Soil Biology

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Biofertilizers for Sustainable Agriculture and Environment

Springer

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Preface

With the introduction of high-yielding varieties and application of chemical fertilizers and pesticides, the agricultural production has increased significantly but gradually becoming dependent on the inputs of cumulative dosages of these menacing chemicals. These chemicals not only are expensive to the farmers but also reduce organic carbon and microbial activities in the agricultural soils and are harmful for human health as they enter the food chain. The increasing dependence upon such chemicals for greater agricultural production compels the scientific community to overcome this problem and find out realistic solutions.

The application of biofertilizers could be a desirable alternative as they make agriculture more sustainable and environmental-friendly; indeed, the growing crops using biofertilizers are worthy for human health. Biofertilizers are consist of plant remains, organic matter, and safe and beneficial microorganisms, which are natural, organic, biodegradable, eco-friendly, and cost-effective. Biofertilizers indeed meet the integrated nutrient demand of the crops, hence ascribed as indispensable for obtaining greater crop yield, and attribute to increased fertility and health of the soil by providing nutrients and natural environment in the rhizosphere. Microbes present in the biofertilizers are important because they produce nitrogen, phosphorus, potassium, zinc, iron, and other nutrients required for the growth of plants. In fact, several microbes produce plant growth-promoting substances like auxins, cytokinins, and gibberellins, which are essential for the growth and development under vital soil conditions. Microorganisms like *Rhizobium*, *Azospirillum*, *Azotobacter*, *Azolla, Piriformospora indica* (*Serendipita indica*), and *Cyanobacteria*/blue green algae have been found to add a significant amount of nitrogen under optimum soil conditions, thereby largely reducing the use of chemical fertilizers. The application of such microbial inoculants showed a robust impact on the crop yield. Furthermore, several microbes exhibit the ability to recover heavy metals from soil, thereby making the soil environment suitable for growing crop plants.

Phosphate-mobilizing or phosphorus-solubilizing microorganisms convert insoluble soil phosphate into soluble forms by secreting several organic acids. Symbiotic fungi enhance the uptake of water and macro- and micronutrients by extending

extra-radical hyphae several meters beyond the depletion zone, thus increasing the nutrient uptake ability of the host plant. Moreover, they protect plant from environmental stresses like salinity and drought and also strengthen the defense system of plant, thereby suppressing the incidence of plant diseases, and thus help in the biocontrol of plant diseases. In general, biofertilizers improve physicochemical properties of the soil. Hence, it is pertinent to state that biofertilizers are a vital and powerful tool for sustainable agriculture and environment.

The book *Biofertilizers for Sustainable Agriculture and Environment* comprises 24 provocative chapters written by the experts of this field, highlighting the latest research on the beneficial microbial inoculants such as phosphate-solubilizing and phosphate-mobilizing fungi; N_2-fixing bacterial inoculants (free living and symbiotic); phosphorus-, potassium-, and zinc-solubilizing bacteria; algal inoculants; microbes for the removal of heavy metals from agricultural fields for sustainable agriculture; microbes for recycling of biodegradable municipal, agricultural, and industrial waste; and biocontrol agents and biopesticides. Though, under current circumstances, the application of microbial inoculants cannot be treated as an alternative for chemical fertilizers and pesticides, indeed, these natural inoculants can largely be utilized to reduce the use of these chemicals. With a fortune of information on the different aspects of biofertilizers, this intensive volume indeed provides useful information, dealing with different groups of microorganisms and their beneficial effects, and is a valuable resource for researchers, academician, environmentalists, and students in the broad field of microbiology, biotechnology, and agriculture and for the industrialists involved in the production of biofertilizers.

We are highly delighted and thankful to all our contributing authors for their endless support and outstanding cooperation to write selflessly these authoritative and valuable chapters. We extend our sincere thanks to all our colleagues who helped us in the preparation and compilation of this generous volume. We thank the Springer officials, specially William F. Curtis, Eric Schmitt, Sabine Schwarz, Isabel Ullmann, Beate Siek, and Anand Venkatachalam, for their generous support and efforts in accomplishing this volume. We specially thank our families for their consistent support and encouragement.

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