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REGULAR ARTICLE

Biochar adsorbed ammonia is bioavailable

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Abstract Biochar is produced as a by-product of the low temperature pyrolysis of biomass during bioenergy extraction and its incorporation into soil is of global interest as a potential carbon sequestration tool. Biochar influences soil nitrogen transformations and its capacity to take up ammonia is well recognized. Anthropogenic emissions of ammonia need to be mitigated due to negative environmental impacts and economic losses. Here we use an isotope of nitrogen to show that ammonia-N adsorbed by biochar is stable in ambient air, but readily bioavailable when placed in the soil. When biochars, containing adsorbed ^{15}N labelled ammonia, were incorporated into soil the ^{15}N recovery by roots averaged 6.8% but ranged from 26.1% to 10.9% in leaf tissue due to differing biochar properties with plant ^{15}N recovery greater when acidic biochars were used to capture ammonia. Recovery of ^{15}N as total soil nitrogen (organic+inorganic) ranged from 45% to 29% of ^{15}N applied. We provide a proof of concept for a synergistic mitigation option where anthropogenic ammonia emissions could be captured using biochar, and made bioavailable in soils, thus leading to nitrogen capture by crops, while simultaneously sequestering carbon in soils.

Keywords N stable isotope · Ammonia · Biochar · Nitrogen · Ryegrass

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Introduction

Biochar is produced as a by product of the low temperature pyrolysis of biomass during bioenergy extraction (Lehmann et al. 2006) and its incorporation into soil is of global interest as a potential carbon sequestration tool and soil conditioner (Lehmann and Joseph 2009). It has been estimated that current net emissions of carbon dioxide, methane and nitrous oxide (N_2O) could be reduced by 12% per annum if biochar was used to sequester carbon into soil (Woolf et al. 2010). Biochar can influence soil nitrogen (N) transformations (Clough and Condron 2010) and has been shown to mitigate N_2O emissions in the field (Taghizadeh-Toosi et al. 2011) influence nitrification rates (Ball et al. 2010), alter biological N fixation rates (Rondon et al. 2007) and alter N leaching rates (Singh et al. 2010). It is well recognized that