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Towards a more sustainable fertilization: Combined use of compost and inorganic fertilization for tomato cultivation

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ABSTRACT

The feasibility of using combined organic and inorganic fertilizers as an alternative to conventional inorganic fertilization was tested for tomato crops. To do this, two different composts (compost from a mixture of cow manure + alperujo + olive prunings and compost from sheep and goat manure) were added to an agricultural soil either, alone or along with inorganic fertilization, for tomato cultivation in greenhouse conditions. Conventional inorganic fertilization was used as reference. When used alone, the organic fertilizers led to lower N concentrations in leaves and fruits than the conventional inorganic fertilization. The combined use of compost and inorganic fertilizer, however, produced higher yields and better fruit quality than soils that underwent the respective inorganic treatment when used alone. In addition, soils with combined fertilization showed higher values of microbial biomass C, basal respiration and dehydrogenase activity than the respective inorganic treatment. The conjunctive use of compost and inorganic fertilizer made it possible to reduce inorganic fertilization by about 40% while obtaining similar fruit quality and amounts in addition to improving soil characteristics.

1. Introduction

Intensive cultivation and the failure to implement effective soil conservation practices have led to soil degradation and a decline in productivity because of excessive soil erosion, nutrient run-off and a decrease in stable soil organic matter. Efforts must be made to halt the decline in soil productivity and to restore the productivity of degraded soils in the shortest possible time. This could be achieved through proper management and recycling of organic wastes on land to protect agricultural soils. The efficient and effective use of organic wastes as soil conditioners and fertilizers constitutes one of the best means for maintaining and restoring soil productivity (Passarini et al., 2014; Kumar et al., 2014).

The utilization of organic wastes in agriculture depends on several factors, including the characteristics of the waste such as its organic matter, nutrient and heavy metal content, its energy value, the odor generated by the waste, its benefits to agriculture, its availability and the transportation costs and regulatory considerations. Although the importance of these factors can vary by type of organic waste, the considerations for use are similar for most organic wastes. Organic amendments affect soil properties in numerous and variable ways. These effects can be due to the intrinsic properties of the organic amendment (direct effect) or as a consequence of the beneficial effect of the organic amendment on the physical, chemical and biological properties of the soil (Stewart et al., 2000; Tejada et al., 2006, 2009). Organic wastes do several things to benefit the soil that synthetic fertilizer cannot do. First, they add organic matter, which improves the way water interacts with the soil. In sandy soils, organic wastes act as a sponge to help retain water in the soil that would otherwise drain down below the reach of plant roots, thus protecting the plant against drought. In clay soils, compost helps to add porosity to the soil, making it drain more easily so that it does not stay waterlogged and does not dry out into a brick-like substance. Organic wastes also inoculate the soil with vast numbers of beneficial microbes (bacteria, fungi, etc.) that promote the biological activity of the soil (Siddiqui et al., 2009; Jain et al., 2014). These microbes are able to extract nutrients from the mineral part of the soil and consequently make them available for plant uptake. Furthermore, when properly processed, organic wastes reduce soil-borne diseases without the use of chemical control (Pascual et al., 2000; Garcia et al., 2004; Suarez-Estrella et al., 2013). Beside nutrients, organic amendments add organic matter to the soil, contributing to the improvement of soil quality and fertility, as compared to the use of mineral fertilization alone.

The management of soil organic matter by using composted organic waste is the key for sustainable agriculture (Nyamangara et al., 2003). Several works have highlighted the beneficial effects of organic waste application for crop production. In addition to its

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