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Soil functional impacts of annelids affected by different vertical placement of crop litter due to tillage

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It is widely known that annelids have strong soil functional impacts like the decomposition of crop residues, which affects carbon dynamics and nutrient cycling. In this study the objective was to investigate the combined effect of the vertical placement of organic material and soil annelids on carbon pathway and plant available nutrients. We hypothesize that endogeic earthworms, such as anecic earthworms and thus enchytraeids react differently because of their various lifestyles.

A microcosm experiment with undisturbed soil columns (30 cm high, 15 cm Ø) was carried out from October 2017 to February 2018 in a dark climate chamber at 10 °C. The soil columns were taken from a long-term experimental field-site at plots with reduced tillage after winter wheat harvest. The soil type is a Haplic Luvisol with a silt loam texture. Soil columns were defaunated by freezing for one week at -20°C before the experiment started. During the experiment they were hermetically sealed, continuously supplied with fresh air and automatically irrigated (3 times day-1 10 ml). Gas fluxes were obtained and analyzed every 4.5 hours utilizing a gas chromatograph.

For the organism treatment we used: (i) the endogeic earthworm species Octolasion cyaneum (four individuals each column), (ii) the anecic earthworm species Lumbricus terrestris (two individuals each column) or (iii) a combination of the two enchytraeid species Enchytraeus crypticus and E. christenseni (350 individuals each column). Half of the columns were inverted manually to simulate inverse tillage. For these columns we placed 5 g of maize leaves, which was used as a crop residue, in a depth of 15 cm. For the columns with simulation of no-till systems, the organic material was put on the surface. All annelid treatments were combined with both organic matter location treatments.

At the end of the experiment, soil columns were harvested destructively. Carbon-dioxide was measured as an indicator of biological activity [mg CO_2-C kg-1 dry soil]. For biotic soil properties mircrobial biomass carbon was measured by Chloroform-Fumigation-Extraction (CFE) and ergosterol concentration was quantified as a proxy for fungal biomass. The path of carbon through the system is investigated by isotope ratio mass spectometry 13C/12C.

First results show that earthworms reached a higher biomass in all treatments and numbers of enchytraeid individuals increased ten times. Contrary to the expectation that anecic earthworms only pick up organic matter, which is on the surface, the uptake of maize leaves could be shown by isotopic analysis in both treatments. On the other hand, it could be confirmed that the position of organic material in a depth of 15 cm seems to be of advantage for endogeic earthworms. Analysis of the biological activity shows that soil annelids respond in a different way the location of the organic material, depending on size scales (enchytraids vs. earthworms) and on ecological performance (endogeic vs. anecic earthworms).