One of the biological methods of removing petroleum pollutants from contaminated soil is phytoremediation. In this method, apart from plants, rhizosphere microorganisms that inhabit the soil directly adhered to the roots also play a key role. In this soil, due to the activity of microorganisms, intensive degradation processes take place. However, under highly polluted conditions or in nutrient-poor areas, the number and activity of microorganisms may not be sufficient to effectively clean the soil. Then, actions are taken to intensify biological treatment processes. One of them is bioaugmentation, defined as the introduction to contaminated soil of strains selected in laboratory conditions that have the ability to degrade petroleum hydrocarbons, produce surface-active compounds that increase their bioavailability, and promote the growth of plants. Before introducing these strains into the soil, they are characterized in the laboratory, under optimal conditions, however, the polluted soil into which they are then introduced is an extremely hostile environment. Under these conditions, the introduced strains may behave in a completely different way than it was confirmed in previous, laboratory tests. In addition to the reduction of metabolic activity caused by the presence of toxic pollutants, it is also possible that they die quickly after being introduced into the soil, e.g. as a result of competition with other microorganisms inhabiting the treated soil. Both of these factors mean that the effectiveness of our activities aimed at increasing the soil degradation potential and intensifying plant growth is low.

To discover the interactions between bacteria and plants that determine the success of bacterial-assisted phytodegradation of petroleum hydrocarbons, we need to look deep into the soil to find out if the strains we use are also active after introduction into the environment. We can find out about it using modern methods of molecular biology, an example of which is metatranscriptomics. Due to the use of this technique, we will find out which bacterial mechanisms are active in the soil and contribute to the improvement of plant growth, as well as to increased degradation of pollutants. Now, we could only guess the role of the introduced strains, while the new approach proposed in this project will allow us to obtain reliable information on the factors determining the effective phytoremediation of areas contaminated with petroleum hydrocarbons. This project is an example of the interconnection of basic research with application research. The results obtained by us may contribute to the optimization of phytoremediation processes conducted on a large scale.