EGU2020-8959
https://doi.org/10.5194/egusphere-egu2020-8959
EGU General Assembly 2020

Changes in soil nutrient content, biological activity and CO2 emission rate as a result of low-dose municipal sewage sludge compost application

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Land application of sewage sludge is an increasingly popular means of the reuse of sewage sludge as it allows for recycling of valuable components, such as organic matter, N, P and other nutrients. Indeed, sewage sludge amendment to the soil modifies the soil's physico-chemical properties, such as plant-available macro/micro nutrient contents, organic matter content. Additionally, sewage sludge applications can significantly increase the amount of microbial biomass in the soil and can also increase the soil enzyme activities. The aim of the present study is to investigate the impact of low-dose municipal sewage sludge compost amendment on the nutrient status and the biological activity in Chernozem soils.

The study area, located near Újkígyós (SE Hungary), is a 5.6 ha arable land, where 2.5 m^3/ha/year municipal sewage compost has been regularly disposed since 2013. The pH (in H_2O) and humus content of soils were measured according to standard procedures. The macronutrients P_2O_5 and K_2O were extracted using ammonium-lactate, while the nitrogen forms (NO_2^- + NO_3^- -N) were extracted with KCl-solution. The nutrient content was then determined by a flow injection analysis photometer. In order to determine the bacterial composition and enzyme activity of the soil samples, the number of living cells (CFUs), the catalase enzyme activity (CAT) and the dehydrogenase activity (DHA) were determined. The CO_2 emission was measured by an EGM-5 Portable High Precision CO_2 Meter in the field.

The sewage sludge compost applied to Chernozem soils improved soil properties by adding slowly decomposing organic matter, abundant in plant macronutrients (N, K, P). The anaerobic microorganisms and the DHA enzyme activity in the anaerobic soil layers did not increase in the compost-amended soils. The aerobic microorganisms (CFUs) and CAT activity tended to be higher in treated soils compared to the non-amended (control) site, however not significantly. These results suggest that the soil biological activity is only moderately affected by the low-dose municipal sewage sludge compost applications. According to our field CO_2 emission measurements, the yearly application of the sewage sludge compost in a low-dose seemingly did not affect the soil respiration rates, compared to a local control site.

The research was funded by the ‘Thematic Network for the Sustainable Use of Re-sources – RING2017’ project (program code: EFOP-3.6.2-16-201700010).