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Influence of Vegetations' Metabolites on the Composition and Functioning of Soil Microbial Complex

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Microbiota is one of the major factors of soils fertility. It transforms organic substances in soil and, therefore, serves as the main component in the cycles of carbon and nitrogen. Microbial communities (MC) are characterized as highly diverse and extremely complex structures. This allows them to adapt to any affection and provide all the necessary biospheric functions. Hence, the study of their functional diversity and adaptivity of microbiota provides the key to the understanding of the ecosystems' functioning and their adaptivity to the human impact.
The formation of MC at the initial stage is regulated by the fluxes of substrates and biologically active substances (BAS), which vary greatly in soils under different vegetations. These fluxes are presented by: low molecular weights organic substances (LMWOS), which can be directly included in metabolism of microbes; polymers, that can be decomposed to LMWOS by exoenzymes; and more complex compounds, having different "drug effects" (e.g. different types of phenolic acids) and regulating growth and enzymatic properties of microbiota. Therefore, the main hypothesis of the research was formulated as follows: penetration of different types of substrates and BAS into soil leads to the emergence of MC varying in enzymatic properties and structure.

As a soil matrix we used the soil from the untreated variant of the lysimeter model experiment taking place in the faculty of Soil Science of the MSU for over the last 40 years. It was sieved with a 2mm sieves, humidified and incubated at 25C during one week. Subsequently, the samples were air-dried with occasional stirring for one more week. Thereafter, aliquots of the prepared soil were taken for the different experimental variants.
The samples were rewetted with solutions of various substrates (glucose, cellulose, starch, etc.) and thoroughly mixed. The control variant was established with addition of deionised water. The samples were incubated at the 25C. During the incubation the rate of mineralisation of organic substances was assessed with CO_2 measurements. In 5, 10 and 21 days of incubation the enzymatic properties of the formed MC were studied by the hydrolysis of fluorogenic substrates.
The influence of BAS on enzymatic properties of MC were researched by addition of different concentrations of phenolic acids (e.g. salicylic, vanillic, benzoic, etc.) to the samples from various substrates treatments. The acute toxicity of BAS was studied with bacterial luminescent test.
After the last measurement, the isolations of microorganisms on elective nutrient medias were made. The dominant microorganisms were collected to the library for further identification and physiological tests. MeOH-chloroform extraction of phospholipids were performed with the remaining samples. Finally, they were stored for subsequent FAME identifications.

The obtained data prove that penetration of various substrates into the soil determines the formation of MC different in structure and properties. It was found, that EC50 of the most studied phenolic acids are similar to naturally occurring concentrations. This means that they can be the real drivers of forming endemical MC under various vegetations along with the plant-specific fluxes of nutrients.