



## Review article

# Long-term effects of organic amendments on soil fertility. A review

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**Abstract** – Common agricultural practices such as excessive use of agro-chemicals, deep tillage and luxury irrigation have degraded soils, polluted water resources and contaminated the atmosphere. There is increasing concern about interrelated environmental problems such as soil degradation, desertification, erosion, and accelerated greenhouse effects and climate change. The decline in organic matter content of many soils is becoming a major process of soil degradation, particularly in European semi-arid Mediterranean regions. Degraded soils are not fertile and thus cannot maintain sustainable production. At the same time, the production of urban and industrial organic waste materials is widespread. Therefore, strategies for recycling such organic waste in agriculture must be developed. Here, we review long-term experiments (3–60 years) on the effects of organic amendments used both for organic matter replenishment and to avoid the application of high levels of chemical fertilizers. The major points of our analysis are: (1) many effects, e.g. carbon sequestration in the soil and possible build-up of toxic elements, evolve slowly, so it is necessary to refer to long-term trials. (2) Repeated application of exogenous organic matter to cropland led to an improvement in soil biological functions. For instance, microbial biomass carbon increased by up to 100% using high-rate compost treatments, and enzymatic activity increased by 30% with sludge addition. (3) Long-lasting application of organic amendments increased organic carbon by up to 90% versus unfertilized soil, and up to 100% versus chemical fertilizer treatments. (4) Regular addition of organic residues, particularly the composted ones, increased soil physical fertility, mainly by improving aggregate stability and decreasing soil bulk density. (5) The best agronomic performance of compost is often obtained with the highest rates and frequency of applications. Furthermore, applying these strategies, there were additional beneficial effects such as the slow release of nitrogen fertilizer. (6) Crop yield increased by up to 250% by long-term applications of high rates of municipal solid waste compost. Stabilized organic amendments do not reduce the crop yield quality, but improve it. (7) Organic amendments play a positive role in climate change mitigation by soil carbon sequestration, the size of which is dependent on their type, the rates and the frequency of application. (8) There is no tangible evidence demonstrating negative impacts of heavy metals applied to soil, particularly when high-quality compost was used for long periods. (9) Repeated application of composted materials enhances soil organic nitrogen content by up to 90%, storing it for mineralization in future cropping seasons, often without inducing nitrate leaching to groundwater.

soil fertility / soil carbon and organic matter / organic amendments / long-term experiments