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Perspective

Impact of Microbial Inoculants on Soil Microbial Communities

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DECSRIPTION

Since using inoculants would significantly reduce the need for chemical fertilisers and pesticides, the use of inoculants is thought to be very desirable. As a result, more and more inoculants are being commercialised for different crops. Agricultural systems depend on microbes, particularly those that encourage plant development. The following three methods are primarily responsible for plant growth benefits: that operate as biofertilizers, such as phosphate-solubilizing bacteria and nitrogen-fixing bacteria, help plants absorb nutrients by supplying fixed nitrogen or other nutrients. (ii) Phytostimulators, which are microorganisms that express phytohormones like Azospirillum, can directly encourage plant development by generating plant hormones. (iii) Biological control agents that defend plants from phytopathogenic organisms include Trichoderma, Pseudomonas, and Bacillus.

Several evaluations have covered various facets growth promotion. However, vaccination-related potential environmental effects were never considered. Since inoculation involves providing high concentrations of effective and viable microorganisms for a quick colonisation of the host rhizosphere, it would at least temporarily disturb the equilibrium of soil microbial communities. If significant native species are lost, the makeup of the microbes may change in an unfavourable way that will have an impact on future crops. However, ecosystem resilience, which is influenced by the degree of diversity and interactions of the plant-soil biota, could act as a buffer against an alteration in the bacterial community structure brought on by inoculation.

However, due to bacterial redundancy, which allows multiple bacterial species to perform the same duties, the loss of some bacterial species might not have an impact on how the system functions. A significant problem for soil ecology is the complexity and dynamic nature of the soil microbial community, whose composition differs between different compartments and layers. Despite being more informative, high-throughput sequencing techniques are still not economically feasible for inoculation impact studies due to the large number of samples and duplicates required. As inoculants, soil microorganisms such as rhizobia, azospirillum, mycorrhizal fungi, and biocontrol agents have been used.

Rhizobia inoculants

Different pathways have been suggested by rhizobia to affect crop growth, yield, and nutrient uptake. They fix nitrogen, aid in fostering naturally occurring nitrogen-fixing bacteria, increase the availability of other nutrients like phosphorus and iron, produce plant hormones, enhance the growth of other helpful bacteria or fungi, fight bacterial and fungal diseases, and aid in the management of insect pests. A Rhizobium strain that has been released into the wild contains the genes for the antibiotic peptide trifolitoxin, which makes it more competitive with strains of protists that are susceptible to the substance. Ribosomal intergenic spacer analysis demonstrated a significant reduction in the diversity of proteobacteria that are trifolitoxin-sensitive while having little apparent impact on the majority of microorganisms using both a cultivation-dependent method and a polymerase chain reaction, single-strand conformation polymorphism method.

It is commonly known that Azospirillum has agricultural advantages. Numerous mechanisms of action are thought to be involved, particularly the production of phytohormones such as indole-3-acetic acid. Since Azospirillum inoculation can have a significant impact on root growth and exudation, it is anticipated that the use of these phytostimulatory will change the structure of the rhizosphere's resident microbial community. Inoculating maize with *Azospirillum lipoferum* increased the genetic diversity of the rhizobacterial communities between different field-grown maize plants and between sampling times, according to research using automated ribosomal intergenic spacer analysis but did not change the overall number of root bacteria.

Mycorrhizal fungi inoculants

Arbuscular Mycorrhizal Fungi (AMF) which is included in the phylum Glomeromycota, has the capacity to establish mutualistic

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symbioses with the majority of terrestrial plants and colonise a larger soil area. They absorb carbon from their host, promoting plant growth by taking advantage of resources and giving back minerals and water. AMF affect soil microorganisms connected to their extraradical mycelium, resulting in the formation of the mycorrhizosphere, a distinct region of soil. The AMF may have a detrimental, a favourable, or no impact on the biomass and development of particular microbial species in the mycorrhizosphere. Numerous studies have demonstrated that particular bacterial species react to the presence of particular AMF, indicating a high level of bacterial specificity associated with AMF.