SINGLE-IMPACT FICHE
COVER AND CATCH CROPS

IMPACT: PESTS AND DISEASES

Data extracted in January 2022
Fiche created in February 2024

Note to the reader: This fiche summarises the effects of Cover and catch crops on PESTS AND DISEASES. It is based on 7 synthesis papers[1], including from 15 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 PESTS AND DISEASES (referred to the subsequent cash crop) is reported separately for natural enemies of pests, pests (other than weeds) and weeds (**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.

- Natural enemies of pests were not significantly affected by cover crops according to 1 synthesis paper reporting on cover crops applied to orchards/tree-crops.
- Pests (other than weeds) resulted in either a significantly positive effect (i.e. decrease, according to 2 results, one of which regarding orchards/tree-crops) or a non-significant change (according to 2 results).
- Weeds were generally significantly suppressed with cover crops (positive effect), with 5 out of 7 results reporting positive effect.
- Both legume (1 result) and non-legume cover crops (1 result) resulted in significant suppression of weeds.

Out of the 7 selected synthesis papers, 6 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	Cover crops	Bare soil	0	0	1	0
Decrease pests and diseases	Pests	Cover crops	Bare soil	2	0	2	0
Decrease pests and diseases	Weeds	Cover crops	Bare soil	5	0	2	0
		Legume cover crops	Bare soil	1	0	0	0
		Non-legume cover crops	Bare soil	1	0	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 7 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.

[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.

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
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	1) Weeds; 2) Diseases; 3) Pests	Weed and disease presence significantly decreased in the cover crop treatments. Pests showed no significant responses to cover crops.	62%
Ref14	Maize	US midwest	15	Winter cover crops	no cover crop (fallow) . all other aspects of management held constant like in the intervention.	1) Weed biomass; 2) Weed density;	Cover crops significantly reduced weed biomass. There was no evidence cover crops reduced weed density.	100%
Ref23	Cereals and vegetables	Global	53	Cover crops	no cover crop	Weed suppression (i.e., weed biomass, density, and percentage of weed control)	Cover crops provided a range of weed suppression (all statistically significant), depending on management decisions such as choice of cover crop species, cover crop sowing season (fall or spring), sowing dates within seasons, seeding rate, termination date, delay in main crop planting date after cover crop termination, tillage system under which the cover crop was produced, and integrating the cover crop with other weed control inputs.	69%
Ref24	Arable crops in Mediterranean area	Global (Mediterranean climate)	57	Winter cover crops (legumes, non legumes, mixtures).	Bare soil	1) Food crop damage; 2) Weed abundance; 3) Weed diversity;	Weeds were 27% less abundant in plots with cover crops (R = 0.73). This included measurements of weed biomass, cover, and density. Weed diversity and food crop damage were not significantly different between plots with or without cover crops, but 15% more carbon dioxide was emitted by plots with cover crops (R = 1.15).	88%
Ref25	Cotton fields	US, Brasil, Greece	104	1) Cover crops (dicotyledon legume); 2) Cover crops (dicotyledon non-legume); 3) Cover crops (monocotyledon);	No cover crops	Weed biomass	Overall, cover crops had a positive effect on weed suppression in cotton production.	69%
Ref27	Cereals and vegetables	Global. Of the 46 studies, 36 were conducted in North America, 6 in Europe, 3 in Asia, and 1 in South America. Studies from the United States alone accounted for 72% of the total studies used for this review	46	Cover crops	no cover crop (fallow) . all other aspects of management held constant like in the intervention.	1) Weed biomass; 2) Weed density	Cover crops can effectively suppress weeds after termination and up to early stage of crop growth.	75%
Ref29	Vineyards. Global dataset. About 40% of all datasets originated from irrigated vineyards, 50% were rainfed vineyards and the other studies did not provide information on the use of irrigation. Most datasets came from vineyards under Mediterranean climates (n = 100), oceanic climates (n = 56), and steppe or continental climates (n = 22; three studies included vineyards from different climates). Most studies implemented randomized block designs within one experimental vineyard (n = 113), only few studies implemented block designs in several vineyards (n = 12), whereas 56 datasets used individual vineyards as replicate. The majority of studies investigated the effects of bare soil management (mostly due to tillage, sometimes by use of herbicides or both) compared to cover crops or natural vegetation (n = 137 datasets). We investigated the effects of conventional vs. organic management in 27 studies and 17 datasets originated from other types of intensive vs. extensive vegetation management like the contrast of single to diverse cover crop species in inter-rows or mulching vs. mowing of vegetation.	Global. Major wine producing regions world-wide except Asian countries, New Zealand and Argentina	74	Cover crops or natural vegetation growth for soil cover in vineyards	Bare soil or removal of spontaneous vegetation in vineyards by herbicides use or tillage	1) Natural enemy-related parameters (Abundance of potential natural enemies, Percentage of parasitism and predation); 2) Pest-related parameters (Pest abundance, Damage per vine and plot)	Pest-related parameters (positive values show mean lower values of pest species in the treatment), one of the two subsets of the ES-type pest control, also showed a significant positive response to extensive natural vegetation management in comparison to the non-significant effect on natural enemies.	94%

