Geophysical Research Abstracts
Vol. 20, EGU2018-9119, 2018
EGU General Assembly 2018

Benefits and risks of organic amendments obtained through biological treatment of wastes and by-products

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The application of organic materials to agricultural soil is considered an important practice to recover plant nutrients and to improve soil organic matter content. Although this practice is widely used, the high volume of municipal wastes, as well as waste and by-products derived from agricultural and industrial activities, still represents an environmental issue. It is well known that these organic wastes are mostly characterized by highly labile organic matter, ammonia and heavy metals contents, e.g. in slurry, manure and sludge. Wastes may even contain organic contaminants, such as pesticides, PAH, furans, as well as residues of pharmaceuticals. For these reasons, the raw organic materials, before their agricultural reuse as organic amendments, need to be treated through biological processes, as composting and/or anaerobic digestion, obtaining compost and digestate, respectively.
Several studies were carried out to optimize the composting and the anaerobic digestion by evaluating many physico-chemical parameters. The research was particularly focused on the evolution of the most labile fraction and the quality of the organic matter, in terms of dissolved organic matter and humic-like substances, throughout and at the end of the biological processes.
In several experiments, the soil organic matter and microbial dynamics after the addition of different organic amendments were investigated by evaluating the greenhouse gas emissions, the C-biomass and the quality of dissolved organic matter. Moreover, a molecular approach was used to study the microbial community structure by DNA extraction and the application of Roche 454 Next Generation Sequencing was adopted. The potential toxicity to soil microorganisms was evaluated by testing the enzymatic activities and plant bioassays and seed germination tests were carried out to test the potential phytotoxicity.
The organic amendments obtained from the composting and the anaerobic digestion, result in enhanced products compared to the starting materials, in terms of organic matter quality, GHGs emission, absence of organic contaminants and decrease of phytotoxicity. It is also true that a long-term organic amendment might be monitored in order to avoid environmental risks, due to the increased production of wastes over the years and the different soil conditions related to climate change.