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ROLE OF SOIL BACTERIA IN PLANT NUTRITION - CURRENT AND FUTURE ASPECTS

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Abstract :

The soil has a wide variety of microorganisms that are part of a varied ecosystem that includes plants. It has long been understood that some of these microorganisms, such as nitrogen-fixing symbiotic bacteria or mycorrhizal fungi, play significant roles in plant performance by enhancing mineral nutrition. However, only recently have researchers begun to identify the full range of microorganisms connected to plants and their potential to replace artificial agricultural inputs. The understanding of the make-up and behaviour of rhizospheric microbiomes has advanced significantly in recent years. Long-term use of these fertilisers frequently results in a drop in pH and exchangeable bases, rendering them inaccessible to crops and lowering agricultural productivity. Farmers have become increasingly reliant on chemical sources of nitrogen and phosphorus to solve this issue and increase plant yields

Keywords: Soil, Rhizosphere ,Plants, ecosystem

Introduction

Because microorganisms play a significant role in establishing a complex relationship between plants and soil, it is crucial to promote soil health for good crop growth. Soil serves as the foundation for agricultural crop production. The soil system's dynamic component of soil, soil microorganisms carry out a variety of helpful tasks. Microbes aid in a variety of biological transformations, including the biological fixation of nitrogen and the conversion of organic materials. Additionally, they improved the plants' access to nutrients. One gramme of soil with more than 90 million bacteria in it typically aids plants in nutrient uptake by converting inaccessible nutrients into forms that are available to plants. People underestimate the significance of bacteria, which leads them to believe that they have negative effects because they frequently operate as However, according to the agricultural point of view microbes are very well beneficial for plant growth. Now a day's biotic stress is a big challenge for agrarian because dramatic increase in the human population is causing land degradation and reduces the microbial population which ultimately negatively affect the plant growth. Therefore, the present review describes the role of soil microbes in agricultural crop production. Uncontrolled application of fertilisers, especially those high in nitrogen and phosphorus, has significantly contaminated the soil, the air, and the water in the process of modern agriculture. (Gupta et al 2015).These substances have negative effects on soil microorganisms, have an adverse impact on soil fertility, and pollute the environment when used excessively. (Youssef, & Eissa, 2014). Long-term use of these fertilisers frequently results in a drop in pH and exchangeable bases, rendering them inaccessible to crops and lowering agricultural productivity. Farmers have become increasingly reliant on chemical sources of nitrogen and phosphorus to solve this issue and increase plant yields. (Gupta et al 2015). Chemical fertiliser manufacture is expensive, wastes nonrenewable resources like the oil and natural gas used to make them, and is hazardous to both people and the environment. India's agricultural policy has significantly changed over the past few decades as a result of diversification efforts and a focus on environmentally friendly producing methods. Since the term "rhizosphere" was coined to describe the comfortable environment of microorganisms near plant roots, rhizosphere study has produced a number of unexpected and intriguing research questions.(Akhtar et al,.2012) Hiltner coined the phrase "rhizosphere" for the first time. They participate in a variety of biotic activities that keep the soil ecosystem dynamic and sustainable for crop production. In recent years, PGPR has received a lot of attention because it can replace agrochemicals (fertilisers and pesticides) for the promotion of plant growth through a number of mechanisms, including the formation of soil structure, the breakdown of organic matter, the recycling of essential elements, the solubilization of mineral nutrients, the production of numerous plant growth regulators, the degradation of organic pollutants, the stimulation of root growth, which is essential for soil fertility, and biocontrol of soil. (Gupta et al 2015). Systems of plant-microbe interactions have typically been thought of in terms of host-pathogen interactions. It distinguishes between two immune systems in plants, one that responds to molecular patterns associated with microbes through pattern-triggered immunity (PTI), and the other that does so in response to effectors attempting to block PTI. The interaction dynamics we are interested in cannot be captured by this image because it is only an explanatory model . In fact, the following key components must be included in order to create a predictive model of plant-microbe interactions, particularly advantageous ones: (i) the actual chemical elements driving the interactions, such asif the objective is to build a predictive model of plant–microbe interactions, and in particular beneficial ones, the fundamental ingredients include: (i) the actual molecular factors driving the interactions, like the ones discussed in the previous sections of this review; (ii) environmental conditions inducing different reactions, e.g., to stresses; (iii) temporal and spatial scales of the phenomena under study. While it would be nice to have a single model drawn from a universal theory of plant–microbe interactions, we are mostly at the stage where mathematical models are first needed to answer a limited number of focused and well-defined biological questions. With the current advancement in “omics” experimental techniques and with the development of computational methods to understand metabolic pathways, quantitative models of plant–microbes ecosystems at the molecular level become an appealing possibility. Although soil is commonly just seen as a source of nutrients for plants by plant physiologists, it is actually a complex ecosystem that supports bacteria, fungus, protists, and animals.The relationships between plants and these organisms in the soil span the complete spectrum of ecological possibilities (competitive, exploitative, neutral, commensal, mutualistic). The majority of interaction investigations in modern plant science have concentrated on reducing pathogenic impacts like herbivory and infection or reducing abiotic stress conditions. The emphasis of research has evolved significantly since the 2000s from studying specific bacteria strains to using metagenomics to map the variety and abundance of the root microbiome. According to the findings of these sequencing research, the rhizospheric niche is a hotspot of ecological richness, with plant roots containing a huge variety of microbial species. (Jacoby et al,.2015)

