Workshop „Pharmaceuticals in Soil, Sludge and Slurry" of the German Federal Environment Agency (18th June to 19th June 2013)

TITLE: STRUCTURAL DIVERSITY OF SOIL MICROORGANISMS IS A SENSITIVE INDICATOR OF ADVERSE EFFECTS FROM PHARMACEUTICAL ANTIBIOTICS

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ABSTRACT BODY:
Pharmaceutical antibiotics reach agricultural soils through fertilization with contaminated manure. Antibiotics are bioactive agents and several tend to persist in soil. Consequently, adverse effects on soil microorganisms have been determined. The question followed up in this presentation is whether the structural diversity of soil microbial communities is a suitable endpoint to test adverse effects of antibiotics in soil.

Effects of pharmaceutical antibiotics (sulfonamides) on soil microorganisms were investigated in microcosm, mesocosm and field experiments. Contaminated manure was used for soil spiking. Phospholipid fatty acids (PLFA) and 16S rRNA genes were analyzed as markers of the soil community structure and functional enzymatic activities were determined. Special attention was paid to effects in soil microcompartments.

Manure itself has strong influences on functional and structural parameters of the soil microbial community, which influences are altered by antibiotics. The extractable (available) concentrations of antibiotics quickly dissipate in soil, following the application with manure. However, effects on microorganisms tend to increase on a mid-term; some effects of SDZ on soil microorganisms were significant for several months. This results in an apparent concentration independence of antibiotic effects. Effects of SDZ on single functional parameters were often small and insignificant. Distinct effects of SDZ on microbial biomass and structural diversity were determined, which interacted with the manure application rate. Both manure and SDZ induced shifts in the community structure, making communities of different soils and soil compartments more similar. Derived ratios of bacteria-to-fungi and gram+- to-gram- bacteria indicated changes in the structural diversity induced by SDZ. Furthermore, manure-borne bacteria, designated as antibiotic-resistant, survived several weeks in soil treated with SDZ contaminated manure. Accumulation of SDZ and related effects were different in soil microcompartments, i.e. earthworm burrows, aggregates, and rhizosphere compared to bulk soil. Structural diversity of soil microbial communities is a sensitive measure of antibiotic effects.