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Recycling of bioenergy waste-stream materials to soil in organic farming systems

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BIOCONCENS – a 4-year interdisciplinary projects addressing production and use of energy in organic agriculture (OA) in order to reduce the reliance on non-renewable fossil fuels and minimize greenhouse gas (GHG) emissions, while at the same time considering soil fertility and socio-economical aspects. In the BioConcens (Biomass and bioenergy-production in organic agriculture) project one important **objective is to evaluate how waste-stream materials from bioethanol and biogas production affect the soil fertility when recycled to the field as fertiliser**. Applying the residue materials from bioenergy production, there may be a risk that the decreased content of organic carbon and the readily available mineral nutrients will have a negative effect on soil fertility parameters - like the soil microbial community, soil structure and content of organic carbon. This poster presents data from a incubation experiment where residues from biogas production were incorporated into soil and compared with raw manure and a green (clover-grass) manure with regard to soil quality parameters that are crucial in organic farming systems.

Materials & Methods

Soil sampled from an organically managed field was amended with raw cattle manure, de-gassed manure, de-gassed mixture of manure and maize, de-gassed mixture of manure and clover-grass or fresh clover-grass (green manure). The materials were incorporated homogeneously into separate soil volumes, which were sampled destructively at 0, 1, 3 and 9 days after incorporation.

Assays: 1) Labile soil organic C and mineral N pools (water extractable), 2) Greenhouse-gas emissions (N_2O and CO_2), 3) Soil mineral N concentration, 4) Microbial genetic (PLFA) and functional (MicroResp) diversity in the soil.

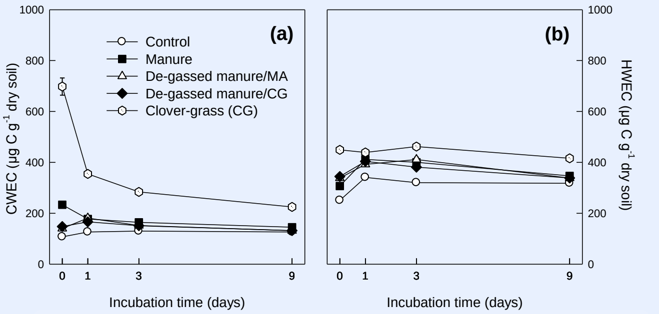

Fig. 1. cold- (a) and hot-water (b) extractable organic C

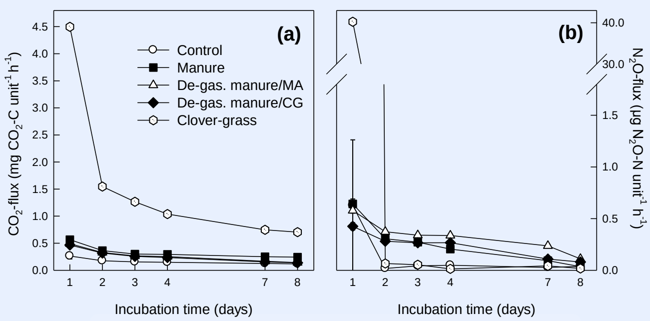

Fig. 2. CO_2 (a) and N_2O (b) emissions

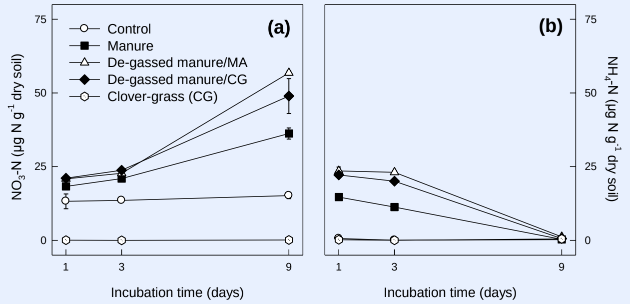

Fig. 3. Soil NO_3 (a) and NH_4 (b) concentration

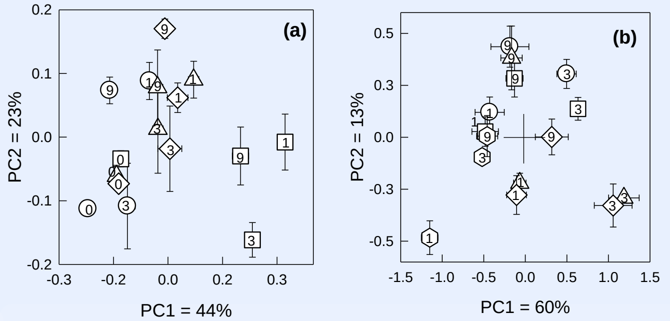

Fig. 4. Genetic (a) and functional (b) diversity of microb. community (PC-analysis; incubation day inside symbols; symbols as other figs).

Results

Labile org. C content highest with clover-grass applied (Fig. 1).

Clover-grass also caused the highest emissions of CO_2 and N_2O (Fig. 2).

Available mineral N was enhanced with the de-gassed materials applied, while clover-grass caused complete N immobilization (Fig. 3).

Microbial diversity was indeed changed by the different treatment, although this effect was apparently only temporary (Fig. 4).

Conclusions

In the current experimental setup, residues after bio-gasification seems suited for fertilizer usage and not much different from application of raw cattle manure. However, the long-term effects on soil organic matter content needs to be further clarified.

Application of clover-grass to the soil caused a significant loss of C and N due to gaseous emissions. This specific situation was, however, not observed in a similar parallel field experiment.

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