Functionality Groups of Plant Microbiome

23/04/2026

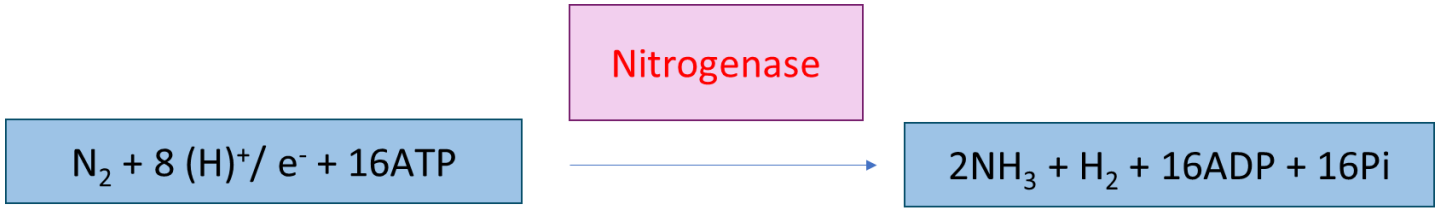
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- Plant microbiome?
- Functionality groups?
- Influence on plant growth, health, and ecosystem processes

Plant Growth-Promoting Rhizobacteria (PGPR) and Fungi

Enhance plant growth directly through nutrient acquisition and hormonal modulation

Nitrogen-Fixing Bacteria:



- Convert atmospheric nitrogen (N2) into usable forms (ammonia, nitrate) for plants

