FARMING PRACTICE
ORGANIC FARMING SYSTEMS

IMPACT: PESTS AND DISEASES

Reference 28

Garratt, MPD; Wright, DJ; Leather, SR. 2011 The effects of farming system and fertilisers on pests and natural enemies: A synthesis of current research AGRICULTURE ECOSYSTEMS & ENVIRONMENT 141, 261-270. 10.1016/j.agee.2011.03.014

Background and objective

Organic agriculture can increase arthropod diversity but the response of pests and their natural enemies is variable. Fertiliser is an important component of agricultural systems and its effects on pests and natural enemies will influence agroecosystems. To compare farming system (organic and conventional) and fertiliser effects on arthropod pests and their natural enemies.

Search strategy and selection criteria

The scientific literature search engine 'Web of Knowledge' was utilised using the search words 'organic', 'conventional', 'farming system', 'fertiliser/fertilizer', 'pest' and 'natural enemies'. A systematic search of appropriate paper reference lists was also made. Only peer reviewed literature was included in the analysis. Studies were included in this meta-analysis if they compared conventional farming systems with organic farming systems with respect to invertebrate crop pest or natural enemy biology. A treatment was considered 'organic' when the use of synthetic fertilisers or chemical pesticides was not permitted. The treatment did not have to have organic status which imposes many limitations on the land management history. Consequently, many of the treatments involved in the meta-analyses were not termed 'organic' but 'biorational', 'biological' or 'low intensity' farming methods.

Data and analysis

The effect size Hedges' d was used for these meta-analyses and is calculated from the mean, standard deviation and sample size from each study. In many cases these were provided in the text or data tables. In other instances information was taken from graphs using Image Jtm or calculated from standard errors or raw data. For analysis, effect sizes calculated as Hedges' d were incorporated into random-effects models. Additionally, for each meta-analytical model a within and between category Q statistic was calculated. For this investigation a vote-counting techniques involving the response direction (+ or –) was used. Studies were divided into one of two categories, a positive response to organic farming or fertiliser or a negative response. A binomial test was then used to test if the number of positive and negative responses might arise by chance alone at a significance level of $P < 0.05$.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
71	Studies assessing the performance of organic systems in comparison to conventional systems.	Organic systems	Conventional systems	Metric: Abundance, fecundity, development rate, size and damage. Pests and natural enemies of pests.; Effect size: Hedge g (standardized difference) comparing the considered metrics between intervention and control	56.25

Results

- Pests showed a significant increase in organic farming practices with a near 40% increase in the measured response and the heterogeneity of these responses was not significant (Q = 50.79).
- With a mean effect size of 0.33, natural enemy numbers, impact or performance, depending on the measured response, was on average over 30% greater under organic treatments.
- There was no significant mean effect of organic fertilisers on arthropod pests following the meta-analysis and there were no significant treatment effects on mean pest responses to organic or conventional fertiliser treatments when considered by taxonomic or feeding group.
- There was a significant positive effect of organic fertilisers on natural enemy responses.
- NULL

Factors influencing effect sizes

- Pests type : NA
- Crop type : NA
- Presence of pest management : NA
- Experiment scale : The scale of the experiments had an impact on the measured natural enemy response, with a significant positive mean effect size shown by natural enemies in farm scale studies (Fig. 2e). Field scale studies showed an opposing response although this was not significant.

Conclusion

Pest responses suggest that controlling pests in organic systems may be a limitation. Nonetheless, natural enemy abundance is higher in organic systems than in conventional systems