Contribution of biogas residues to soil carbon and CO₂ emissions when applied to arable soil

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Biogas residues (BGRs) are by-products of biogas production process and consist of mainly microbial biomass (residues) in addition to non-fermented feedstock leftovers. High nutrient content gives BGRs the potential to replace other organic fertilizers. However, the knowledge on the impacts of BGRs on soil carbon balance and greenhouse gas emissions is limited. We produced stable isotope labeled BGRs with a novel technique using highly enriched KH¹³CO₃ together with substrate in the biogas reactors in order to label the anaerobic microorganisms taking part in the process. The labeled BGRs were then applied to arable soil and incubated for 378days. Concentrations and isotopic compositions of CO₂, bulk Carbon, as well as phospholipid and total fatty acids were determined. Overall results showed that CO₂ production was stimulated with BGRs addition in the beginning of experiment but this effect lasted for a short-term. An important portion of the BGR-derived carbon was stable in soil until the end of experiment. The C flow in living biomass during the incubation was from the G^+ bacteria into G^- bacteria, fungi and other G^+ bacteria. In addition to that, we studied other additives (biochar, compost and farmyard manure) in order to improve the stability of BGRs with further tests. It is shown that BGRlabeling method can be used in studying BGR-soil carbon interactions even though there are some disadvantages. This research gives a clear result about the impact of the BGRs on the soil organic matter and contributes to recommendations about the use of BGRs as fertilizers in agriculture.