Rhizobium in legumes

Free-living *Azotobacter*



Yeast Extract Mannitol Agar (YEMA) with Congo Red

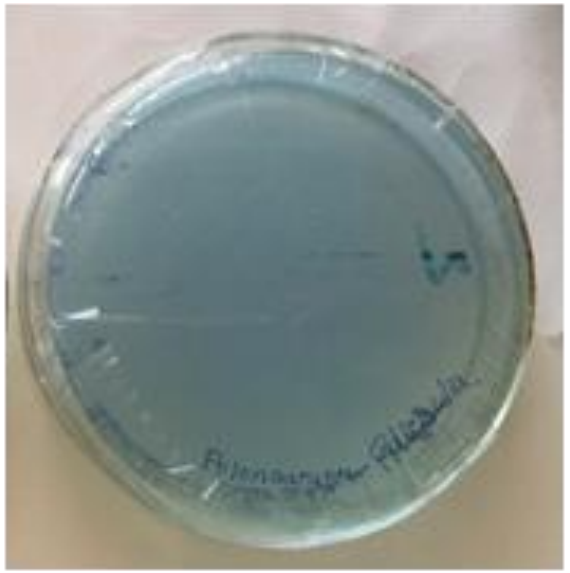


Ashby's Mannitol Agar

Nitrogen-free Malate Medium with Bromothymol Blue



Control

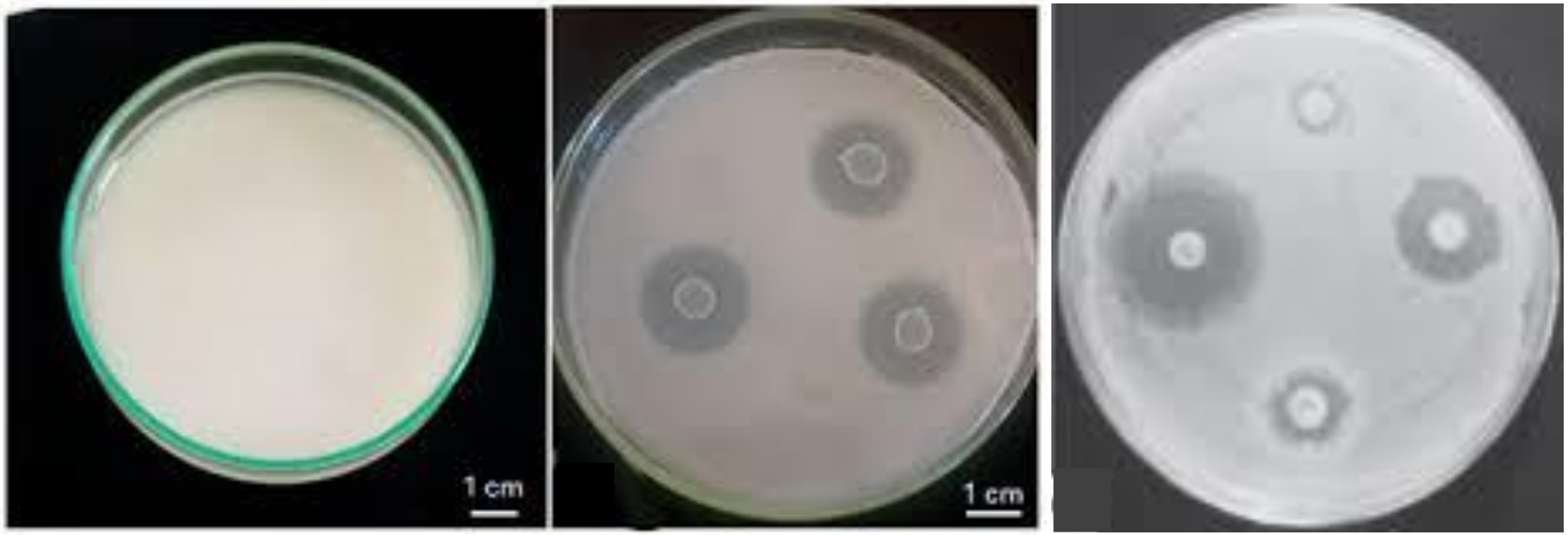




N fixation
Positive

- Phosphorus Solubilizers:

Bacteria (e.g., *Pseudomonas* spp., *Bacillus* spp.) and fungi (Penicillium spp.) convert insoluble phosphate in the soil into soluble forms that plants can take up



