Use of digestate from a decentralized on-farm biogas plant as fertilizer in soils: An ecotoxicological study for future indicators in risk and life cycle assessment - DTU Orbit (08/11/2017)

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Over the last decade, the number of decentralized farm biogas plants has increased significantly in the EU. This development leads not only to an increasing amount of biogas produced, but also to a higher amount of digestate obtained. One of the most attractive options to manage the digestate is to apply it as biofertiliser to the soil, because this gives the opportunity of recovering the nutrients, primarily nitrogen and phosphorus, and of attenuating the loss of organic matter suffered by soils under agricultural exploitation. Studies have claimed that digestates can present a residual biodegradability, and contain complex organic elements, salts or pathogenic bacteria that can damage terrestrial organisms. However few ecotoxicological studies have been performed to evaluate the ecological impact of digestate application on soil.In this study, the use of digestate as biofertiliser in agriculture was assessed by a battery of ecotoxicological tests considering the potential pollutants present in the digestate as a whole by using the ‘‘matrixbased” approach (also known as ‘‘whole effluent toxicity” for eluates or waste water effluents). The directand indirect tests included plant bioassays with Lepidium sativum, earthworm bioassays with Eiseniafetida, aquatic organisms (Artemia sp. and Daphnia magna) and luminescent bacteria bioassays (Vibrio fischeri). Direct tests occurred to be more sensitive than indirect tests. The earthworm bioassays did not show serious negative effects for concentrations up to 15% (dry weight/dry weight percent, w/w dm) and the plant bioassays showed no negative effect, but rather a positive one for concentrations lower than20% (w/w dm), which encourages the use of digestate as a biofertiliser in agriculture provided that proper concentrations are used. The indirect tests, on the eluate, with the using aquatic organisms and luminescent bacteria showed an LC50 value of 13.61% volume/volume percent, v/v) for D. magna and no toxicityfor Artemia sp. and V. fischeri.The ecotoxicological parameters obtained from the experimental activity have been analyzed so that they could serve in both ecological risk assessment (ERA) and life cycle assessment (LCA) to assess the risks and impacts of using digestate as a biofertiliser in agriculture. An interim effect factor of1.17E3m3/kg-in-soil is advocated and can be used in life cycle impact assessment modelling of terrestrial ecotoxicity. A predicted non effect concentration for soil organisms was defined at 341 mg-digestate/kg-soil and can be used for the dose–response assessment step in ERA. Although these values are recommended for use in ERA and LCA applications, it should be stressed that they underlie important uncertainties, which should be reduced by increasing the number of toxicological tests, in particular ofchronic studies conducted at different trophic levels.

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