

## MICROBIOTA ACTIVITY RESTORATION IN SOIL DAMAGED BY A SHELL EXPLOSION

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Military operations in Ukraine are catastrophic stress factors that negatively affect soil quality and its biological potential. Pollution by substances that have entered the soil as a result of explosions of ammunition, rocket fuel, burning of equipment, changes in the organic matter content and the structure of microbiocenoses, causes justified concern about possible disturbances in the ecological balance in ecosystems and in the microorganism-plant system. Poisoning by toxic substances, the destruction of agronomical useful microbial communities as a result of high-temperature explosions, in turn, leads to the development of the phytopathogenic microorganisms of microbiocenoses. Toxic substances present in the soil, overcoming the barrier of the rhizosphere microbiota, enter plants and agricultural products, and then through trophic chains – to the human body. Therefore, there is an urgent problem of restoring the biological potential of the indigenous microbiota and its ability to self-clean, improve the growth and development of crops to obtain higher yields on available land using the microorganisms' biosynthetic potential.

The object of the research was soil taken near of Bakhmut city (Donetsk region), which was damaged as a result of military operations and the formation of a crater from the artillery shell explosion. The control was soil taken at a distance of 50 m from the crater. Microbiological analysis of the military-affected and control soils was carried out to determine the amount of microorganisms of the main ecologically functional groups and the direction of ecologically trophic processes that occurred in them at the time of sampling and in the dynamics of the remediation process during treatment with biological agents.

Analysis of the microbiota of soil samples from places exposed to intense explosions in the Bakhmut city revealed significant changes in the amount of some ecologically functional groups microorganisms compared to the control sample.

In the soil from the crater, a decrease in the oligoazotrophic and nitrogen-fixing microorganisms amount by 3.2-fold was noted; a 6-fold decrease in the phosphate-mobilizing microorganisms amount; amylolytic microorganisms amount by 85% and the content of cellulose-destructive microorganisms: bacteria – by 2.8-fold, streptomycetes – by 2.9-fold, micromycetes – by 17-fold. Ammonifying microorganisms were also identified in the affected soil, which were not sensitive to the explosion effects. The amount of this group increased by 75% compared to control samples. It was found that in the affected soil the amount of oligotrophic microorganisms increased by 35% compared to the control. The amount of micromycetes increased significantly (by 2.4-fold) to 405.6 thousand CFU/ g of absolutely dry soil. This can be explained by a shift in the balance of the microbiota towards a decrease in the bacteria quantity and an increase in micromycetes. Determination of the microbial processes direction in the soil by ecological coefficients showed inhibition of the transformation of nitrogen and carbon compounds and humus formation.

Treatment of the affected soil with a complex of microbial bioformulations and next phytoremediation with the plants, that stimulated by microorganisms, contributed to the restoration of the microbiota population within 60 and 120 days, a balanced ratio of individual groups of the microbial community and directions of ecological and biochemical processes in the soil. The use of the developed complex of bioremediation measures is effective for the activation and restoration of agronomical useful microbiota in soils damaged by military actions, corrects rhizosphere microbial communities to stimulate plants, and promotes their stable development.