Pedosphere **32**(1): 149–170, 2022
doi: 10.1016/S1002-0160(21)60042-5
ISSN 1002-0160/CN 32-1315/P

PEDOSPHERE
www.elsevier.com/locate/pedosphere

Actinobacteria-enhanced plant growth, nutrient acquisition, and crop protection: Advances in soil, plant, and microbial multifactorial interactions

Debasis MITRA[1], Rittick MONDAL[2], Bahram KHOSHRU[3], Annaman SENAPATI[4], T. K. RADHA[5], Bhaswatimayee MAHAKUR[6], Narendra UNIYAL[7], Ei Mon MYO[8], Hanane BOUTAJ[9], Beatriz Elena GUERRA SIERRA[10], Periyasamy PANNEERSELVAM[4,5], Arakalagud Nanjundaiah GANESHAMURTHY[5], Snežana ANDELKOVIC[11], Tanja VASIC[*12], Anju RANI[13], Subhadeep DUTTA[2] and Pradeep K. DAS MOHAPATRA[1,14,*]

[1]*Department of Microbiology, Raiganj University, Raiganj, West Bengal 733134 (India)*
[2]*Department of Sericulture, Raiganj University, Raiganj, West Bengal 733134 (India)*
[3]*Department of Soil Science, Faculty of Agriculture, University of Tabriz, Tabriz 516664 (Iran)*
[4]*Crop Production Division, Indian Council of Agricultural Research (ICAR) National Rice Research Institute, Cuttack, Odisha 753006 (India)*
[5]*Division of Soil Science and Agricultural Chemistry, ICAR Indian Institute of Horticultural Research, Bengaluru, Karnataka 560089 (India)*
[6]*Department of Botany and Biotechnology, Ravenshaw University, Cuttack, Odisha 753003 (India)*
[7]*Genetics and Tree Propagation Division, Forest Research Institute, Uttarakhand 248001 (India)*
[8]*Biotechnology Research Department, Department of Research and Innovation, Ministry of Education, Kyaukse 05151 (Myanmar)*
[9]*Laboratory of Biotechnology and Molecular Bioengineering, Faculty of Sciences and Technology, Cadi Ayyad University, Marrakech 40000 (Morocco)*
[10]*Universidad de Santander, Facultad de Ciencias Exactas Naturales y Agropecuarias, GrupoMicrobiota, Campus Universitario Lagos del Cacique, Bucaramanga 680002 (Colombia)*
[11]*Institute for Forage Crops, Kruševac 37251 (Republic of Serbia)*
[12]*Plant Protection, Faculty of Agriculture, University of Niš, Kosančićeva 4, Kruševac 37000 (Republic of Serbia)*
[13]*Department of Life Sciences, Graphic Era (Deemed to be University), Dehradun, Uttarakhand 248002 (India)*
[14]*Professor A. K. Rathin Environment Conservation Centre, Raiganj University, Raiganj, West Bengal 733134 (India)*

(Received October 23, 2020; revised December 16, 2020; accepted April 12, 2021)

ABSTRACT

Agricultural areas of land are deteriorating every day owing to population increase, rapid urbanization, and industrialization. To feed today's huge populations, increased crop production is required from smaller areas, which warrants the continuous application of high doses of inorganic fertilizers to agricultural land. These cause damage to soil health and, therefore, nutrient imbalance conditions in arable soils. Under these conditions, the benefits of microbial inoculants (such as Actinobacteria) as replacements for harmful chemicals and promoting ecofriendly sustainable farming practices have been made clear through recent technological advances. There are multifunctional traits involved in the production of different types of bioactive compounds responsible for plant growth promotion, and the biocontrol of phytopathogens has reduced the use of chemical fertilizers and pesticides. There are some well-known groups of nitrogen-fixing Actinobacteria, such as *Frankia*, which undergo mutualism with plants and offer enhanced symbiotic trade-offs. In addition to nitrogen fixation, increasing availability of major plant nutrients in soil due to the solubilization of immobilized forms of phosphorus and potassium compounds, production of phytohormones, such as indole-3-acetic acid, indole-3-pyruvic acid, gibberellins, and cytokinins, improving organic matter decomposition by releasing cellulases, xylanase, glucanases, lipases, and proteases, and suppression of soil-borne pathogens by the production of siderophores, ammonia, hydrogen cyanide, and chitinase are important features of Actinobacteria useful for combating biotic and abiotic stresses in plants. The positive influence of Actinobacteria on soil fertility and plant health has motivated us to compile this review of important findings associated with sustaining plant productivity in the long run.

Key Words: biocontrol agents, microbial inoculant, metabolites, nitrogen fixation, plant growth promoters, sustainable agriculture

Citation: Mitra D, Mondal R, Khoshru B, Senapati A, Radha T K, Mahakur B, Uniyal N, Myo E M, Boutaj H, Guerra Sierra B E, Panneerselvam P, Ganeshamurthy A N, Andelković S, Vasić T, Rani A, Dutta S, Das Mohapatra P K. 2022. Actinobacteria-enhanced plant growth, nutrient acquisition, and crop protection: Advances in soil, plant, and microbial multifactorial interactions. *Pedosphere*. **32**(1): 149–170.

INTRODUCTION

Owing to the increasing global population, the demand for agricultural productivity is also increasing. To cope with the rising food demand, large-scale applications of chemically synthesized pesticides and fertilizers have been practiced to boost agricultural productivity (Zhang *et al.*, 2018). With the recent advances in agricultural equipment and innovative methods of application, traditional methods have reached their limits of efficiency (Pivoto *et al.*, 2018). For high-yielding varieties, chemical fertilizers are conventionally used in higher doses to increase productivity. These

*Corresponding author. E-mail: pkdmrnrcc@gmail.com.