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The effect of drought on the structure and diversity of bacterial communities in forest soils differently polluted with heavy metals

Marcin Chodak (1), Marcin Gołębiewski (2), Justyna Morawska-Płoskonka (3), Katarzyna Kuduk (3), and Maria Niklińska (3)

(1) AGH University of Science and Technology, Department of Surface Mining, Kraków, Poland (chodak@agh.edu.pl), (2) Nicolaus Copernicus University, Department of Biotechnology, Toruń, Poland, (3) Jagiellonian University, Institute of Environmental Sciences, Kraków, Poland

The chemical properties of soil such as nutrient contents, acidity or heavy metal pollution may affect the ability of soil microorganisms to withstand stressing factors. The objective of this study was to assess the effect of drought stress on the structure of bacterial communities in organic horizons of forest soils differing in acidity and heavy metal pollution. The samples were taken from coniferous forest soils at nine sites differently polluted with Cu, Zn and Pb and having different pH. The samples were placed at stressing conditions (temperature 20 – 30 °C, drought) for eight weeks. The structure of soil bacterial communities was determined prior to and directly after the drought period using pyrosequencing of 16S rRNA genes. The Chao1 index calculated based on the pyrosequencing data was used to assess diversity of the bacterial communities. The chemical analyses of samples included measurement of pH and the contents of Corg, Nt, St, Zn, Cu and Pb.

After the drought period the share of Proteobacteria decreased whereas the shares of Actinobaceria and Acidobacteria increased. Decrease of Proteobacteria and increase of Acidobacteria after drought was stronger in soils with lower pH. The share of Bacteroidetes decreased strongly after drought in more acid soils but in the less acid ones remained almost constant. The increase of Actinobacteria share after drought did not depend on soil pH or heavy metal pollution.

The heavy metal pollution affected the reaction of Betaproteobacteria, Verrucomicrobia, Cyanobacteria and Chloroflexi to the drought stress. For Betaproteobacteria stronger decrease was observed in the less polluted soils. Similarly, the share of Verrucomicrobia after drought stress increased in the heavy metal polluted soils but decreased in the clean ones. For Cyanobacteria and Chloroflexi the opposite was the case – the shares of these bacterial phyla decreased due to the drought stress in the polluted soils, but remained constant or increased in the clean ones. Chao1 index decreased after the drought in most of the samples, however its decrease did not depend on any of the analyzed soil chemical properties.

The obtained results indicated that various bacterial phyla differ in their ability to withstand drought stress and that soil pH and heavy metal pollution modify the reaction of several bacterial phyla to environmental stress.

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