



AGRI MAGAZINE

(International E-Magazine for Agricultural Articles)

Volume: 03, Issue: 09 (September, 2026)

Available online at <http://www.agrimagazine.in>

©Agri Magazine, ISSN: 3048-8656

Plant Growth Promoting Rhizobacteria (PGPR)

*Pitchaikumar S¹ and Pothiraj G²

¹The Indian Agriculture College, Radhapuram, Tirunelveli, Tamil Nadu, India

²ICAR-Indian Agricultural Research Institute, Regional Station, Pune, India

*Corresponding Author's email: spkumarpatho@gmail.com

Plant pathogens and pest can significantly affect agricultural productivity. Plant diseases are estimated to cause yield losses of 21-30% in several major crops worldwide. Meanwhile, some plant pathogens have developed long term resistance to chemical measures. Greater awareness of the environmental and health risks associated with synthetic chemical pesticides is essential for promoting sustainable crop management. Biological control of plant pathogen has been the subject of much research in recent years. It has the potential to reduce the use of chemical pesticides that are harmful to the environment. The use of PGPR represents a potentially attractive and alternative for disease management approach, as these bacteria have the capacity to simultaneously enhance crop yield and protect plants from pathogens.

Characteristics of PGPR

PGPR are capable of effectively colonizing plant roots and surviving and multiplying in the microhabitats associated with the root surface, even in competition with another microorganism in the rhizosphere. These bacteria contribute to plant protection by suppressing plant pathogens through various mechanisms, including the production of antibiotics, siderophores, lytic enzymes and other bioactive compounds. In addition, PGPR can promote plant growth and enhance the plants natural defense mechanism, thereby contributing to improved plant health and productivity.

Mechanism of PGPR

1. Siderophore production

Siderophore is a Greek derived term meaning "iron carrier". They are small, high affinity iron chelating compounds secreted by microorganisms, particularly bacteria and fungi. Most aerobic and facultative anaerobic microorganisms respond to low iron stress by producing siderophores. These compounds bind ferric iron and make it more accessible to plants and beneficial microorganism. Plants can utilize siderophore bound iron through interactions with plant growth promoting rhizobacteria including genera such as *Bacillus* and *Pseudomonas* etc. Iron chelators such as pseudobactins and pyoverdins produced by *P. fluorescens* chelate the iron available in the soil, thereby depriving the pathogens of its "Fe" requirements. Thus, siderophore production by PGPR can contribute to improved iron availability, plant growth, and protection against plant pathogens.

2. Potassium solubilization

More than 90% of the potassium in the soil exists in the form of insoluble forms, mainly rocks and silicate minerals, making it largely unavailable to plants. PGPR can enhance potassium availability by solubilising potassium bearing minerals through the production and secretion of organic acids and other metabolites. Bacteria belonging to genera such as *Pseudomonas* have been reported to release potassium bearing minerals into forms that are readily accessible to plants. Therefore, the application potassium solubilizing PGPR

biofertilizer can improve potassium availability; promote plant growth and support sustainable and eco-friendly crop production.

3. Phosphorus solubilization

Phosphorus is a major essential plant nutrient required for various physiological and metabolic processes. However, a large portion of soil phosphorus is in unavailable form and cannot be readily taken up by plants. PGPR play an important role in converting unavailable phosphorus into forms that are readily accessible to plants. PGPR possess the ability to solubilize inorganic phosphates and mineralize organic phosphorus compounds through the production of organic acids and other enzymes. *Bacillus megaterium* and *Pseudomonas fluorescens* are well-known phosphate-solubilizing PGPR that can enhance phosphorus availability and thereby promote plant growth and increase crop yield.

4. Antibiosis and lysis

The production of antibiotics is considered to be one of the most powerful and well-studied biocontrol mechanism employed by plant growth promoting rhizobacteria against phytopathogens. PGPR strains can produce a variety of antimicrobial compounds of plant pathogens. In addition, PGPR are capable of producing several hydrolytic and other enzymes including chitinases, dehydrogenases, lipase, proteases etc. These enzymes contribute to the degradation of pathogen cell components, disrupting cellular membrane structures, preventing the formation of initiation complex on the small ribosomal unit and help suppress phytopathogens, thereby enhancing plant health and providing effective biological control of plant diseases.

5. Induced systemic resistance

The application of plant growth promoting rhizobacteria known to induce resistance in plants against pathogens. Induced resistance refers to a state of enhanced defensive capacity developed by plants following appropriate stimulation. ISR involves jasmonate and ethylene signaling which stimulate the host plant defense responses against a broad range of plant pathogens. Systemic acquired resistance and induced systemic resistance are two major forms of induced resistance that can be distinguished based on the nature of the elicitor and the regulatory pathways involved.

Conclusion

Plant growth promoting rhizobacteria in the rhizosphere are highly dynamic and versatile, contributing to the mineral transformation, mobilization and solubilization of nutrients. PGPR play dual roles in promoting plant growth and acting as effective biocontrol agents against plant pathogens. They suppress plant pathogens through both direct and indirect mechanisms, including the production of antibiotics, siderophores, hydrolytic enzymes and other bioactive compounds as well as by inducing systemic resistance in plants. Although PGPR are naturally abundant in the environment, the screening and selection of effective can be challenging. Nevertheless, the integration of PGPR into integrated disease management strategies offers a promising sustainable and eco-friendly approach for controlling a wide range of plant pathogens while improving crop growth and yield.