

Note to the reader: This fiche summarises the effects of Landscape features on PESTS AND DISEASES. It is based on 5 synthesis papers¹, including from 35 to 121 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effect on pests and diseases differs among landscape features.

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.

- Landscape features in general (hedgerows, field borders and lands taken out of production pooled together as percentage of natural area) have a significantly positive effect on the abundance of natural enemies and disease control and a non-significant effect on the abundance, diversity, population growth of pests or plant damage compared to agricultural lands without or with lower percentage of semi-natural habitat features, according to 2 synthesis papers.
- Field margins have a significant positive effect on pests and diseases (i.e. decrease of pests and diseases) compared to cropland or grassland without field margins, according to 2 synthesis papers.
- Flower strips have a significantly positive effect on pests and diseases compared to cropland or grassland without flower strips, according to 1 synthesis paper.
- Hedgerows have differing effects on pests and diseases compared to cropland without hedgerows. 3 synthesis papers reported a non-significant effect while 2 reported a significant positive effects.

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.

Impact	Metric	Intervention	Comparator	Statistically tested			Non-statistically tested
				Significantly positive	Significantly negative	Non-significant	
Decrease pests and diseases	Pest control	Field margins	No field margins	2	0	0	0
		Flower strips	No flower strips	1	0	0	0
		Hedgerows	No hedgerows	2	0	3	0
		Landscape features in general	No semi-natural habitat features	1	0	1	0
Decrease pests and diseases	Pests and diseases	Landscape features in general	No semi-natural habitat features	1	0	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

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.

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 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
Ref5	Cropland	North America, Europe, New Zealand	35	1) Flower strips; 2) Hedgerows	1) No flower strips; 2) No Hedgerows	Natural pest control service	This synthesis demonstrates enhanced natural pest control services to crops adjacent flower strips plantings but not adjacent to hedgerows, across a broad suite of regions, cropping systems and types of flower strips studied.	62%
Ref16	Terrestrial landscapes in rural, agricultural, mixed rural-urban or natural habitats regions	Global	121	High landscape complexity (percentage of natural area)	Low landscape complexity (percentage of natural area)	1) Natural enemies (natural enemy abundance, richness, diversity, and direct effects on pest reduction) ; 2) disease control (disease prevalence, host and vector abundances, infection levels); 3) pest response (pest abundance, richness, and damage)	The percentage of natural areas had positive effect on disease control and natural enemies, while it has no effect on the loss of pests' response. The meta-analyses reinforce the importance of considering landscape structure in assessing ecosystem services for management purposes and decision-making.	81%
Ref20	Arable crops	Global (temperate climate)	60	1) Grass strips; 2) Hedgerows	1) No grass strips; 2) No hedgerows	1) Predator density; 2) Predator diversity; 3) Aphid density	Predator diversity and density are significantly higher and aphid density was reduced in the grass strips systems. Hedgerows increased predator diversity.	75%
Ref27	Fields, orchards, and vineyards of food crops	Global	46	High compositional complexity (landscape complexity: proximity or proportion of non-crop or natural habitats in the landscapes surrounding food crops; or local complexity: proximity or diversity of non-crop plants in margins of food crops)	Low compositional complexity	Abundance and richness of crop pest natural enemies	Some pollinators and natural enemies seem to have compatible responses to complexity, and it might be possible to manage agroecosystems for the benefit of both.	81%
Ref30	Farmlands	Global	46	1) % natural habitats ; 2) Length woody edges	1) No natural habitats; 2) No woody edges	1) Natural enemies; 2) Pests	The positive response of natural enemies does not necessarily translate into pest control, since pest abundances show no significant response to landscape complexity.	81%

Table 3: Reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**.

Impact	Metric	Intervention	Comparator	Statistically tested			Non-statistically tested
				Significantly positive	Significantly negative	Non-significant	
Decrease pests and diseases	Pest control	Field margins	No field margins	Ref20 and Ref27			
		Flower strips	No flower strips	Ref5			
		Hedgerows	No hedgerows	Ref20 and Ref30	Ref5, Ref20 and Ref30		
		Landscape features in general	No semi-natural habitat features	Ref30	Ref30		
Decrease pests and diseases	Pests and diseases	Landscape features in general	No semi-natural habitat features	Ref16	Ref16		

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
Distance to field edge	Ref5

4. KNOWLEDGE GAPS

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

Ref Num	Gap
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Ref Num	Gap
Ref20	To quantify and predict pest control on agricultural parcels, a very comprehensive analysis of both species spatial distribution, mobility and lifecycle, at parcel and landscape levels is necessary.
Ref27	The authors identified the interactions between pollinators and natural enemies and their interacting effects on crop productivity as knowledge gaps.

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
Ref5	Albrecht, M; Kleijn, D; Williams, NM; Tschumi, M; Blaauw, BR; Bommarco, R; Campbell, AJ; Dainese, M; Drummond, FA; Entling, MH; Ganser, D	2020	The effectiveness of flower strips and hedgerows on pest control, pollination services and crop yield: a quantitative synthesis	ECOLOGY LETTERS, 23(10), 1488-1498.	10.1111/ele.13576
Ref16	Duarte, GT; Santos, PM; Cornelissen, TG; Ribeiro, MC; Paglia, AP	2018	The effects of landscape patterns on ecosystem services: meta-analyses of landscape services	LANDSCAPE ECOLOGY, 33(8), 1247-1257.	10.1007/s10980-018-0673-5
Ref20	Van Vooren, L; Reubens, B; Broekx, S; De Frenne, P; Nelissen, V; Pardon, P; Verheyen, K	2017	Ecosystem service delivery of agri-environment measures: A synthesis for hedgerows and grass strips on arable land	AGRICULTURE ECOSYSTEMS AND ENVIRONMENT, 244 32-51.	10.1016/j.agee.2017.04.015
Ref27	Shackelford, G; Steward, PR; Benton, TG; Kunin, WE; Potts, SG; Biesmeijer, JC; Sait, SM	2013	Comparison of pollinators and natural enemies. A meta-analysis of landscape and local effects on abundance and richness in crops	BIOLOGICAL REVIEWS, 88(4), 1002-1021.	10.1111/brv.12040
Ref30	Chaplin-Kramer, R; O'Rourke, ME; Blitzer, EJ; Kremen, C	2011	A meta-analysis of crop pest and natural enemy response to landscape complexity	ECOLOGY LETTERS, 14(9), 922-932.	10.1111/j.1461-0248.2011.01642.x

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