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Effects of conventional and no-tillage soil management and compost and sludge amendment on soil CO2 fluxes and microbial activities

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Soil management exerts a significant influence on the dynamic of soil organic matter, which is a key issue to enhance soil quality and its ecological functions, but also affects to greenhouse gas emissions and C sequestration processes. The objective of the present research was to determine the influence of soil management (conventional deep-tillage and no-tillage) and the application of two different organic amendment –thermally-dry sewage sludge (TSL) and municipal waste compost (MWC)– on soil CO2 fluxes and microbial activities in a long-term field experiment under semi-arid conditions. Both organic amendments were applied at a rate of 30 t ha-1 prior to sowing a barley crop. The experiment was conducted on an agricultural soil (Calcic Luvisol) from the experimental farm "La Higueruela" (Santa Olalla, Toledo). Unamended soils were used as control in both conventional and no-tillage management. During the course of the experiment, soil CO2 fluxes, microbial biomass C (MBC) and enzyme activities involved in the biogeochemical cycles of C, N and P were monitored during 12 months.
The results obtained during the experiment for soil CO2 fluxes showed a great seasonal fluctuation due to semi-arid climate conditions. Overall, conventional deep-tillage soils exhibited higher CO2 fluxes, which was particularly larger during the first hours after deep-tillage was performed, and smaller MBC content and significantly lower dehydrogenase, beta-glucosidase, phosphatase, urease and BAA protease activities than no-tillage soils. Both MWC and TSL amendments provoked a significant increase of CO2 fluxes in both conventional and no-tillage soils, which was larger in TSL amended soils and particularly in no-tillage soils. The application of these organic amendments also enhanced MBC content and the overall enzyme activities in amended soils, which indicate a global revitalization of soil microbial metabolism in response to the fresh input of organic compounds that are energy sources for microbial growing, especially with TSL that is a raw organic material with no stabilization treatment.