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Uptake of 15N fertilizer in plants and microbes in a Biochar amended, agricultural soil

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Previously conducted field experiments showed that Biochar applications of up to 72 t ha-1 did not cause significant N yield or plant yield depression as a consequence of N immobilization when mineral N fertilizer was added. Charring carbon appeared to reduce the N immobilization impact of carbon, in contrast when one t ha-1 of un-charred maize carbon was added to a temperate Austrian soil with similar climatic conditions in a previous study, it resulted in a significant 20% decrease in maize N yield compared to controls over similar time scale. This lack of yield depression on the application of Biochar is important to farmers if we are to promote carbon farming and appeared to be a Biochar specific effect. We set out to explore the mechanisms behind this phenomenon. In a glasshouse experiment similar quantities of pyrolysed and un-pyrolysed carbon was added to the soil and 15N fertilized barley grown. Results showed that in the uncharred carbon treatments grain yields were halved as a consequence of immobilization, but the impact was not observed in the Biochar treatments. Immobilization of N was evident from the significantly higher 15N enrichment of the soil microbial biomass in the un-charred carbon treatment (615‰ $\pm$ 115) which was twice that of both the NPK (332‰ $\pm$ 128) and BCN (278‰ $\pm$ 23) treatment, confirming our hypothesis that microbial N immobilization was significantly altered as a consequence of charring. Indeed, these experiments suggest little or no immobilization of nitrogen on the addition of $\sim$58,000 kg of C ha-1 in the form of Biochar which resulted in similar if not improved rates of plant fertilizer nitrogen uptake, with a potential maximum carbon credit value of around $7000 ha-1 based on social cost of carbon values obtained from the literature.