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Muhammad, I., Sainju, U.M., Zhao, F., (...), Fu, X., Wang, J. 2019 Regulation of soil CO₂ and N₂O emissions by cover crops: A meta-analysis Soil and Tillage Research 192, pp. 103-112 10.1016/j.still.2019.04.020

Background and objective

Cover crops provide multiple agronomic and environmental benefits, such as enhanced soil carbon sequestration, aggregation, water infiltration, and reduced erosion and nutrient leaching compared with no cover crop. However, little is known regarding the effect of cover crop species, biomass quality and quantity, and method of residue placement on greenhouse gas (GHG) emissions. The objectives were to: 1) quantify the effect of cover crop characteristics and residue management on CO₂ and N₂O emissions in various regions with different soil and climatic conditions, 2) determine which cover crop management practice can reduce GHG emissions. Here, only results regarding the effect of green manures on SOC are reported.

Search strategy and selection criteria

Peer-reviewed research articles published before June 2017 were searched in Google Scholar and Web of Science with the following keywords and phrases: "nitrous oxide emissions, carbon dioxide emissions, greenhouse gas emissions, cover crop, green manure, or catch crop". Only studies that reported both N₂O and CO₂ emissions, cover crops grown between harvesting and planting of cash crops, and cash crops with similar management practices, such as irrigation, fertilization, and tillage practices were selected for the study. Studies that lack mean values, replications, and standard error or standard deviation of the mean were discarded.

Data and analysis

All graphical results were conducted using GetData graph digitizer 2.26. The authors used a random model MetaWin 2.1 to compute the mean effect size and generate 95% bootstrapped confidence intervals (CIs).

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
48	Arable crops	Cover crops (legume/non-legume; incorporated/surface/removed)	Bare soil with the same treatments than in the intervention	Metric: Soil organic carbon; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	62.5

Results

- The RRs of cover crops compared to no cover crop were positive for SOC. Cover crops increased SOC by 15% compared to no cover crop.
- Incorporation of cover crop residue into the soil increased SOC, while having no effect on SOC with residue removal.
- The mixed cover crop resulted in a higher SOC than legume or nonlegume cover crop.
- NULL
- NULL

Factors influencing effect sizes

- Cover crop type : The mixed cover crop resulted in a higher SOC than legume or nonlegume cover crop.
- Cover crop residue management : Incorporation of cover crop residue into the soil increased SOC compared to residue removal.

Conclusion

Cover crops increased SOC by 15% compared to no cover crop. Incorporation of cover crop residue into the soil increased SOC, while having no effect on SOC with residue removal.