POPULAR SCIENTIFIC ABSTRACT

Aim of the project

The project aims to understand the nature of the interaction of all components of the modified soil system, which includes plant, soil, and its microbiota This mentioned modification will introduce into the soil, among other things, nutrients in the form of secondary raw materials from the agri-food industry. The research plan also provides the modification of soil microbiota with beneficial microorganisms with plant growth-stimulating properties or the natural ability to increase the absorption of nutrients from a form inaccessible to plants. The project distinguishes two scenarios for modifying the microbiota of the soil system through the ►**strategy of 'infection' of plants**, where the following methods have been distinguished: (i) microbiological seed treatment; (ii) dipping the roots of the cuttings in suspension; (iii) spraying the inflorescence with suspension and a ►**soil inoculation strategy**, where three forms of inoculum are distinguished: (i) suspension of microorganisms; (ii) a microbial lyophilisate; (iii) immobilized microorganisms.

Description of research

The research will focus on assessing the efficiency of the degradation process and bioconversion of waste biomass by soil systems, in which microbiota has been enriched with beneficial microorganisms. The proposed set of microorganisms, with which the soil system will be modified, includes bacteria and fungi with different properties and potential applications. Among them, we can distinguish bacteria/fungi which ►solubilize phosphorus, potassium, and zinc, ►oxidizing, ►hydrolytic and ►keratolytic microorganisms. The effectiveness of the bioconversion processes will be assessed mainly in terms of the ►solubilization of nutrients, ►the stability of microorganisms in the soil system, and ►the morphological properties of the obtained plants and their elemental composition. For this purpose, special bioreactors will be constructed, which will allow the monitoring of all elements of the soil system, mainly ►the growth rate of microorganisms and ►the solubilization of nutrients in real-time. In addition, the planned scope of the research includes ►analysis of the surface of waste streams before and after the solubilization process, ►identification of enzymes, metabolites, and chemicals produced/released into the environment by plant roots and microorganism cells. The main research objective of this project will be to understand the impact of the method used to introduce the microorganism into the plant growth environment (soil system) or the plant itself on the previously mentioned parameters, which is a proposal that has not been studied so far. Ultimately, based on the operational parameters of the tested soil systems obtained in laboratory conditions, the ones with the highest efficiency will be selected and subjected to pot and field tests. In all research on the soil system, the parameters of the obtained model plants will be taken into account, e.g., ►the effectiveness of 'infecting' plants with beneficial microorganisms, but also parameters such as ►the volume of the root ball, ►the mass of the green-part and ►the chlorophyll content. In addition, ►the elemental composition of plant biomass will also be assessed for possible biofortification with nutrients (e.g., Zn). There will be a strong emphasis on safety given the potential presence of undesirable substances introduced into the soil via secondary raw materials.

Reasons for taking up this research topic

The existing homeostatic mechanism, antagonistic interactions between individual species in the soil environment, creates a serious risk of an unsatisfactory level of adaptation of the desired microorganism or a consortium of microorganisms in the soil environment. Being aware of the importance and role played by microorganisms in the soil system, it is necessary to search for new effective ways of introducing beneficial strains into the soil environment, assessing their effectiveness in the context of stabilization, and above all, usefulness in the process of waste bioconversion and nutrient release.

The most important effects expected

The expected effect of this project is the understanding of the nature of the relationship between the various elements of the soil system, which will allow refining the strategy of the effective introduction of microorganisms, new species/strains, into the soil system, adapted to a specific source of plant nutrients. As a result, it is expected to obtain a set of microorganisms forming a stable consortium that, effectively introduced into the soil system, will effectively release nutrients from the agri-food waste matrix, covering the demand for all necessary plant nutrients while using secondary raw materials as part of a circular economy strategy and the circulation of nutrients.