Bacteria-Soil-Plant Interaction: This Relationship to Generate can Inputs and New Products for the Food Industry

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Abstract

A thorough study of microbial communities that inhabit aquatic agro-ecosystems is crucial to a better understanding

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they remain in soil particles adhered to the roots, and thus can provide the ideal moisture to the roots to keep them alive [1]. ere are groups of microorganisms that produce endospores, which stay dormant and viable in the environment for years, remaining so during adverse situations waiting for a favorable environment for their development, when they return to active form. Some organisms use the energy of chemical interactions, others are even able to photosynthesize and produce their own energy [29]. Most studies of microbial communities in irrigated rice are focused on mass of populations from soil experimentally developed, as many microorganisms are closely linked to the ground by removing nutrients and interfering in its composition [30].

Diazotrophic Bacteria

e endophytic bacteria play a fundamental role in plants and do not cause disease symptoms in which they are associated. ese species are able to invade the internal tissues providing a systemic dissemination. e population of viable endophytic diazotrophs in cultivated rice varies with the type of soil, the growth phase of rice culture, and plant tissue. In general, bacterial populations are larger in the roots, compared with stems and leaves [30]. e rice roots harbor endophytes equivalent to 10^8 cultivable nitrogen- xing bacteria by root gram of dry weight, and an even larger number of non-cultivable bacteria [31]. Nitrogen is one of the most important nutrients for achieving high productivity of annual crops due to high demand of the plant for this nutrient. erefore, the low availability of this nutrient limits the productivity of the crop. Most of the nitrogen xation from air takes place through diazotrophs such as Azospirillum, Herbaspirilium and Burlkoderia [32]. e diazotrophs, which are inserted in nitrogen utilization in the soil, are important organisms that can be used as an alternative to nitrogen fertilization [33].

e fact of being able to process organic and inorganic substrates successfully, bacterias become critical for the dynamics of aquatic ecosystems. e interaction between plant and microorganism is little explored in agriculture, despite having global and local importance in the dynamic equilibrium of ecosystems.

e plant and microorganism association in the root system is essential for the chemotactic response of the endophyte to root exudates. In the colonization process, several stages occur, beginning with the displacement of the microorganism into the root system, clinging and distributing through roots [34].

e endophytic bacteria, in order to penetrate the roots, rst need the formation of intra and intercellular microcolonies. e di erent associations of endophytic bacteria can cause changes in plant colonization processes. Accordingly, the microorganisms migrate to the rhizosphere in response to root exudates, which are rich in amino acids, organic acids, sugars, vitamins, purines/pyrimidines, among others. In addition to providing nutritious substances, the plants can also eliminate secretions that facilitate colonization of speci c groups of bacteria [35,36]. Microorganisms allow the recycling of nutrients such as lost carbon that can be reintroduced into the food web. Aquatic environments di er in physical and chemical aspects as there are microbial di erences. Fungi and bacteria are mainly responsible for the decomposition process in aquatic ecosystems by converting organic matter into inorganic substances. Rainfall, when high, appears to contribute to the high bacterial rates [37].

Heterotrophic Bacteria

Bacteria that inhabit the rhizosphere promote the growth of host plants through the production of phytohormones such as auxins, the phosphate solubilization, the production of iron chelators (siderophores), the release of antimicrobial metabolites and for competition for nutrients [38]. e bacteria found in soil are highly diversi ed. In hot soils, for example, there is the presence of thermophilic microorganisms and microbial population changes very quickly as the available nutrients are modi ed [39].

e soil has great spatial variability composed of many micro habitats that may di er in their physicochemical properties [40], (Figure 1). ese characteristics provide a diverse composition of microorganisms, which accomplish the primary decomposition, cycling and regulation of nutrients and minerals retention. Bacteria

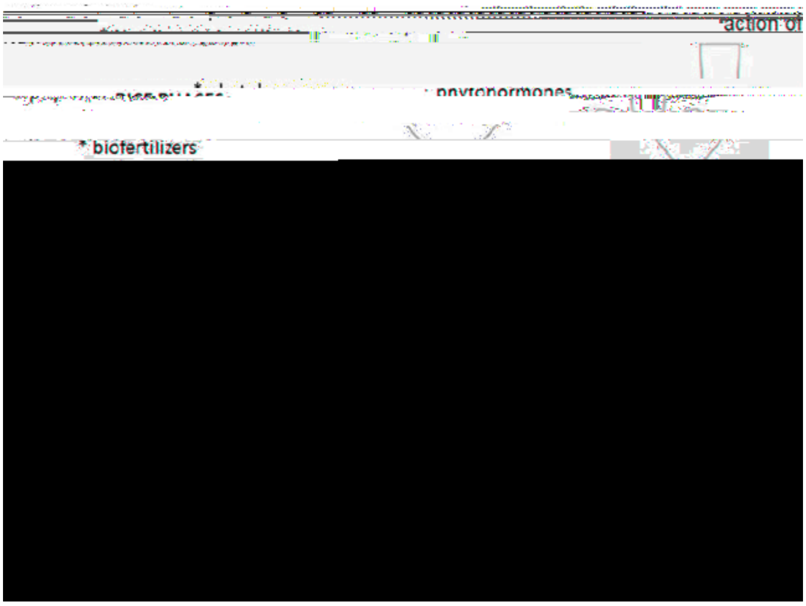

Figure 1: Interactions between bacteria and the rice plants in their different development stages.

necessary to observe some points, as food production is directly linked to environmental quality. Rice is one of the most consumed foods in the world, one of the most important grains in global economic terms. Rice is a culture that besides being simple is a great resource for human consumption. Rice, although not a food rich in vitamins, has a di erential, it is easily assimilated by the starch, which provides power, serving as fuel for the operation body. Currently, crops cultivation methods seek to optimize the potential of agricultural production through the application of fertilizers and pesticides and which consequently cause human health problems and an imbalance in agricultural ecosystems, especially in the communities that inhabit the soil. e rice crops su er and bene t from various microbial actions, including interactions between plants and microorganisms [54,55]. Rice agroecosystems consist of several micro-habitats and provide the suitability of a wide variety of microorganisms. e management of rice promotes changes of physical and chemical characteristics of the water and due to changes in pH, turbidity, temperature, radiation and amount of organic matter that may be related to the dynamics of microbial communities in the soil. Soil is a habitat full of living microorganisms that directly in uence the development of the plant. e bacteria that act in it are inserted in the process of chemical transformations that facilitate nutrient cycling and can be added to the food, generating inputs that provide functionality and well-being to the human being. e challenge of scientists in the area is still the search for a better quality of life, environmental protection and sustainable development, because rice is one of the grains produced in the world and extremely important for the world economy.

Acknowledgement

"Give thanks to the Lord, for he is good." Psalm 136:1. The authors thank &13T)$3(5*6 1875,)25 DQG 81,6,126 IRU WKH ¿QDQFLDO VXSSRUW , PÀD , cmeT303>d 520a sr2t38003123>d 520a 9 Paulay,þôe
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