR "systematic* review*" OR "evidence map" OR "global synthesis" OR "evidence synthesis" OR "research synthesis")
Search dates	No time restrictions
Databases	Web of Science and Scopus, run on 20 July 2020
Selection criteria	Three main criteria led to the exclusion of a synthesis paper: (1) the paper does not deal with organic systems; (2) the paper does not assess the impacts of organic systems in comparison to another cropping system; (3) the paper is neither a meta-analysis nor a systematic review. Synthesis papers that passed the relevance criteria were subject to critical appraisal carried out on paper by paper basis. From an initial number of 122 synthesis papers, we finally selected 10 meta-analyses or systematic reviews.