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Long-term effects of biomass ashes, composts and digestates, and their combination on soil chemical and biochemical parameters, plant yield and soil microbiome.

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There are different recycling products which can be used as fertilizers such as composts, manures, anaerobic slurries and ashes from biomass combustion, which are all containing different nutrients and hence have a different impact on soil microbiota and plant yield. However, despite knowing that biomass ashes have a good potential as highly effective soil amendment, and serve as a valuable substitute of lime in acid soil, most of them are disposed of by landfilling. On the other hand, applying biomass ashes in combination with other recycling products, such as compost or digestate, which act as sources of N and C, not only increases soil pH-and provides nutrients for the crop, but also stimulates microbial activity. In addition to this, the use of anaerobic slurry instead of undigested manures as fertilizer, has proven superior in terms of nutrient content and availability and pathogen load. Therefore, it is of great interest to study the effects of ashes as such combination fertilizers over a longer timeframe.

Thus, the aim of the present work was to study the effects of biomass ashes alone or in combination with other N-containing fertilizers on grassland, regarding soil properties, plant biomass production, as well as the abundance and composition of the soil microbiome in a field experiment.

In a grassland trial, 16 treatments (in quadruplicate) representing different combinations of ashes, traditional liming (calcium oxide), compost, cattle slurry, and anaerobic slurry, were set up in November 2010 at AREC Raumberg-Gumpenstein. An unamended control was also included in the design. Soil was sampled once a year, and plant yield was measured for 3 cuts per year. The applied organic fertilizer dose (90 kg N_{tot} ha^{-1} $year^{-1}$) was chosen according to the Austrian fertilization guidelines. Biomass ash was applied at the allowed rate for grassland of 500 kg ha^{-1} $year^{-1}$; whilst calcium oxide was applied at a ratio equivalent to the Ca content of 500 kg ash ha^{-1} $year^{-1}$.

Several soil physico-chemical parameters, such as pH-value, EC, Ctot, Ntot, and soil mineral nitrogen (NO_3^- and NH_4^+), as well as soil basal respiration and microbial biomass, potential nitrification and ammonification were measured. To better understand how the different fertilizers affect the soil microbial communities, sequencing of soil microbiome (bacteria, archaea and fungi), is schedule for the samples taken back in 2018.

Preliminary results indicate that the main differences found between the treatments were in response to the organic amendment applied to the soils, rather than the liming source (ash or calcium oxide). Furthermore, the plant growth on treatments where biomass ash or calcium oxide were applied did not show significant differences, emphasizing that the use of wood ash as a substitute of traditional liming can be adopted in acidic grasslands

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