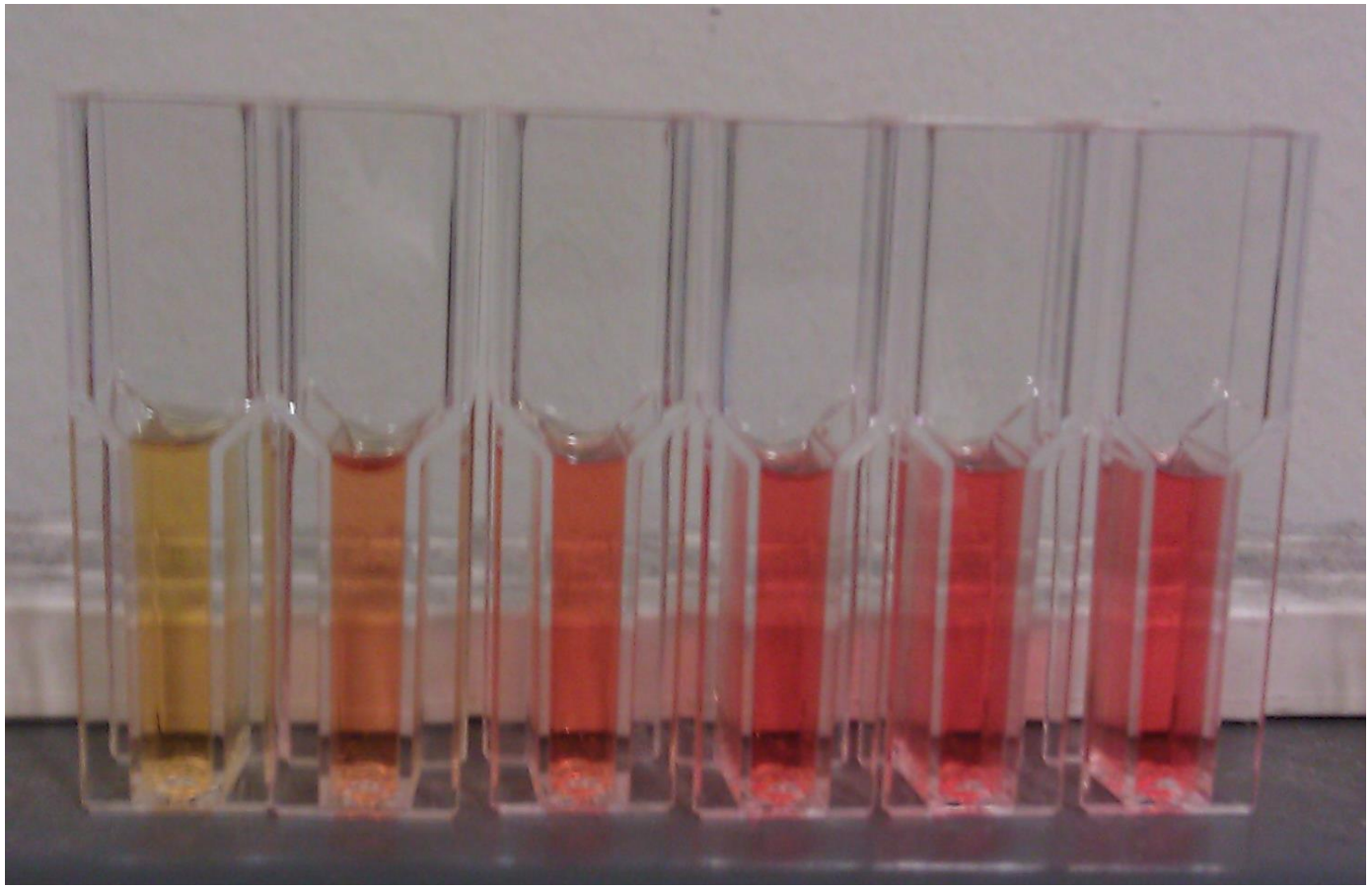
Control

Phosphate solubilization positive

The National Botanical Research Institute's phosphate (NBRIP)

- Phytohormone Producers:

Microbes that produce hormones like auxin (indole-3-acetic acid, IAA), gibberellin, and cytokinin, which stimulate root growth and branching



IAA Production

- ACC Deaminase Producers:

  These microbes break down 1-aminocyclopropane-1-carboxylate (ACC), a precursor to the stress hormone ethylene, thereby reducing stress and promoting plant growth

- Screened on Dworkin and Foster (DF) minimal salts medium
  - ✓ grown on DF plates supplemented with ACC
  - ✓ Bacteria that produce ACC deaminase can utilize ACC as their sole nitrogen source allowing them to grow, while others cannot

Plant Protectors and Biocontrol Agents

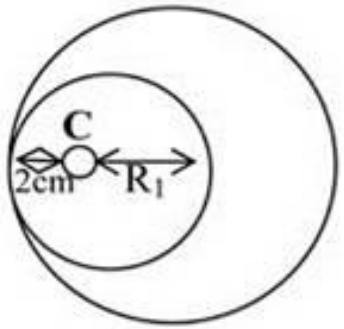
Protect plants from biotic stresses (pathogens and pests)

- Antibiotic Producers:

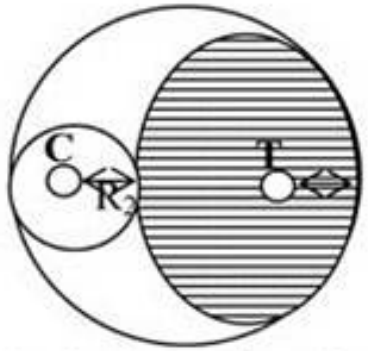
Species such as *Pseudomonas* and *Streptomyces* produce compounds (e.g., phenazine, pyrrolnitrin) that inhibit the growth of pathogenic bacteria and fungi



Dual culture technique



Control plate (R_1)



Dual culture plate (R_2)



- Siderophore Producers:

Microbes that produce siderophores (iron-chelating agents) to sequester iron, making it unavailable to pathogens



Chrome Azurol S (CAS) assay

- Induced Systemic Resistance (ISR) Inducers:

  Beneficial microbes that stimulate the plant's immune system, making it more resistant to future pathogen attacks

Stress Tolerant Microbes

Help plants survive abiotic stressors, including drought, salinity, and extreme temperatures

- Extremophiles/Extremotolerant Archaea: Specialized archaea (e.g., *Crenarchaeota, Euryarchaeota*in the rhizosphere that contribute to resilience in harsh environments, such as high-temperature or saline soils.

- Abiotic Stress Modulators: Microbes that assist in protecting against oxidative and osmotic stress.

