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Effect of increasing biochar doses on soil–plant–microbial functions and nutrient uptake of tomato

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Abstract

Agriculture is a continuously and dramatically changing system since the end of the 20th century. Productivity has exceptionally increased due to new technologies, mechanization, increased chemical use, specialization, and government policies that favoured maximizing production. In recent years, increasing consumer concern about issues such as food quality, environmental safety, and soil conservation has led to sustainable agricultural practices. "Sustainability" is defined as a set of farming practices that conserve resources and the environment without compromising human future needs (Kocsis et al., 2022). The use of organic fertilizers, such as animal manures and composted materials, has been proposed as the main tool of sustainable agriculture. Animal manures and plant-originated composts are valuable resources of soil nutrients, due to the fact, that they provide large amounts of macro-, meso- and micronutrients for crop growth and development. Besides this, they can provide low-cost, environmental-friendly alternatives to mineral fertilizers. Organic manures are essential substrates for the growth of various microorganisms in the soil, resulting in the decomposition of soil organic matter into available inorganic compounds for plants. Organic fertilizers on the other hand are becoming a rather limited source nowadays. Finding alternative solutions might have the upmost importance. Organic soil amendments are needed and ensuring not only the nutrient supplementation of crops but also to improve the chemical, physical and biological properties of the soils. One possible, but still less well-known way to improve soil's physical, chemical, and also biological conditions are the application of biochar products (Kocsis et. al., 2018). Its use has been increasing in the last decade and, according to the literature, biochar seems to be suitable for removing carbon from the carbon cycle and sequestrating it in the soil for a long period (up to a hundred years), thus mitigating the effects of global warming processes (Fekete et al., 2021). Biochar might be considered a recalcitrant industrial material, produced from organic wastes, under highly reductive conditions. Many organic materials can be used in the production, but it might be key important that used substances might come from environmentally and climate-friendly sources. Its characteristics are usually 2-5 mm size of black granulated material that can be used similarly to the synthetic, inorganic fertilizers (Kocsis et a., 2022). All of the biochar products might restore the natural balance of soils and might improve soil fertility parameters, furthermore in case of proper soil water content. It might improve crop production characteristics. This phenomenon is highly appreciated in environmental stressed conditions. Its usage can lead to changes in soil biota communities that are of interest but also of concern. In the quantitative development of the microbial community, not only Plant Growth Promoting Rhizobacteria (PGPR), which are favorable for cultivation, but also potential soil-borne pathogens may multiply (Papp et al., 2021). This refers to soils' suppressive or receptive properties against pathogens, to which biochar can contribute in both positive and negative ways. Soil microbes are increasingly appreciated as important drivers of vegetation structure and dynamics. With this aim, increased microbial biomass has been determined in biochar-treated soil with various testing methods. The widely known of these are molecular nucleic acid-based techniques, breeding and/or classical colony-counting method, substrate-induced respiration, fumigation extraction method, phospholipid fatty acid (PLFA) analysis, and microscopic examination of staining particles (Kocsis et al., 2022). On the other hand, the linear relationship between soil microbiological status and plant nutrient uptake is even less well-known. The aim of this study is to learn the effects of increasing biochar doses on the culturable soil microbiota and its interrelation with soil fertility in a slightly humus sandy soil (Arenosol). It is our aim also to find the optimal application doses of the used plant-coal biochar, simultaneously for the improvement of better yield quantity and also the fruit quality, i.e. the taste of tomato fruits, grown among organic environmental conditions.

Biography

Tamás Kocsis has his expertise in evaluation and passion for improving soil health and food safety. He is currently working as an Assistant Professor at the Hungarian University of Agriculture and Life Sciences in Budapest, Hungary. Tamás does research mainly in Microbiology Science, but also in Applied Sciences. He is actively exploring the effect of biochar (as a soil improver) on fertility and biological activity. In recent years, he has published several scientific publications on this topic.

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