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In-pot evaluation of different composted and pelletized organic fertilizers on soil carbon dioxide efflux and basal respiration

Francesca Opsi (1), Eugenio Cavallo (1), Stefania Cocco (2), and Giuseppe Corti (2)

(1) Institute for Agricultural and Earth Moving Machines (IMAMOTER), Italian National Research Council (CNR), Strada delle Cacce, 73 – 10135 Torino, Italy (f.opsi@ima.to.cnr.it), (2) Dipartimento di Scienze Agrarie, Alimentari e Ambientali, Università di Ancona, I-60131 Ancona, Italy

Climate change is one of the most important environmental problems and it is closely related to concentration changes of greenhouse gases (GHG) in the atmosphere, mainly due to anthropogenic activities. As a consequence, measures have been taken to reduce GHG emissions, some of which are associated with agriculture, as well as to the enhancement of soil carbon storage. Modern intensive farming activities have also raised problems related to the safe disposal of large volume of animal waste, such as pig slurry, where the excessive land spreading can lead to water pollution and GHG evolution to the atmosphere. Composting is a great environmentally sustainable option for recycling agricultural by-products, and pelletisation is a promising technology to reduce the large volume of mature composted material in pelleted fertilizers, more suitable for long-distance transport. This study consisted of a pot-incubation experience carried out in a greenhouse of the National Research Council of Italy, under controlled conditions. The aim of the research was to investigate the effect of a composted swine solid fraction (CS, 13% w/w) and swine solid fraction blended with sawdust and composted (CSS, 9% w/w), both also as a result of pelletisation process (CSP, 12% w/w and CSSP, 8% w/w, respectively), on soil organic matter mineralization and basal respiration. Results were obtained by monitoring CO_2 efflux, basal respiration and microbial biomass C on amended soil, freshly collected in a vineyard planted on a Typic Ustorthent, fine-loamy, mixed, calcareous, mesic. Samples, adjusted and maintained to about 50-60% of water holding capacity, were conditioned at 25±3 °C for 31 days of incubation. The CO_2 fluxes showed a high production at the initial stage of incubation, where differences among treatments were well-rendered. CSSP produced the highest values, while CSS showed values as lower as about 45%. Intermediate values, and similar to those found in the soil sample used as control, were reported by CS and CSP treatments. The daily basal respiration rate confirmed what was previously observed, namely that microorganisms of CSSP showed an increased level of respiration followed by CS, while CSP and CSS treatments were characterized by a lower respiration activity. The addition of fertilizers caused an inhibition of microorganisms in the soil. The CSSP and CS samples showed the lowest values of microbial biomass C and the highest metabolic quotient levels, which were ascribed to stress conditions that led to a greater consumption of energy and therefore a high respiration activity. The higher mineralization rate of CSSP in the soil suggested that this material should not be tested under field scale conditions, while the protective role in term of degradation played by sawdust to organic matter could be better expressed in free form compared to pelletized one.