EFFECT OF BIOCHAR AMENDMENT ON NUTRIENT FLUXES DURING MANURE FERMENTATION

Oldrich Latal, Agrovyzkum Rapotin Ltd., Czech Republic
latal.oldrich@post.cz
Martin Brtnicky, Mendel University in Brno, Czech Republic
Jiri Holatko, Mendel University in Brno, Czech Republic
Tereza Dokulilova, Mendel University in Brno, Czech Republic
Antonin Kintl, Agriculture Research, Ltd., Czech Republic

Key Words: nitrogen, mineralization, activation, greenhouse gas emissions

Biochar is a charred organic matter often used as a soil amendment. Among other beneficial applications in agriculture belongs to its usage as an additive and bulking agent in composting. The biochar amendment to manure has the potential to reduce greenhouse gas emissions and nutrient leaching during the composting process. Biochar addition reduces NH_3 and N_2O emissions from manure. Recent studies showed that maximal ammonium sorption occurs on low pyrolysis temperature (400 °C) biochar at near neutral pH (7.0–7.5). Consequential lower NH_3 emission is explained due to the greater incorporation of ammonium (NH_4^+) in organic compounds during microbial utilization of dissolved organic carbon (DOC). Both facts are related to findings that low-temperature biochar have a much higher content of utilizable carbon as well as less low molecular weight (LMW) acids. However, the knowledge of the impact of biochar on the mineralization of manure is still sparse. More studies about the effects of biochar on both nitrification and denitrification processes during composting are needed.

The main interest of our studies was the transformation of organic nitrogen during the fermentation process of biochar-amended manure. A small-scale FYM- experiment for monitoring the fermentation of FYM amended by various amounts of biochar was designed and carried out in 50 litters tightly closed barrels. Each of these barrels was filled up with 20 kg of FYM, biochar was added in some barrels in amounts corresponding to particular variants. All variants were prepared in five replicates. The experimental variants were as follows: [1] control FYM; [2] FYM + biochar 40 $g.kg^{-1}$; [3] FYM + biochar 100 $g.kg^{-1}$; [4] FYM + biochar 200 $g.kg^{-1}$. The portion of 17 g of biochar closed in a polyurethane bag was inserted in each barrel containing biochar as a control sorption matrix for monitoring of time-course microbial and chemical enrichment of biochar. These biochar samples served also for monitoring of changes in surface structure and chemical parameters. The fermentation process was run for 6 weeks on a shaded place (stables), a concentration of NH_4^+ was periodically measured. FYM was sampled at time 0, 13, 27, and 41 days from the start of the experiment. pH values and the dry mass were estimated, chemical analyses of nutrients (N, P, K) were done. Microbial biomass was quantified via qPCR SYBR-green methods for estimation of: 16S rDNA copy number (bacteria), 18S rDNA (fungi), amoA gene copy number (ammonium oxidizing bacteria - AOB).

The results showed that amoA copy number and concentration of NH_4^+ changes indirectly to the increasing amount of amended biochar whereas the nitrogen content is comparable between all variants. Differences in amounts of bacteria, *Actinomycetes*, and fungi may indicate biochar-mediated changes in utilization of nutrient sources and in mineralization of organic nitrogen and carbon. The abundance of methanogenic microflora (quantified by qPCR) significantly increased during the fermentation process but possible methane formation was putatively mitigated by the addition of biochar, thus the variants amended with high amount of biochar exerted lower methanogen-specific 16S rDNA values.

The FYM-biochar fermentation technology is intended to produce superior quality FYM type fertilizer enriched with nutrients (thus reduced production of greenhouse gases should protect nutrition elements from volatilization) and to produce beneficial soil amendment biochar, which might be activated by structural changes mediated during the FYM fermentation via the activity of microorganisms. Thus, the aim of ongoing study is also the development of an efficient method for the bio-activation of biochar.

Aknowledgements: The work was supported by the project of Technology Agency of the Czech Republic TH03030319: „Promoting the functional diversity of soil organisms by applying classical and modified stable organic matter while preserving the soil's production properties”.