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Effects of applying an effective microorganism consortium on the biological properties and humus content of soils in three contrasting agroecosystems

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Abstract. One of the key environmental problems in modern agriculture is the imbalance between the processes of organic matter decomposition and humification in soils, leading to the progressive soil dehumification and reduced agroecosystem sustainability. The aim of the study was to investigate the influence of the effective microorganism consortium (Vostok EM-1) on structural and functional alteration of the microbial community and the processes of organic matter transformation in soils of three contrasting agroecosystems located in agricultural regions of Russia. Field experiments were conducted during 2018–2024 in Samara Oblast (agrochernozems), Krasnoyarsk Krai (agro-dark gray soils), and Primorsky Krai (agro-dark humus podbels). The analytical and calculation methods commonly accepted in soil microbiology (total soil biogenicity, cellulolytic activity), soil science (humus content), and agrochemistry (crop yield assessment) were employed. It was found that the application of the microbiological agent increased the overall biogenicity (from 10 to 295%) and cellulolytic activity (by an average of 60%) in all studied soils. The shift in the microbial community from a fungal (mineralizing) to a bacterial (humus-forming) type was observed in soils from all studied regions. A cumulative effect of the microbiological agent application on the ecological regulation of humus formation was identified. The transformation of the microbial community and subsequent stabilization of humus compounds were achieved in the third year of the microbiological agent application in agrochernozems from the Samara Oblast, with humus losses decreasing eightfold. A stable positive effect was determined in the second year of the microbiological agent application in agro-dark gray soils from Krasnoyarsk Krai, including a 32% increase in humus and a 2.3-fold increase in B:F ratio. A positive effect from the microbiological agent was observed as early as the first year of its application in agro-dark humus podbels from Primorsky Krai, with a 36% increase in humus. The obtained results indicate directed regulation of soil microbiota by the applied effective microorganism consortium, which allows it to be considered an effective instrument for optimizing the decomposition and humification of organic compounds, accompanied by carbon sequestration in the plough layer of various soil types and by increased environmental sustainability of the soil system.

Keywords:
soils of agroecosystems, humus, effective microorganisms, Vostok EM-1, biotic regulation, ecological sustainability

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