Geophysical Research Abstracts
Vol. 15, EGU2013-5499-1, 2013
EGU General Assembly 2013

Effects of N-ammonoxidized lignins amendment on N availability and soil fertility: An incubation study

José María De la Rosa (1), María López-Martín (1), Falk Liebner (2), and Heike Knicker (1)

(1) Instituto de Recursos Naturales y Agrobiología (IRNAS-CSIC), Departamento de Geoecología, Biogeoquímica y Microbiología Ambiental. Reina Mercedes Av, 10. Seville, Spain (jmrosa@irnase.csic.es), (2) University of Natural Resources and Life Sciences Vienna (BOKU), Department of Chemistry, Konrad-Lorenz-Str. 24, A-3430 Tulln, Austria.

The shift towards a biobased economy will probably generate the application of bioenergy by-products and charred residues to the soil as either amendments or fertilizers. The process of ammonoxidation (application of gaseous oxygen and aqueous ammonia under ambient pressure breaks down aromatic lignin moieties and introduces N in the form of urea, amides and amines), converts lignin, a major by-product of the pulp and paper industry, or other ligneous materials into artificial humic matter (N-lignin). The use of N-ammonoxidized lignin as soil improvers is in theory an economically viable solution, especially interesting for agricultural areas of Mediterranean countries, in which additional factors such as water shortage and fires contribute to declining N availability by lowering nutrient diffusion, litter input or sequestration of N in charred structures. However, limited research has been done to determine how this will influence C and N dynamics and soil fertility.

Therefore we performed pot experiments in which a perennial ryegrass (Lolium perenne L.) was grown on a typical Andalusian soil (chromic Luvisol) after amendment of N-lignins highly enriched in 15N (Sarkanda and Indulin ammonoxidized lignins) for 75 days. For comparison, the incubation was also carried out on soils fertilized with $15NO_3$ and unfertilized (control). The application of ammonoxidized lignins altered the pH and electrical conductivity of the soil. At higher concentrations a retardation of seed germination was evidenced, an observation that needs further considerations before N-enriched technical lignins can be applied in agriculture. After 75 days, the plant shoots from the pots amended with15N-Indulin and 15N-Sarkanda accumulated 8% and 20%, respectively of the initial 15N (15N0). The N was efficiently sequestered from fast release or leaching and most of 15N0 remained in the soil (64%) in the 15N-Indulin pots. In contrast, the 15N-Sarkanda pots showed a lower efficiency in the N retention. The N-sequestration potential of ammonoxidized lignins seems to be mainly due to a quick N transfer into newly formed microbial biomass. However, the efficiency of this transfer depends on the kind of used N-lignin.

The notable increase in the 15N of the grass production (> 20%) evidences a more efficient use of N derived from the soil amendment of the Indulin pots. Solid-state NMR spectroscopy revealed that the N of the added N-lignins was quickly transformed into peptide-type N, most tentatively of microbial origin, without major alteration of the lignin backbone. This indicates that in soils the competition for nutrients favors N immobilization into biomass and its subsequent sequestration within recalcitrant biopolymers rather than its stabilization by covalent binding to lignins.