Rhizobacterial Forms that Promote Plant Growth :

Extracellular plant growth promoting rhizobacteria (ePGPR) and intracellular plant growth promoting rhizobacteria (iPGPR) are two different types of plant growth boosting bacteria (Joshi et al,.2006). In contrast to iPGPRs, which are typically found inside the specialised nodular structures of root cells, ePGPRs can exist in the rhizosphere, on the rhizoplane, or in the spaces between the cells of the root cortex. Agrobacterium, Arthrobacter, Azotobacter, Azospirillum, Bacillus, Burkholderia, Caulobacter, Chromobacterium, Erwinia, Flavobacterium, Micrococcous, Pseudomonas, and Serratia are among the bacterial taxa that belong to the ePGPR . The iPGPR is a member of the Rhizobiaceae family, which also includes endophytes and Frankia species that can symbiotically fix atmospheric nitrogen with higher plants . Rhizobiaceae comprises Allorhizobium, Bradyrhizobium, Mesorhizobium, and Rhizobium (Gupta et al 2015).

By serving as ideal indicators for specific tasks in soils' surrounds, soil microorganisms link soil to roots, recycle nutrients, break down organic materials, and respond quickly to any changes in the ecology of soil. A variety of non-symbiotic (Azotobacter, Azospirillum, Bacillus, and Klebsiella sp.) and symbiotic (Rhizobium sp.) bacteria are increasingly being employed globally to boost plant production. Microbial biomass is one of the biological components of soil organic matter. Microbes are widely used in organic agriculture and on natural agricultural land since they are helpful in lowering the issues caused by the use of chemical fertilisers and pesticides. As the active component of organic matter, microbial biomass has an impact on nutrient storage, nutrient transformations, and cycling. In their native habitat, plants are a component of a diversified ecosystem that also includes a large number of microorganisms. It has long been understood that some of these microorganisms, such as nitrogen-fixing symbiotic bacteria or mycorrhizal fungi, play significant roles in plant performance by enhancing mineral nutrition. However, only recently have researchers begun to identify the full range of microorganisms connected to plants and their potential to replace artificial agricultural inputs. The understanding of the make-up and behaviour of rhizospheric microbiomes has advanced significantly in recent years. There is overwhelming evidence that both bacteria have evolved different adaptations to survive in the rhizospheric niche and that plants influence microbiome architecture, most likely through root exudates (Jacoby et al,.2015)

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