

## Plant Growth-Promoting Rhizobacteria

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Plant growth-promoting rhizobacteria (PGPR) are the rhizosphere bacteria that can enhance plant growth by a wide variety of mechanisms like phosphate solubilization, siderophore production, biological nitrogen fixation, rhizosphere engineering, production of 1-Aminocyclopropane-1-carboxylate deaminase (ACC), quorum sensing (QS) signal interference and inhibition of biofilm formation, phytohormone production, exhibiting antifungal activity, production of volatile organic compounds (VOCs), induction of systemic resistance, promoting beneficial plant-microbe symbioses, interference with pathogen toxin production etc. The potentiality of PGPR in agriculture is steadily increased as it offers an attractive way to replace the use of chemical fertilizers, pesticides and other supplements. Growth promoting substances are likely to be produced in large quantities by these rhizosphere microorganisms that influence indirectly on the overall morphology of the plants. Recent progress in our understanding on the diversity of PGPR in the rhizosphere along with their colonization ability and mechanism of action should facilitate their application as a reliable component in the management of sustainable agricultural system.

### Types of PGPRs

**Extracellular PGPR (ePGPR):** existing in the rhizosphere, on the rhizoplane, or in the spaces between cells of the root cortex. Eg: Agrobacterium, Arthrobacter, Azotobacter, Azospirillum, Bacillus, Burkholderia, Caulobacter, Chromobacterium, Erwinia, Flavobacterium, Micrococcus, Pseudomonas and Serratia.

**Intracellular PGPR (iPGPR):** Locate generally inside the specialized nodular structures of root cells. Family of Rhizobiaceae includes Allorhizobium, Bradyrhizobium, Mesorhizobium and Rhizobium, endophytes and Frankia species.

### Role of PGPR in agriculture

PGPR performs a various mechanism (i.e. direct and indirect), that plays a crucial role in augmenting the growth of plants. The rhizosphere contains small fraction i.e. 2-5% of total bacteria are present in the vicinity are PGPR. PGPR possess a different mode of action that all

depends upon the host type plants. Some PGPR have high affinity toward the nitrogen fixation like rhizobium sp., Azotobacter and frankia fix the nitrogen in the range of 50-250, 20-30 and 50-150 kg N/ha/year respectively.

Some strains of PGPR are used as a bio-remediation for control the abiotic and biotic stress which is the major constraints in the soil that directly or indirectly reduces the yield of crop. Some of these are;

**a) Phytostimulator**

Phytostimulator is a synthetic substance which produced outside the plant and act as a growth stimulator of the plant and also boosting the crop production. Phyto hormones are organic substances which are produced by microorganisms that alter the concentration of IAA, Gibberelic acid and cytokinines.

**b) Auxin**

Auxin is one of key molecules that regulating the most crucial metabolic activity of plant by directly and indirectly.

**c) Gibberelic acid (GA)**

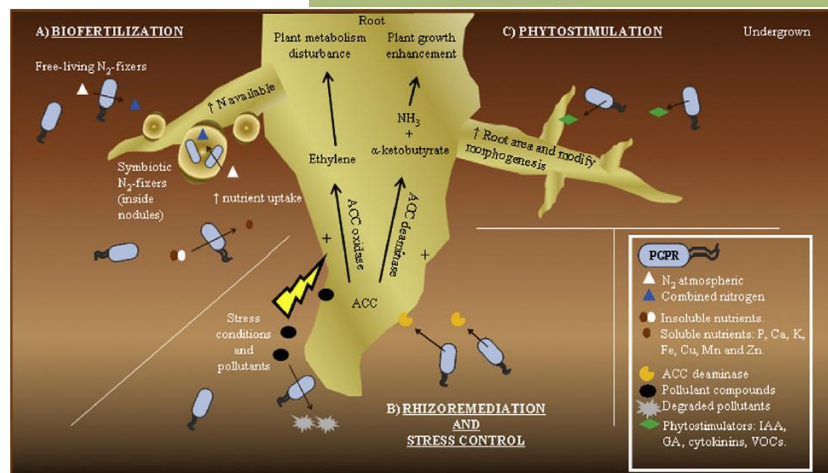
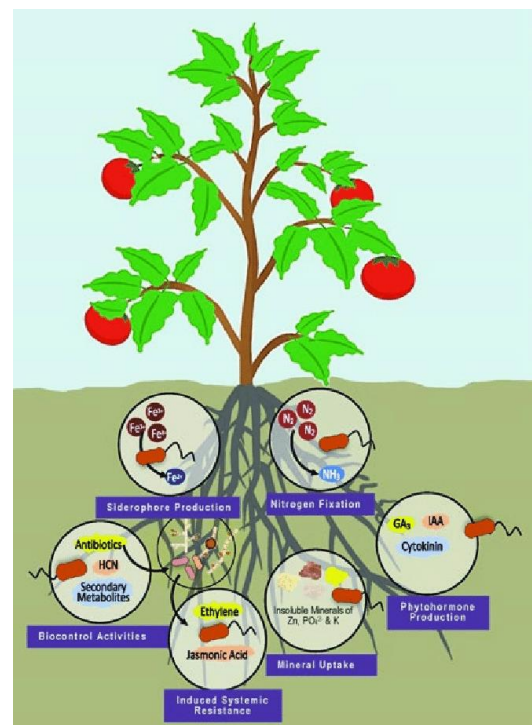
GA is a synthetic compound that plays an important role in seed germination, stem elongation, floral induction and fruit setting.

**d) Cytokinines**

Cytokinines is a crucial molecule which function is prominently observed in shoot and root initiation, cell division, cell enlargement and induce root hair proliferation that increase root surface area significantly.

**e) Biofertilizer**

Biofertilizer is a product that containing latent cells or living strains of efficient microbes which can be applied on seed, plant surface and soil that colonizes in the root vicinity of rhizosphere and enhanced the root growth by increasing primary nutrient availability.





## References

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