POPULAR SCIENTIFIC ABSTRACT

Aim of the project

The project aims to understand the nature of the mechanism responsible for neutralizing and/or stabilizing heavy metal ions present in the soil by introducing strains of microorganisms into the soil environment to solubilize plant nutrients. Bacteria and fungi used as activators of nutrients introduced into the soil in the form of fertilizer preparations, in which waste streams are used as a source of nutrients, contribute to obtaining satisfactory parameters of plant production and at the same time keep the level of heavy metals in plants at a very low level, despite their significant amounts present in the growth medium (soil).

Description of research

To properly describe the mechanism and identify the relationship between the type of microorganism used to activate nutrients and the amount of heavy metals taken up by the plant, a series of tests has been planned, thanks to which the systems/groups of microorganisms will be selected, which, with appropriately adjusted doses of raw materials, stimulate plant growth by increasing the availability of nutrients and at the same time immobilize, stabilize or inactivate heavy metal ions present in the soil. The planned scope of the research includes analysis of the surface of waste streams before and after the solubilization process, surface analysis of bacteria/fungi, identification of enzymes and chemicals produced/released into the environment by microorganism cells, as well as the impact of the method used to introduce the microorganism into the plant growth environment or the plant itself. Taking into account the results obtained in laboratory conditions, the systems with the highest efficiency will be selected, and their functional properties will be assessed in pot tests and field tests. The parameters of the obtained model plants will be taken into account, e.g. effectiveness of "infection" of plants (mainly roots) with beneficial microorganisms, but also parameters such as the volume of the root ball, part weight. green, chlorophyll content, as well as multi-element composition, which will be particularly important due to the assessment of the effectiveness in reducing the amount of heavy metal ions taken up by the root system from the substrate, thanks to the sets of microorganisms used.

Reasons for taking up this research topic

The use of waste streams for the production of fertilizers as part of closing the nutrient cycle carries a high risk of introducing hazardous substances into the soil, and consequently increases the possibility of their accumulation in subsequent links of the food chain. Therefore, particular attention should be paid to minimizing and monitoring the flow of undesirable substances to the final fertilizing products through waste streams or developing methods to minimize their negative impact on plant growth. A strategy to overcome these limitations can be found in the natural properties of microorganisms and their biological processes, the use of which is characterized by low cost, low energy consumption and low wastewater generation. Microorganisms can be used to positively modify the growth capacity of plants and make them resistant to biotic and abiotic stresses, such as stresses related to the presence of toxic substances in the soil (e.g. heavy metals), which are likely to occur much more often with the increasing use of fertilizer products obtained from waste streams.

The most important effects expected

Knowledge of the mechanism of controlling the amount of heavy metal ions available to plants by the soil environment (microorganisms + substrate) contaminated with heavy metals will allow for precise adjustment/modification of the composition of fertilizing biopreparations based on the natural properties of microorganisms, which in turn will allow for safe plant production - the plant product will be was characterized by a low content of heavy metals - despite their presence in the plant growth environment, while using secondary raw materials as a source of nutrients as part of a circular economy strategy and closing the nutrient cycle.