

Course Code	Course Name	Credits
26BY608	BIOFERTILIZERS	04

Course Objectives

- Design next-gen biofertilizer consortia for INM/sustainable agriculture.
- Engineer mycorrhizal systems for nutrient uptake/phytoremediation.
- Optimize cyanobacterial-*Azolla* for N-fixation/soil restoration.
- Develop PGPR nano-formulations for nutrient mobilization.
- Implement molecular QC/commercial-scale production.

Learning Outcomes

Upon successful completion of this course, it is intended that a student will be able to:

- Formulate consortia predicting synergies in INM systems.
- Deploy AM fungi for nutrient uptake/contaminated sites.
- Engineer *Anabaena-Azolla* for N-fixation/carbon sequestration.
- Create CRISPR-PGPR with P-solubilization/siderophores.
- Validate using qPCR/metabolomics and scale production.

Unit 1 - Introduction to Biofertilizers (12 Hrs.)

Definition, types, symbiotic relationships, chemical alternatives, and INM role. Nano-biofertilizers, synthetic consortia, CRISPR strains, climate-resilient development.

Unit 2 – Mycorrhizal Biofertilizers (12 Hrs.)

Types (ecto/endo/AM), isolation/inoculation/culture, nutrient uptake/soil health. ITS sequencing, metatranscriptomics, phytoremediation (As/Cd/Pb), dual PGPR symbiosis.

Unit 3 - Cyanobacterial Biofertilizers (12 Hrs.)

Genera (*Anabaena/Nostoc*), *Azolla-Anabaena*, mass cultivation/field application. Heterocyst genomics, biofilm engineering, photobioreactors, saline restoration.

Unit 4 – Bacterial Biofertilizers & PGPR (12 Hrs.)

Azospirillum/Azotobacter/Rhizobium/PSB/PGPR, fermenter/liquid production, N-fixation/P-solubilization. VOCs/quorum sensing, nano-formulations (chitosan), tripartite systems.

Unit 5 - Production, Quality & Extension (12 Hrs.)

Carriers/shelf life/standards/application/extension/diagnosis. qPCR/viable counts, metabolite profiling, 5KL bioreactors, FSSAI/GMP/AI optimization.

Reference Books:

1. Subba Rao, N. S. (2023). *Soil Microbiology, Ecology and Biotechnology* (7th ed.). Oxford & IBH.
2. Kannaiyan, S. (2025). *Biotechnology of Biofertilizers* (3rd ed.). Scientific Publishers.
3. Maheshwari, D. K. (2024). *Bacteria in Agrobiolgy: Climate Resilience*. Springer.
4. Smith, S. E., & Read, D. J. (2020). *Mycorrhizal Symbiosis* (4th ed.). Academic Press.
5. Bashan, Y., et al. (2023). *PGPB Inoculants: Formulation & Application*. Springer
6. Vessey, J. K. (2022). *Biological Nitrogen Fixation: Advances*. Wiley.