Acidic char decreases denitrification gene abundances and nitrous oxide emissions in a sandy loam soil

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It has been demonstrated that alkaline char amendment has the potential to mitigate nitrous oxide (N2O) emissions from soils. However, little is known about the impact of acidic char on soil nitrogen (N) transformations, abundance of microbial functional genes and N2O emissions. A short-term (60 days) incubation experiment under 75% water filled pore space (WFPS) was carried out to investigate the effects of acidic char addition on N dynamics, abundance of denitrification genes (narG, nirK, nirS and nosZ) and N2O fluxes in a sandy loam soil. Acidic eucalyptus char (pH=3.4) was produced by a wild fire (ca. 500 oC, Queensland, Australia) in 1969 and had been subject to the aging process. Results showed that acidic char significantly increased soil NH4+ concentration compared with control, but significantly decreased soil NO3- concentration. The abundance of all denitrification genes (narG, nirK, nirS and nosZ) was greatly inhibited in the acidic char treatment at the end of experiment, which might be due to the sorption of labile N substrate to porous char surface or lower pH which was not suitable for the microbial growth. Furthermore, acidic char decreased N2O fluxes across 14 sampling times during the 60-day incubation. The findings suggest that the acidic biochar could limit NO3- availability through N immobilization, decrease the abundance of soil denitrification genes by changing soil biogeochemical properties, and effectively suppress N2O emissions in a sandy loam soil. However, more long-term studies are needed to further evaluate acidic char's effects on soil N2O emissions in different soil systems.