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Does improved soil quality generate higher crop yields?

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Recent legislative restrictions and the trend toward more sustainable agricultural farming systems are reducing the input of mineral fertilizers and pesticides. This implies a greater reliance on the self-regulating processes of the soil such as supply of nutrients, water regulation and disease suppression. Soil is greatly affected by many agricultural management practices, and sustainable land management is needed to build high-quality soils. Practices for enhancing soil quality include the use of animal manures and cover crops, good residue management, the use of crop rotations, application of composts, reduced tillage, etc. This research focuses on the use of farm compost. Applying compost can contribute to agricultural sustainability. When managed properly, compost provides a whole array of nutrients to soils, increases soil organic matter (SOM), improves water holding capacity and other physical properties of soil like bulk density, penetration resistance and soil aggregation, increases beneficial soil organisms, reduces plant pathogens and shows a beneficial effect on the growth of a variety of plants.

Over the last 15 years, soil quality has received great attention from soil scientists. Their main focus has been on defining the concept of soil quality and searching for reliable ways to evaluate soil quality. But soil quality only seems to be valuable when it is either linked to important soil functions, used to characterize (agro)ecosystems or used to predict sustainability or productivity. This study has a twofold aim: first, to assess the influence of farm compost on soil quality and second, to evaluate the causal relationship between soil quality and crop yields.

Evaluation of soil quality must integrate physical, chemical and biological indicators since the correct functioning of a soil depends on an immense number of physical, chemical and biological properties. This research uses soil bulk density, penetration resistance, aggregate stability (physical), total organic carbon (TOC), total nitrogen, pH and hot-water extractable carbon (HWC) (chemical) and earthworms, microbial biomass, ergosterol (estimate of soil fungal biomass) and nematodes (biological) as indicators to determine soil quality. Based on these soil parameters, a Soil Quality Index (SQI) will be calculated and the relation between this SQI and crop productivity will be discussed.

Our research was performed at a pre-established trial site. The experiment, started in 2004, combined a crop rotation of potatoes, fodder beet, forage maize and Brussels sprout with the addition of farm compost. Repeated applications of farm compost resulted in increased soil organic carbon content, hot-water extractable carbon, pH, earthworm and nematode numbers, microbial biomass-C, ergosterol concentration and reduced soil bulk density. Consequently, compost amendment resulted in a higher SQI. Our results confirm the potential benefits of farm compost application for soil quality by improving the physical, chemical and biological properties of the soil. Furthermore, the effect of farm compost on crop yields became significant for all crops after the fourth year of compost application and this effect persisted in the following three years (not for all crops), underscoring the ability of compost amendments to support crop yields over time. Despite these promising results, the causal relationship between the SQI and crop yields is not yet conclusive.