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Effect of acidification and drying on carbon and nitrogen availability of digestate solids

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Unutilized digestate solids represent an environmental pollution risk and an unexploited nutrient and carbon source which needs to be recycled back to agricultural systems. Thermal drying to reduce the mass of the solids may facilitate storage and transportation of excessive amounts in areas with nutrient deficiencies, as well as remove potential pathogens. A draw-back of this technology is the inorganic N (N_{inorg}) losses occurring during drying, which results in a product almost depleted in plant accessible forms of N. In my previous research on a combined acidification and drying treatment of digestate solids, I have shown this to be an adequate solution to retain the original ammonium content in the dried solids (see Research Brief No 12).

Plant growth is often most limited by soil inorganic N_{inorg} availability; thus knowledge of organic amendments N mineralization in soil is a pre-requisite for their agronomic utilization. In the current study, acidified (pH 5.5) (ASD) and non-acidified manure-based digestate solids (26.6% dry matter (DM)) (SD) were dried to approximately 85% DM, at 70 °C (ASD70, SD70) and 160 °C (ASD160, SD160). Raw and dried solids were mixed with a sandy loam soil (1% DM Kg^{-1} soil) and incubated at 15 °C for 6 months.

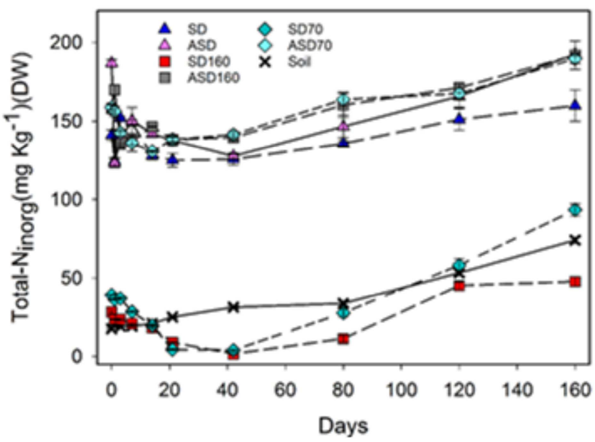

Figure 1 Inorganic N evolution in soil amended with different treatments of digestate solids

The evolution of N_{inorg} in soil during the incubation (Fig.1) showed that after an initial period of microbial N immobilization, soil amended with acidified solids either raw or dried, had higher net N mineralisation and N_{inorg} concentration compared to soil receiving non-acidified digestate solids. Furthermore, non-acidified solids dried at the highest temperature (160 °C), strongly immobilized N_{inorg} throughout the incubation period. Further analyses of the NH_4^+ and NO_3^- results (not shown) revealed that acidification induced a delay in the nitrification that was preserved for two weeks. A strong effect of acidification was also observed in the CO_2 respiration of the soils receiving the different treatments. Both raw and dried acidified solids showed close to 50% reduced CO_2 emissions compared to the respective non-acidified treatments, during the experiment (Fig 2).

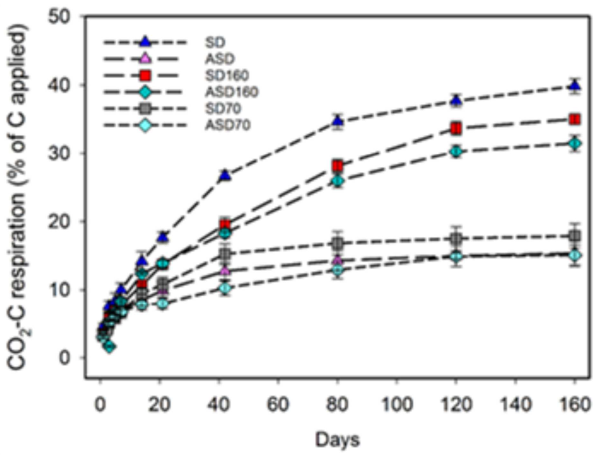

Figure 2 Soil CO2-C respiration of the different solid digestate treatments

These results indicate that an added-value product with increased plant N availability can be produced from a combined acidification-drying post treatment of digestate solids. Apart from the apparent benefits concerning storage stability and transportation costs, the acidified and dried solids could provide higher crop fertiliser value and contribute to the restoration of soil organic matter.

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