FARMING PRACTICE
ORGANIC FARMING SYSTEMS

IMPACT: PESTS AND DISEASES

Reference 6

Katayama, N; Bouam, I; Koshida, C; Baba, YG 2019 Biodiversity and yield under different land-use types in orchard/vineyard landscapes: A meta-analysis. Biological Conservation 229: 125-133. 10.1016/j.biocon.2018.11.020

Background and objective

Continuous growth in the human population poses a critical challenge to the maintenance of global food production with minimal loss of biodiversity. This study provides the first meta-analysis comparing the three measures of biodiversity (taxon richness, abundance, and community similarity) and yield among different land management regimes in orchard/vineyard landscapes.

Search strategy and selection criteria

The ISI Web of Knowledge was searched on 31 March 2017 using the following combinations of terms: (1) biodiversity OR richness OR abundance OR density OR yield; (2) orchard* OR vine- yard*; and (3) conventional OR intensive OR abandoned OR extensive OR organic OR biotic OR biodynamic OR* -friendly OR agri-environment* OR IPM OR IBM OR reduced-risk OR mating disruption (see details in Appendix A). To be included in the meta-analysis, each study had to be written in English. To estimate taxon richness and community similarity, a study had to provide raw data on the abundance or occurrence frequency of more than three taxonomic groups (at the species, genus, or family level) in two or more of the five land management regimes. To be included in the analyses of taxon abundance and yield, a study had to report the mean abundance/yield, its variance (standard deviation [SD], standard error [SE], or 95% confidence interval), and sample size ($n > 1$) in two or more of the five land management regimes for abundance or of the three (Con, Int, and Org) for yield.

Data and analysis

Response variables were the log response ratio of rarefied and observed richness. The mean effect size was calculated using an intercept model (i.e., no explanatory variable) with the name of the publication as a random effect. The uncertainty in the intercept coefficients was given by 95% confidence intervals (CIs). For taxon abundance and yield with variance ($n > 1$), a hierarchical meta-analysis was conducted by fitting a hierarchical Bayesian linear model (HBLM). The response variable was the log response ratios of taxon abundance and yield in each pair of land management regimes. The mean effect size was calculated using an intercept model with the name of the publication as a random effect. The uncertainty in the intercept coefficients was given by 95% credible intervals (CIs). We estimated $I2$, the proportion of total variance that is due to true heterogeneity among effect sizes. For the pairs with > 30 samples (Con vs. Org for richness, Con vs. Int/Org for abundance, Con vs. Org for yield), the effects of following explanatory variables were estimated: region (e.g., Europe, the Americas), crop type (e.g., apples, grapes), taxonomic group (e.g., in- vertebrates, microbes), functional group (e.g., natural enemies, con- sumers), sampling unit (plot or orchard scale), survey duration (within a year or multiple years), and publication year.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
53	Studies assessing the performance of organic in comparison to conventional perennial orchards and vineyards.	Organic orchards and vineyards	Conventional systems	Metric: Natural enemies taxon richness; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control.	93.75

Results

- Europe and the Americas were the dominant regions for all the pairs of land management regimes, comprising 60–100% of each dataset. Apples were the dominant crop type for all the pairs, followed by grapevines or olives.
- Invertebrates were the major taxonomic group examined, followed by microbes or vertebrates, mainly birds. For functional groups, natural enemies, followed by decomposers or consumers (mostly crop pests), were the dominant groups, although studies focusing on consumers were only in the abundance dataset.
- Compared to that of Con, rarefied richness was on average 11% (95% CI: 3–20%) higher in Int, 16% (6–27%) higher in Org, and 24% (0–54%) higher in Aba. The other two pairs (Int vs. Org and Con vs. Nat) had small sample sizes, and the 95% CIs overlapped zero. There was no significant effect of any explanatory variable on the effect size for Con vs. Org.
- Compared to that of Con, taxon abundance was on average 51% (95% CI: 20–91%) higher in Org and 34% (13–106%) higher in Nat. There was high variability in the effect sizes across the studies ($I2 > 95\%$ for all five pairs). There was no significant effect of region, year, taxonomic group, or spatial scale on the effect sizes.
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Organic farming significantly restored both biotic richness and abundance in orchards and vineyards, including a variety of (dis)service-providing organisms.