FARMING PRACTICE
COVER AND CATCH CROPS

IMPACT: SOIL BIOLOGICAL QUALITY

Reference 12

Kim, N; Zabaloy, MC; Guan, KY; Villamil, MB 2020 Do cover crops benefit soil microbiome? A meta-analysis of current research SOIL BIOLOGY & BIOCHEMISTRY, 142, 107701. 10.1016/j.soilbio.2019.107701

Background and objective

Because cover cropping can form an agroecosystem distinct from that of bare fallow, the soil microbiome is hypothesized to respond to the altered environmental circumstances. Despite the growing number of primary literature sources investigating the relationship between cover cropping and the soil microbiome, there has not been a quantitative research synthesis that is sufficiently comprehensive and specific to this relationship. The goal was to conduct a comprehensive meta-analysis to fill this gap of knowledge in cover cropping research. Specifically, this meta- analysis assessed whether i) soil microbial abundance, activity, and diversity differ under cover cropping compared to bare fallow, and whether ii) cover cropping effects on soil microbiome are dependent to environmental or managerial factors. Here, only results regarding the effect of green manures on soil microbial abundance and activity are reported.

Search strategy and selection criteria

From September 2018 to March 2019, the authors searched for relevant peer reviewed articles in Web of Science, SCOPUS, and Google Scholar. We used search terms generated from combinations of: scientific names of cover crop species, known measures of soil microbial properties, and methodology terms. This collection was refined for studies that met the criteria for this meta-analysis: i) experimental design allowed pairwise com- parison between cover cropping treatments and bare fallow controls, ii) defined cover cropping as crops that are not harvested nor removed, thereby excluding studies with crop residues, iii) field or greenhouse studies, iv) the study reported sample sizes, means, and standard errors; if these statistics were not reported, authors were contacted or the sta- tistics were calculated if possible.

Data and analysis

With the study effect sizes and variances calculated, we used R package metafor and its function rma to calculate the global effect sizes, 95% confidence intervals (CI), and total between-study hetero- geneity (I2) (Viechtbauer, 2010). Function funnel was used to produce the funnel plots for each soil microbial parameters to visually check significant heterogeneity and publication bias. Data only presented in figures were extracted using WebPlotDigitizer (Version 3.9; Rohatgi, 2015).

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
60	Arable crops	Cover crops	Bare soil with the same treatments than in the intervention	Metric: soil microbial abundance; soil microbial activity; soil microbial diversity; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	87.5

Results

- Global cover cropping effect size means were significantly larger than zero for all soil microbial properties.
- Global effect size means of soil microbial abundance parameters (CFU, MBC, MBN, and PLFA) ranged between 0.14 and 0.41, and activity parameters (BG, Phos, and CO2–C) ranged between 0.14 and 0.35. Global effect sizes for diversity parameters (OTU, H′, S, J, and 1-D) were also positive but much smaller, ranging from 0.003 to 0.05.
- NULL
- NULL

Factors influencing effect sizes

- Climate : For microbial biomass carbon, effect size means by climate varied significantly in the order of tropical (0.87), temperate (0.30), arid/semi-arid (0.19), and continental (0.08), from highest to lowest. Overall, the continental climate had lower effect size means than others.
- Termination type : Cover crop termination method had significant effects only on PLFA, where mechanical termination effect size mean (0.16) was significantly larger than that of chemical termination (0.09).
- Fertilizer rate : NA
- Soil type : Less fertile soils like Oxisols, Ultisols, and Entisols had larger effect size means than those of more fertile soils.

Conclusion

Overall, cover cropping significantly increased parameters of soil microbial abundance, activity, and diversity by 27%, 22%, and 2.5% respectively, compared to those of bare fallow.