Effects of lignohumate and biochar on microbial communities in agricultural soils differing in organic matter content

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Structural and functional microbial characteristics are considered as sensitive indicators of soil health. The abundance and diversity of microorganisms determine high metabolic potential of soils. In different countries, a specific set of indices — determined by the structure and composition of microbial communities—is used to normalize soil quality and to assess environmental risk. However, stability and reliability of microbial indices in soils that differ in humus status have not been sufficiently studied.

The aim of this study was to compare the influence of lignohumate and biochar on microbiological properties of soils polluted by several metals, differing in organic matter content.

Responses of soil microorganisms (fungi and bacteria) on lignohumate (dose of 0.25%, total C content of 36%, Company “RET”, Russia) and biochar (dose of 5%, total C content of 70-80%, Company “Metakom”, Russia) were evaluated in four typical agricultural topsoils (0-20 cm) under controlled conditions using pots experiments. Functional and structural characteristics of microbial communities were analyzed by microbiological, chromatographic and biochemical procedures, including analysis of microbial lipid profiles (GC-MS method), PCR diagnostics, multi-substrate testing (MST).

The results showed that lignohumate and biochar (separately and in mixtures) affected both fungal and bacterial communities. The effect of organic amendments on the composition and structure of soil microbial communities was remarkably stronger than that of Cu, Pd, and Zn addition.

Lignohumate and biochar application resulted in higher microbial carbon biomass (Cmic), microbial quotient (qCO_2), soil enzyme and MST activities. Humus-rich soils were more markedly affected than humus-poor soils.

The change in fungal biodiversity was stronger than in bacterial biodiversity. Biochar alone affected more severely the structural and functional microbial characteristics than in mixture with lignohumate. The most remarkable effects were in metal-polluted, humus-poor soils.

Biochar and lignohumate resulted in higher soil pH and nutrient content.

The effect of humus content in natural samples of investigated soils was stronger than lignohumate and biochar addition and metal contamination on all parameters. This fact should be taken into account for the efficient use of nature-friendly technologies.

Our results highlight additional research need for a better understanding of the effect of humic substances and biochar on microbial communities of different soils and their further effects on ecosystem functions.

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