

Rockström and co-authors (2009) identified nine planetary boundaries that define thresholds for safe human functioning in the world as we know it today. These boundaries relate to: climate change, loss of biodiversity, nitrogen and phosphorus cycling, destruction of the ozone barrier, atmospheric pollution, ocean acidification, drinking water consumption, land use change, chemical pollution. Most of these boundaries relate to the soil environment. Soil, especially its fertility and productivity, plays a huge role in this process. The organic matter content and the composition and abundance of soil microorganisms are the most important factors influencing plant development. The soil environment and soil processes are influenced by many environmental factors - natural and anthropogenic. It is estimated that approximately 33% of the world's soils are degraded. In the Soil Mission, the European Union calls for all soils in Europe to be restored and healthy by 2050. Achieving this goal requires increased work by scientists and farmers.

Exopolymers (EPS) are polymers composed mainly of polysaccharides, structural proteins, enzymes, nucleic acids, lipids, secreted by microorganisms outside of cells. EPSs are produced by bacteria, cyanobacteria, yeast, protists. They have a mucilaginous consistency and perform a number of functions, such as helping microorganisms to form colonies and adhere to surfaces. Most of the properties attributed to EPS are related to the protection of the microorganisms that produce them, as evidenced by the increased production of these compounds in response to environmental stresses (e.g. drought, high temperature, salinity). The production of EPS by bacteria of the genus *Pseudomonas*, among others, has been confirmed, and they also exhibit a number of other plant growth-promoting bacterial (PGPB) properties, such as siderophore production and increased ACC production activity. One of the known and promising functions of EPSs is their ability to aggregate soil particles, directly affecting soil structure, which is important in the case of water shortage stress.

Although the potential of EPSs in protecting bacterial cells is known, their role in the soil environment has not been thoroughly investigated. In addition, the best-known EPS are those derived from marine bacteria or lactic acid bacteria, which are either absent from the soil or represent a small percentage of the population. At the same time, bacteria are known to produce EPS in response to environmental stress. What, then, of soil bacteria whose environment has been contaminated or modified in an unfavourable way? Do they secrete EPSs as a defence mechanism? Do these EPSs support only these bacteria, or can they benefit the whole community and other components of the soil environment?

The main objective of the proposed project is to test whether soil bacteria from soils subjected to different types of stress (including drought, flooding, salinity, PAH contamination) produce EPSs in response to adverse environmental conditions, and whether these compounds can support the soil environment. We will test whether exopolymers of bacterial origin can increase soil stability, water abundance and participate in the bioremediation process. The project also plans to test the effects of EPS on plant health and growth. The project will answer the question of whether any stress mobilises soil bacteria to produce EPS, and whether this survival strategy can be used to remediate stressed soils, so valuable to modern agriculture.