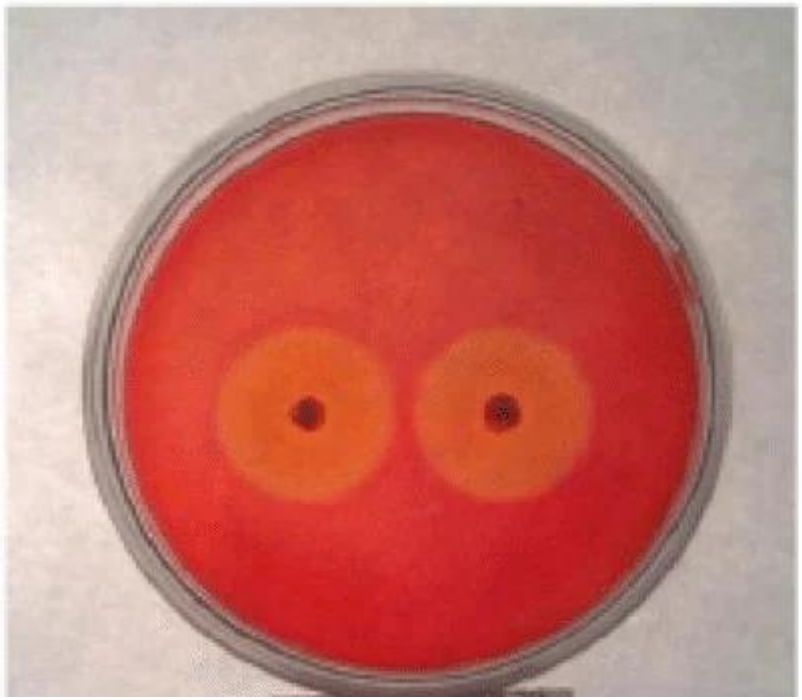
Nutrient Cyclers and Decomposers

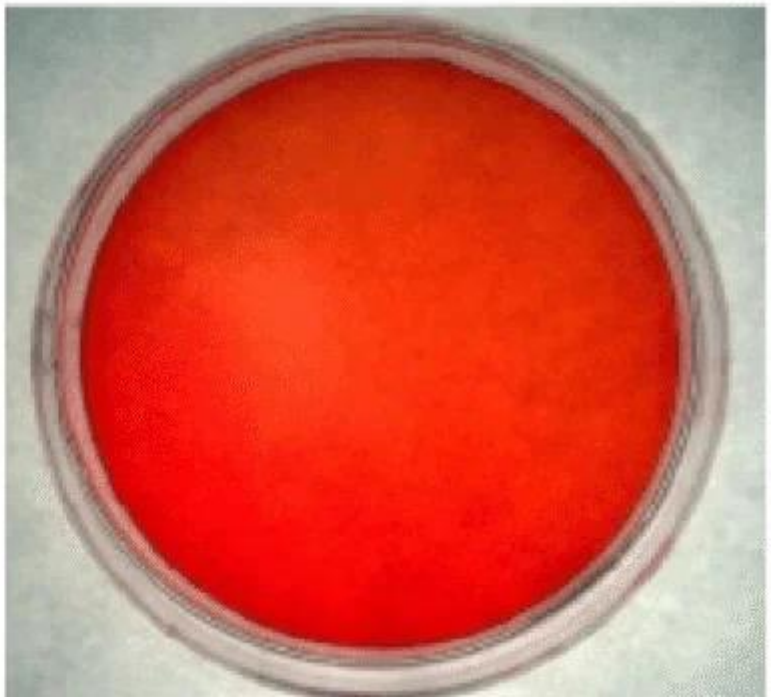
- Carbon Cyclers/Methanogens: Microbes, particularly archaea, involved in methane production and carbon cycling, specifically in rice fields

- Sulfur/Nitrogen Cyclers: Groups involved in sulfite reduction (sulfur cycling) or ammonia oxidation (NH_3 to NO_2^-) to facilitate nutrient uptake

- Cellulose degraders
  - ✓identified via the Congo red CMC-agar plate method
  - ✓Carboxymethylcellulose (CMC) agar medium
  - ✓Plates are flooded with 0.1% Congo red
  - ✓washed with 1 M NaCl
  - ✓a clear hydrolysis zone around the colony confirms cellulose de

Positive





Control

- Lignin degraders
  - ✓lignin peroxidase (LiP) enzyme
  - ✓Agar Plate Screening (Dye Decolorization):
  - ✓Bacteria are grown on agar plates with dyes like Methylene Blue, Azure B, or Toluidine Blue
  - ✓A clear zone around colonies indicates the production of extracellular lignin-degrading enzymes



Thank You!

Questions are welcome!

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