FARMING PRACTICE
COVER AND CATCH CROPS

IMPACT: SOIL BIOLOGICAL QUALITY

Reference 6

Puissant, J; Villenave, C; Chauvin, C; Plassard, C; Blanchart, E; Trap, J 2021 Quantification of the global impact of agricultural practices on soil nematodes: A meta-analysis SOIL BIOLOGY & BIOCHEMISTRY, 161, 108383 10.1016/j.soilbio.2021.108383

Background and objective

Agricultural practices significantly affect soil biodiversity and functions, altering biogeochemical cycles and potentially compromising food production. Increased employment of sustainable agricultural practices is of growing policy concern and requires a better understanding and quantification of how agriculture affects soil functioning. Quantify the effect of agricultural practices on soil nematodes, known to be key biological indicators of soil health. This meta-analysis summarized the effects of tillage, pesticides use, fertilization, manipulation of above-ground plant including cover crop, rotation and agricultural system shift (the conversion from the conventional to conservation or organic agriculture systems). Here we report only the results regarding the conversion of conventional systems to organic.

Search strategy and selection criteria

The authors conducted a literature search, last updated in October 2019, using the Web of Science (Thomson Reuters) search engine. Studies investigating the effect of agricultural practices on soil nematodes. Studies should include nematode data and evaluate the effects of at least one of the four main agricultural practices (manipulation of plant diversity, pesticide use, tillage, fertilization) or those of different types of agricultural systems ("system") on the nematode community. Here we report only data regarding organic farming systems as compared to conventional systems. (1) Data should be available in the articles either in table or in graphical forms. In the case of graphics, the programme GetData Graph Digitizer (version 2.26 http://getdata-graph-digitizer.com/), was used to extract data from figures. (2) Nematode data should be a measurement of the abundance of nematode trophic groups, that is bacterial feeding (BF), fungal feeding (FF), omnivores and predators (OP) and plant feeding nematodes (PF), and/or nematode diversity and/or nematode indices. Diversity indices were taxonomic richness (S) and Shannon diversity (H'). Nematode indices were the maturity index (MI), plant-parasitic index (PPI), structure index (SI), enrichment index (EI), and nematode channel ratio (NCR). Studies had to report at least one of the abovementioned nematode parameters to be included in this synthesis. (3) Studies needed to evaluate the effect of the conversion of conventional agriculture to organic agriculture. Conventional systems use pesticide, mineral fertilizers and tillage. Organic agriculture does not use synthetic pesticide and mineral fertilizers. Tillage is used for weed management. (4) The samples should be collected from the topsoil layer (soil depth between 0 and 30 cm maximum). (5) Studies needed to report means ($\bar{X}$), standard deviations (SD) or standard errors (SE) and sample size (n, number of true replications) of nematode variables in control and treatment groups. When SD, SE or sample size were missing, articles were discarded as these data are required to compute the effect size. A total of 103 articles, i.e. 30% of articles, met these inclusion criteria and were used in the meta-analysis, corresponding to a total of 1338 unique observations (control + treatment, Fig. 2).

Data and analysis

The authors used a multilevel meta-analysis model (mixed model) run with the "rma.mv" function from the Metafor package (Viechtbauer, 2010). The model was fed calculated effect sizes and sampling variances (as described above) and fitted via restricted maximum-likelihood estimation. As we obtained multiple effect size values per study (e.g., several sampling dates), we used a mixed model with "study identification" (study ID) as a random factor to take into account the dependencies among estimates from the same study. To estimate the overall effect of agricultural practices on nematode variables under investigation, we first ran a random-effects model without any moderator variables. The responses of the nematode community parameters were statistically significant if the 95% confidence intervals of the agricultural effects did not overlap zero.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
103	Not specified	Cover crops	Bare soil	Metric: Soil nematodes: 1) Total density; 2) Abundance of bacterial feeders; 3) Abundance of fungal feeders; 4) Abundance of omnivore-predators; 5) Abundance of plant feeders; 6) Taxonomy richness; 7) Shannon diversity index; 8) Maturity index; 9) Plant parasite index; 10) Nematode channel ratio; 11) Enrichment index; 12) Structure index; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	0.9375

Results

- The authors found positive effects of cover crop on the total nematode abundance (+45.3%), as well as on bacterial-feeders (BF, +101.0%) and plant feeders (+79.6%) abundances. No effect for fungal feeders and omnivore-predators.
- The introduction of legumes (Fabaceae) to the cropping system was not found to be a significant moderator.
- NULL
- NULL
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

The authors found positive effects of cover crop on the total nematode abundance (+45.3%).