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	Cover crops	Bare soil			Ref29	
Decrease pests and diseases	Pests	Cover crops	Bare soil	Ref10 and Ref29		Ref10 and Ref24	
Decrease pests and diseases	Weeds	Cover crops	Bare soil	Ref10, Ref14, Ref23, Ref24 and Ref27		Ref14 and Ref24	
		Legume cover crops	Bare soil	Ref25			
		Non-legume cover crops	Bare soil	Ref25			

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
Cash crop seeding time	Ref23
Cover crop biomass production	Ref14 and Ref23
Herbicides use	Ref23
No factor reported	Ref24
Seeding rate	Ref23
Sowing season	Ref23
Ternination period	Ref23
Tillage management	Ref23
Time after cover crop	Ref14
Type of weed	Ref14

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
Ref14	Nicholas, V; Martinez-Feria, R; Weisberger, D; Carlson, S; Basso, B; Basche, A	2020	Cover crops and weed suppression in the US Midwest: A meta-analysis and modeling study	AGR ENV LETT 2020;5, e20022	10.1002/ael2.20022
Ref23	Osipitan OA, Dille JA, Assefa Y, Radicetti E, Ayeni A, Knezevic SZ	2019	Impact of cover crop management on level of weed suppression: A meta-analysis	Crop Science 59, 3, 833-842	10.2135/cropsci2018.09.0589
Ref24	Shackelford, GE; Kelsey, R; Dicks, LV	2019	Effects of cover crops on multiple ecosystem services: Ten meta-analyses of data from arable farmland in California and the Mediterranean	LAND USE POLICY, 88, 104204.	10.1016/j.landusepol.2019.104204
Ref25	Toler, HD; Auge, RM; Benelli, V; Allen, FL; Ashworth, AJ	2019	Global Meta-Analysis of Cotton Yield and Weed Suppression from Cover Crops	Crop science 59, 3, 1248-1261	10.2135/cropsci2018.10.0603
Ref27	Osipitan, OA; Dille, JA; Assefa, Y; Knezevic, SZ	2018	Cover Crop for Early Season Weed Suppression in Crops: Systematic Review and Meta-Analysis	Agronomy Journal 110, 6, 2211-2221	10.2134/agronj2017.12.0752
Ref29	Winter, S; Bauer, T; Strauss, P; Kratschmer, S; Paredes, D; Popescu, D; Landa, B; Guzman, G; Gomez, JA; Guernion, M; Zaller, JG; Batary, P	2018	Effects of vegetation management intensity on biodiversity and ecosystem services in vineyards: A meta-analysis	J APPL ECOL	10.1111/1365-2664.13124

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