
Probiotics in Agroecosystem

Vivek Kumar • Manoj Kumar
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Editors

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 Springer

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Preface

Probiotics in Agro-Ecosystems

As a general notion, probiotics are beneficial microbes for human health, and are, by definition, living microbes, which when administered appropriately confer a benefit to the host. Advertisements and recent research claim that probiotic products are good for our health, resulting in improved digestion, immunity, and management of allergies and colds. However, the probiotic prospective applications in nondairy-food products and agriculture have not received proper recognition. Presently there is increased interest in food and agricultural applications of probiotics, selection of new probiotic strains, and the development of new applications. The agricultural applications of probiotics with regard to animal, fish, and crop plants have increased steadily, yet a number of uncertainties concerning technological, microbiological, regulatory, and ignored aspects do exist.

Human systems obtain benefits from the beneficial bacteria of probiotics. Likewise, plants also reflect a dependency on certain eco-friendly microbes that act in symbiosis, i.e. plant strengtheners, bioinoculants, phyto-stimulators, and biopesticides, which eventually benefit human health and agro-ecosystems. The way these microbes are associated with or inhabit plant systems and the fate of their interaction are still poorly understood at a metabolic level. It most likely differs according to microbial plethora, age, and species of the plant, although numerous environmental factors do influence this association.

Scientists have known for decades that legume plants harbor beneficial bacteria in nodules, which fix unavailable nitrogen into a form the plant can easily use. On the other hand, the plant root surface, especially the rhizosphere region, harbors diverse beneficial bacteria and fungi along with various types of endophytes, which are present in the host tissue. This endophytic plant relationship is a matter of adaptation during the process of evolution. Plants have a restricted capacity to genetically adapt to rapidly changing environmental conditions such as temperature, water stress, pathogens, or limited nutrient resources. Therefore, plants may use microbes that have the potential to evolve rapidly owing to their short life cycles and simple genetic material, and help the plant to overcome unfavorable conditions. During the

process of selection, the host plant chooses or favors the right microbes for particular conditions, which helps the plants to be healthier and competitive. In this way, it is comparable to humans taking probiotics to improve their health.

The increasing interest in the preservation of the environment and the health of consumers is demanding change in production methods and food consumption habits. Consumers demand functional foods because they contain bioactive compounds in bioavailable forms that are involved in health protection. To fulfill consumers' demands, plants are inoculated with biofertilizers, which are linked to the roots or move inside them, thus acting as plant probiotics and to some extent they become reliable substitutes for chemical fertilizers.

These beneficial microbes are plant probiotics, which promote plant growth through diverse mechanisms such as phosphate solubilization, nitrogen fixation, phytohormone and siderophore production, and by mitigating abiotic and biotic stress. They act as vector carriers that take up unavailable nutrients, move them through the soil, and mobilize them to the root. This concept posits that less is wasted, whatever is available is utilized, and that less needs to be applied. The plant thrives in an environment of lower pollution, and nutrients taken up by the organisms are not available to be leached into the ground and surface waters. In addition, this concept creates a healthy soil that produces superior and healthy plants and involves much more than using only chemical inputs. Regular application of only synthetic inputs leads to reduced soil quality and fortifies plants with chemicals, which results in unhealthy produce, imparting negative effects on human health.

Health-conscious society has encouraged farmers and organic growers to adopt these microbial-based probiotic technologies to inoculate seeds/soils/roots to provide nutrients like phosphate, nitrogen, and other phytostimulatory compounds. In addition, microorganisms have also attracted worldwide consideration owing to their role in disease management, drought tolerance, and remediation of polluted soils. Accordingly, selected and potentially selected microbial communities are possible tools for sustainable crop production and can set a trend for a healthy future. Scientific researchers draw on multidisciplinary approaches to understanding the complexity and practical utility of a wide spectrum of microbes for the benefit of crops. The success of crop improvement, however, largely depends on the performance of microbes and the willingness and acceptance by growers to cooperate. A substantial amount of research has been carried out to highlight the role of microbes in the improvement of crops, but very little attempt is made to organize such findings in a way that can significantly help students, academics, researchers, and farmers.

"Plant Probiotics in Agro-Ecosystems" is conceptualized by experts providing a broad source of information on strategies and theories of probiotic microbes with sustainable crop improvement in diverse agro-ecosystems. The book presents strategies for nutrient fortification, adaptation of plants in contaminated soils, and mitigating pathogenesis, and explores ways of integrating diverse approaches to accomplish anticipated levels of crop production under outdated and conventional

agro-ecosystems. It is believed that the enthusiasm and noteworthy opportunities presented in this work regarding our recent understanding of the challenges and relationships that bring about learning plant probiotic and synergistic approaches towards plant and human health will inspire readers to push the field forward to new frontiers.

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About the Editors

Vivek Kumar, PhD is Associate Professor, involved in teaching, research and guidance, with a pledge to enduring knowledge. Dr. Kumar works at Himalayan School of Biosciences, Swami Rama Himalayan University, Dehradun, India. He obtained his Masters and Ph.D degrees from CCS Haryana Agricultural University, Hisar, Haryana, India. He serves as an editor and reviewer of several reputed international journals. He has published 61 research papers, 30 book chapters, six review articles, and four books. Dr. Kumar has also served as a microbiologist for 8 years in the Department of Soil and Water Research, Public Authority of Agricultural Affairs and Fish Resources, Kuwait. He has been credited with first-time reporting and identification of pink rot inflorescence disease of the date palm in Kuwait caused by *Serratia marcescens*. He has also organized a number of conferences/workshops as convener/organizing secretary.

Dr. Kumar's research areas are plant-microbe-interactions, environmental microbiology, and bioremediation. He was awarded the 'Young Scientist Award' for the year 2002 in 'Agricultural Microbiology' by the Association of Microbiologists of India (AMI).

Manoj Kumar, PhD is a positive-minded scientist who has a passion for research and development, with a commitment to lifelong learning. He is devoted to high quality science that contributes broadly to both increasing the intellectual knowledge of plant development and to increasing the ecological niche. He has a high level of professional desire and intellectual curiosity, and the potential to fulfil the dream of his high impact publications and the future recognition of these by academic peers.

Dr. Kumar completed his PhD in plant biotechnology at the prestigious Jawaharlal Nehru University and was then awarded two post-doctoral fellowships consecutively: i) DBT-PDF from IISc Bangalore in 2005 and then NRF-PDF from University of Pretoria.

Dr. Manoj Kumar is a researcher of plant biotechnology in the Amity University Uttar Pradesh, India. His present research goal is to understand the metabolic fate of microbial-mediated precursors in whole plant physiology and genetics through processes occurring at the level of metabolism, particularly through processes of

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Dr. Kumar has published his research work in many prestigious journals and played the role of reviewer for many of his peers.

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He has successfully supervised seven Ph.D., eight M. Tech. and 28 M.Sc. students. He has more than 80 publications in different research journals and various book chapters to his credit. He has also organized various outreach activities.

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