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BLACK NITROGEN OR PLANT-DERIVED ORGANIC NITROGEN – WHICH FORM IS MORE EFFICIENTLY SEQUESTERED IN SOILS?

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Input of charcoal after forest fires can lead to considerable changes of the quality and quantity of organic matter in soils (SOM). This affects not only its organic C pool but also shifts its organic N composition from peptideous to N-heterocyclic structures (Knicker et al., 1996). In the present study we sought to understand how this alteration is affecting the N availability in fire affected soils. Therefore, we performed a medium-term pot experiment in which grass material (Lolium perenne) was grown on soil material (Cambisols) of a fire-affected and a fire-unaffected forest. The soils were topped with mixtures of ground fresh grass residues and KNO_3 or charred grass material (pyrogenic organic matter; PyOM) with KNO_3. Here, either the organic N or the inorganic N was isotopically enriched with 15N. Following the 15N concentration in the soil matrix and the growing plants as a function of incubation time (up to 16 months) by isotopic ratio mass spectrometry allowed us to indentify which N-source is most efficiently stabilized and how PyOM is affecting this process. Preliminary data indicated that only after the germination of the seeds, the concentration of the added inorganic 15N in the soil decreased considerably most likely due to its uptake by the growing plants but also due to N-losses by leaching and volatilization. Additional addition of plant residues or PyOM had no major effect on this behavior. Covering the soil with 15N-grass residues which simulates a litter layer led to a slow increase of the 15N concentration in the mineral soil during the first month. This is best explained by the ongoing incorporation of the litter into the soil matrix. After that a small decrease was observed, showing that the organic N was only slowly mobilized. Addition of 15N-PyOM showed a comparable behavior but with 15N concentration in the soil corresponding to twice of those of the pots amended with 15N-grass residues. After that the 15N concentrations decrease quickly and approached those of the pots with fresh grass litter supporting the mobilization of black nitrogen and its uptake by plants. Our results point to the suggestion that N in PyOM and humified SOM have comparable biochemical stability. In order to test this hypothesis, a further experiment was set up mixtures of soil and humified 15N grass residues or aged 15N grass char to which fresh PyOM or fresh grass residues, respectively, were added. In addition solid-state 15N NMR spectroscopy was applied to disclose the nature of the sequestered N.

REFERENCES

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