World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:15, No:06, 2021

Influence of Digestate Fertilization on Soil Microbial Activity, Greenhouse Gas Emissions and Yield

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Abstract : Agricultural wastes contribute significantly to global climate change through greenhouse gas emissions if not adequately recycled and sustainably managed. A recurring agricultural waste is livestock wastes that have consistently served as feedstock for biogas systems. The objective of this study was to access the influence of digestate fertilization on soil microbial activity and greenhouse gas emissions in agricultural fields. Wheat (Triticum spp. L.) was fertilized with different types of animal wastes digestates (organic fertilizers) and mineral nitrogen (inorganic fertilizer) for three years. The 170 kg N ha^{-1} presented in digestates were split fertilized at an application rate of 90 and 80 kg N ha^{-1}. The soil microorganism activity could be predicted significantly using the dehydrogenase activity and soil microbial biomass carbon. By combining the two different monitoring approaches, the different methods applied in this study were sensitive to enzymatic activities and organic carbon in the living component of the soil organic matter. The emissions of greenhouse gasses (carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) were monitored directly by a static chamber system. The soil and environmental variables were measured to determine their influence on greenhouse gas emissions. Emission peaks was observed in N_2O and CO_2 after the first application of fertilizers with the emissions flattening out over the cultivating season while CH_4 emission was negligible with no apparent patterns observed. Microbial biomass carbon and dehydrogenase activity were affected by the fertilized organic digestates. A significant difference was recorded between the control and the digestate treated soils for the microbial biomass carbon and dehydrogenase. Results also showed individual and cumulative emissions of CO_2, CH_4 and N_2O from the digestates were relatively low suggesting the digestate fertilization can be an efficient method for improving soil quality and reducing greenhouse gases from agricultural sources in temperate climate conditions.

Keywords : greenhouse gas emission, manure digestate, soil microbial activity, yield
Conference Title : ICASSPN 2021 : International Conference on Agricultural Soil Science and Plant Nutrition
Conference Location : Paris, France
Conference Dates : June 24-25, 2021