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Thapa R, Mirsky SB, Tully KL 2018 Cover Crops Reduce Nitrate Leaching in Agroecosystems: A Global Meta-Analysis *Journal of Environmental Quality* 47, 6, 1400-1411 10.2134/jeq2018.03.0107

Background and objective

Cover crops are well recognized as a tool to reduce NO₃⁻ leaching from agroecosystems. However, their effectiveness varies from site to site and year to year depending on soil, cash and cover crop management, and climate. (i) to assess the overall effect of cover crops on NO₃⁻ leaching and subsequent crop yields, and (ii) to examine how soil, cash and cover crop management, and climate impact the effect of non-leguminous cover crops on NO₃⁻ leaching.

Search strategy and selection criteria

We conducted a search of primary articles that compared NO₃⁻ leaching losses between cover crop and no cover crop treatments using the ISI Web of Science (Thompson Reuters) database. The following search terms were used for the literature survey: ('cover crop' OR 'green manure' OR 'catch crop' OR 'rye' OR 'oat' OR 'vetch' OR 'clover' OR 'winter') AND ('nitrate leach' OR 'nitrogen leach' OR 'leach' OR 'drain*'). This search produced 237 articles published in scientific journals from 1931 to 2017. 238 observations from 28 studies. (i) the study compared winter cover crop treatments with no cover crop (control); (ii) NO₃⁻ leaching was measured during at least the cover crop growth period or for the entire year (during both cover crop and cash crop phases); (iii) cumulative NO₃⁻ leaching was calculated using both NO₃⁻ concentrations in the soil solution and the drainage volume; (iv) the study was conducted under natural field conditions (i.e., model-based simulation and indoor lysimeter studies were excluded); (v) all other factors (soil, management, and climate) for each pairwise comparison between no cover crop and cover crop treatments were the same; and (vi) the experimental design, approach, and sampling protocols were clearly described. We excluded studies in which the potential risk of NO₃⁻ leaching was assessed by comparing profile soil N over the cover crop season. Studies with a long history of pasture prior to the experimental year were also excluded because of the potential legacy effect of previous pasture or forage crops on NO₃⁻ leaching that could mask the true cover crop effect. Similarly, studies that were conducted on recently constructed drainage lysimeters or monoliths using disturbed soils were also discarded because the disturbed soil structure in these monoliths could influence drainage characteristics and, hence, NO₃⁻ leaching. We also excluded studies in which the treatment combinations impeded sole comparison between no cover crop and cover crop treatments.

Data and analysis

The authors used an alternative weighting technique based on experimental replications. we employed a cluster-based robust variance estimation technique (clustering on site) using the clubSandwich package to estimate robust SEs for mean effect sizes (Pustejovsky, 2017). Using robust SEs, we calculated the 95% confidence interval (CI) for the weighted natural log mean effect sizes [ln(R)]. For ease of interpretation, ln(R) values were back-transformed to mean effect sizes and expressed as percentage change in response due to cover crop treatments. The mean effect sizes for each response variable were considered significantly different from the controls (p < 0.05) only if the 95% CI did not include zero.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
28	Arable fields with cereal crops	Cover crop (nonleguminous, leguminous, and nonlegume-legume cover crop mixtures). Nonleguminous cover crops included both grasses and broadleaves.	No cover crops	Metric: Cash crop yield; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	87.5

Results

- There was no significant effect of cover crops (either leguminous or non-leguminous) on subsequent crop yields.
- NULL
- NULL
- NULL
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

There was no significant effect of cover crops (either leguminous or non-leguminous) on subsequent crop yields.