SINGLE-IMPACT FICHE
COVER AND CATCH CROPS

IMPACT: SOIL EROSION

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 SOIL EROSION. It is based on 5 synthesis papers[1], including from 10 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 EROSION 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 EROSION is positive (i.e. decrease soil erosion), with 4 results out of 6 indicating a significant decrease in soil erosion.
- One synthesis paper reported uncertain results (i.e. reporting quantitative results without statistical test of the effects).
- The positive effect is confirmed for both leguminous and non-legume cover crops, as well as for cover crops (all types and mixed-species) or natural vegetation cover in orchards/tree crops.

Out of the 5 selected synthesis papers, 4 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 soil erosion	Soil erosion	Cover crops	Bare soil	4	0	1	1
		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 5 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 erosion. 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	Tree crops (orchards)	Global	85	1) Cover crops; 2) Legume cover crops; 3) Non-	Clean tillage management	1) Runoff reduction; 2) Soil loss	Cover cropping showed significant efficiency in reducing runoff, soil	81%

[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
				legume cover crops		reduction	losses from tree-crops fields.	
Ref9	Plots distributed across 53 sites in seven provinces and one autonomous region, covering most areas of the red soil hilly region (RSHR), located in a subtropical monsoon climate. It is the most important strategic agricultural and economic region in China.	China	106	cover crop (Cc), grass cover (Gr)	no cover	1) Runoff; 2) Soil loss	Cover crops and grass cover had significant reduction effect with respect to both runoff and soil loss ($p < 0.05$).	69%
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	Soil erosion	Cover crops significantly decreased soil erosion.	62%
Ref20	Mediterranean agro-ecosystems	Mediterranean agroecosystems	10	Cover crops	No cover crops	Sediment formation	The sample size for mulching, cover cropping, and organic weed management was less than eight and no statistical analysis was carried out. Therefore, the result was set as 'uncertain'.	62%
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) Soil loss; 2) Erosion-related parameters;	Soil loss was strongly reduced (-162 %) by using cover crops instead of bare soil management. Other general erosion-related soil parameters (Water retention; Topsoil penetration resistance; Aggregate stability; Saturated hydraulic conductivity) showed no significant effects.	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 soil erosion	Soil erosion	Cover crops	Bare soil	Ref3, Ref9, Ref10 and Ref29		Ref29	Ref20
		Legume cover crops	Bare soil	Ref3			
		Non-legume cover crops	Bare soil	Ref3			

3. FACTORS INFLUENCING THE EFFECTS ON SOIL EROSION

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

Factor	Reference number
Slope gradient	Ref3
Vegetation coverage	Ref3

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
Ref3	Liu, R; Thomas, B; Shi, XJ; Zhang, XL; Wang, ZC; Zhang, YT	2021	Effects of ground cover management on improving water and soil conservation in tree crop systems: A meta-analysis	CATENA 199, 105085	10.1016/j.catena.2020.105085
Ref9	Chen J., Xiao H., Li Z., Liu C., Ning K., Tang C.	2020	How effective are soil and water conservation measures (SWCMs) in reducing soil and water losses in the red soil hilly region of China? A meta-analysis of field plot data	Science of The Total Environment 735, 139517	10.1016/j.scitotenv.2020.139517
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
Ref20	Lee, H; Lautenbach, S; Nieto, APG; Bondeau, A; Cramer, W; Geijzendorffer, IR	2019	The impact of conservation farming practices on Mediterranean agro-ecosystem services provisioning-a meta-analysis	REG ENVIRON CHANGE	10.1007/s10113-018-1447-y
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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