Global changes, ranging from climate change to biological invasions, nutrient deposition, pollution, and salinification, dramatically impact plant performance and physiology. Drought is among the major abiotic stresses faced by a large number of crop plants. From agricultural and physiological viewpoints, drought stress occurs when the available water for plants in the soil decreased due to the low soil moisture at a certain time. On the other hand, water deficiency in plants occurs when the transpiration rate from leaf surfaces is higher than the water uptake by roots. Drought is multidimensional stress for plants influencing different aspects of plant growth, and development. Because drought can dramatically reduce crop yields and crop hectarage, there is a huge need to overcome this problem. Nevertheless, plants are not living alone, they are supra-organism hosting a wide range of commensal, beneficial, and detrimental microorganisms. The plant with its associated microbiota fights altered environmental conditions as a result of a rapidly changing climate. There is evidence that plants can respond to dry conditions by modifying the microbial species composition of their microbiome.

Under water deficit, many plants selectively recruit and enrich the beneficial microorganisms that help to mitigate the drought stress. Increasing evidence suggests that diverse soil microbial communities associated with roots, leaves and soil can promote plant fitness under stress. Such microbes can influence plant responses to global changes through four mechanisms. First, microorganisms can alter the abiotic environment. These chemicals can cause physiological changes in nearby plants that can stimulate plant growth under water-deficit conditions. Third, microorganisms can alter plant gene expression, triggering physiological changes that in some cases increase tolerance to stressors imposed by the global change. Finally, microorganisms can also mitigate the negative effects of global changes by facilitating access to limited resources. Microbes can affect plant nutrition directly by increasing nutrient availability (e.g. bacteria solubilizing phosphates or rhizobia fixing nitrogen) or indirectly by affecting plant metabolism and growth in ways that promote plant uptake of minerals. All these mechanisms show how microorganisms can benefit plants and minimize the negative consequences of global change on plant growth and fitness. However, global changes can destabilize the plant-microbe symbiosis itself and inhibit beneficial microbial functions.

The proposed project assumes the determination of the role of the bacterial microbiome of maize (*Zea mays*) plants grown under conditions of periodic drought stress. We want to find the answer to the question of which of the bacterial mechanisms are potentially responsible for the mitigation of adverse effects on plant metabolism during the periodical drought and about the answer of maize for soil inoculation with plant growth-promoting bacteria. For this purpose, the most advanced techniques of molecular biology will be used. A global analysis of bacterial gene expression in soil as well as analysis of plants' genes expression will be performed. Additionally, we plan to investigate the influence of bioaugmentation on the physiology of maize, its microbial community composition and the actual activity of microorganisms accompanying maize under repeated stress conditions. In addition to genetic studies, biochemical and physiological analyses will also be carried out to determine the current state of plants and their response to drought stress.

For the implementation of the proposed research project, we plan to use the metatranscriptomics and transcriptomics to verify the following hypotheses: (1) bacteria associated with maize play a crucial protective role for maize growth in stressful conditions caused by periodical drought; (2) maize plants possess their own stable core bacterial microbiome, insensitive to drought stress; (3) part of the dynamic microbiome of maize is sensitive to changing environmental conditions; (4) the bacteria from drought tolerant plant will effectively activate the plant mechanisms of stress defence in more sensitive cultivars.

The obtained results, apart from the purely cognitive aspect, may contribute to the optimization of maize growth under the conditions of periodic drought stress.