FARMING PRACTICE
ORGANIC FARMING SYSTEMS

IMPACT: BIODIVERSITY

Reference 7

Smith, OM; Cohen, AL; Rieser, CJ; Davis, AG; Taylor, JM; Adesanya, AW; Jones, MS; Meier, AR; Reganold, JP; Orpet, RJ; Northfield, TD; Crowder, DW 2019 Organic Farming Provides Reliable Environmental Benefits but Increases Variability in Crop Yields: A Global Meta-Analysis. FRONTIERS IN SUSTAINABLE FOOD SYSTEMS 3. 10.3389/fsufs.2019.00082

Background and objective

While many studies address the mean effects of ecologically intensive farming systems on sustainability metrics, few have considered variability. This represents a knowledge gap because producers depend on reliable provisioning of yields, profits, and environmental services to enhance the sustainability of their production systems over time. The objective of this meta-analysis is to assess the mean and variability of seven sustainability metrics from paired comparison studies of organic and conventional systems.

Search strategy and selection criteria

Data were leveraged from from prior meta-analyses that reported means and standard deviations for paired organic and conventional systems related to the seven metrics of sustainability (biotic abundance, biotic richness, soil organic carbon, soil carbon stocks, crop yield, total production costs, and profitability). Estimates were gathered from the meta-data, which included one metric of mean and standard deviation averaged across replicates and years for each crop and/or organism measured in each study.

Data and analysis

Once log response-ratio effect sizes were calculated, one-sample t-tests were used to determine whether the mean effect sizes for each sustainability metric, and associated variability, differed between conventional and organic sites. In parallel with the t-tests, 90% confidence intervals were calculated for each metric examined by adding and subtracting from the mean the standard error multiplied by the critical t-value at an a of 0.10 for a two-tailed test.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
9	Previous meta-analyses assessing the performance of organic systems in comparison to conventional systems.	Organic systems (annual and perennial crops)	Conventional systems	Metric: Biotic abundance and richness; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control.	56.25

Results

- Compared to conventional sites, organic sites had greater (i.e., log response ratio > 0) mean biotic abundance and richness.
- For biotic abundance and richness, organic sites had higher mean effect sizes for all organismal and functional groups, except microbial richness, herbivore abundance, and decomposer richness, which were similar for both management systems.
- Evaluation of covariates suggests the findings are quite robust.
- Compared to conventional sites, organic sites had lower variability (i.e., CV response ratio < 0) in biotic abundance and richness. Standard deviations in biotic abundance and richness were generally greater on organic farms, but the magnitude of this difference was small in comparison to the large difference in mean biotic abundance and richness in the two farming systems.
- Systems with high levels of richness had the least variable richness.

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Higher mean biotic abundance and richness and lower variability (in biotic abundance and richness) in organic systems than in conventional systems.