

Effects of Biodynamic Preparations: A Network Meta-Analysis

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Abstract

Biodynamic (BD) preparations are central elements of biodynamic farming, yet their agronomic efficacy remains debated. To address this, we conducted a meta-analysis of field trials evaluating the yield response to BD preparations. Based on a systematic search strategy, we compiled data from 54 field trials reported in 36 independent studies across nine countries and four continents, spanning from 1977 to 2023. All analyses were conducted on the natural logarithmic scale and followed a random-effects model weighted by the inverse of the squared standard error. Our results indicate a significant yield increase under BD treatment compared to untreated controls (mean effect: +3.7%, 95% CI: 1.6–5.8%, $p = 0.0009$).

Background and Aims

The biodynamic preparations are a core feature of biodynamic management and distinguish this method from other organic farming approaches. Scientifically spoken, the preparations are intended to support plant health and plant growth on a systemic level. As the rationale of the preparations is rooted in Anthroposophy and contains a lot of hypotheses that lack scientific validation until now, there has been much debate about this practice. Scientific results on preparation effects are heterogenous, leading authors to different conclusions. However, a sophisticated meta study has not been conducted until now. We fill this gap and present results from a meta analysis of published peer-reviewed articles on preparation effects on plant and soil properties.

Methods

The dataset builds on a previous compilation by Alain Morau (unpublished) and includes only peer-reviewed publications and doctoral dissertations. We expanded the literature search to include studies through August 2023 using Web of Science, Google Scholar, and regional databases. To ensure consistency and data reliability, only those trials that fulfilled defined inclusion criteria regarding treatment composition, experimental design, data accessibility, publication status, availability of yield data, and temporal scope were considered eligible for this meta-analysis.

We limited our search to studies published from 1980 onwards 2023 August. This cut-off point was chosen to reflect changes in agricultural practices, the standardisation of BD treatment protocols, and improvements in experimental design over time. Although this approach ensures relevance to modern conditions, earlier trials that could have provided additional historical context may be excluded.

We examined the data set using a factorial ANOVA framework (Piepho et al. 2012). All analyses were performed on the natural log scale (Hedges et al. 1999), and we applied a random-effects model that weights each observation by the inverse of its squared standard error.

Results and Discussion

A total of 54 trials (from 36 independent studies) were conducted across 3 of the 4 major climatic zones and on 4 of the 7 continents, spanning 9 countries. The experiments ran from 1977 to the present, with individual trial durations ranging from 1 to 28 years (mean = 3.9 years; median = 1.5 years).

At the writing of this article we did only finalize the evaluation of preparation effects on crop yields. However, other effects will be presented in detail at the conference and in the intended publication.

Crop yields were slightly (aprox. 4%) but significantly ($p < 0.05$) improved by the application of the biodynamic preparations.

Interpreting the effect, it must be considered that a bias may arise from the fact that we expect the preparations to regulate plant health and growth in a most beneficial way. This regulation must not always result in an increase of yields, but could also decrease yields under certain circumstances, when the environmental conditions or individual properties of the plants rather require a moderation of processes. However, we did not find a valid way to test this hypothesis in our meta study.

Another drawback is that we could not include studies on preparation effects on the microbiome (Milke et al. 2023). Microbiome effects may be a key to the comprehension of the preparations, as they provide a link between the anthroposophical rationale and possible scientific explanations of an impact of the preps. Unfortunately, there are too few studies for a meta analysis of this pathway until now – this must be left to future research.

Conclusions

In our very robust meta analysis we observed a significant positive effect of the biodynamic preparations on crop yields. Even though the effect size was small, it is a clear proof of the existence of a preparation effect according to the expectation. This justifies further research in the biodynamic preparations, which is a very interesting challenge from a scientific point of view.

References

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