
Earthworms increase crop yield. But how? A meta-analysis

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It has often been observed that earthworm activity can increase plant growth and crop yield. However, the overall extent of this effect and the main pathways through which it is exerted are still unclear. Here we use meta-analysis to quantitatively synthesize the results of all published studies on earthworm-induced yield effects. We collected 467 data points from 60 studies that were published between 1910 and 2013. The studies were conducted on all continents except Antarctica, and included all main grain crops as well as pastures and other agricultural crops. Overall, we found that earthworm presence significantly increased crop yield by 26% and aboveground biomass by 24%. Earthworm effects were positively related to crop residue application rates and earthworm density. Aboveground biomass increased due to earthworm presence for grain crops (+33%), grasses (+24%) and pastures without legumes (+29%), but was not significantly increased for legumes or pasture with legumes. As legumes are able to provide their own N through symbiotic N fixation from the air, we further tested our dataset for N availability as a controlling factor for the earthworm effect. When N fertilizer application rates were lower than 30 kg N ha⁻¹ earthworms increased aboveground biomass by 18%, but at higher fertilization rates no significant effect was detected. We conclude that earthworms stimulate plant growth predominantly through increasing mineralisation of N from crop residue and/or soil organic matter. Our results therefore imply that earthworms are of particular importance to those farmers who can't - or won't - use nitrogen fertilizer.