

Course Code	Course Name	Credits
26BY110	BIOFERTILIZERS	04

Course Objectives

- Design biofertilizer systems for integrated nutrient management and soil restoration.
- Optimize mycorrhizal inoculation for nutrient uptake under stress conditions.
- Develop cyanobacterial-*Azolla* systems for wetland rice and phytoremediation.
- Formulate PGPR consortia for nutrient mobilization and plant growth promotion.
- Implement quality-controlled biofertilizer production and extension strategies.

Learning Outcomes

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

- Select biofertilizer combinations for specific crops/soils and predict INM impacts.
- Isolate/cultivate AM fungi and evaluate mycorrhizal colonization efficacy.
- Mass-produce *Anabaena-Azolla* systems and monitor N-fixation rates.
- Formulate *Rhizobium*/PGPR consortia with P-solubilizers for field application.
- Develop shelf-stable liquid biofertilizers and implement quality assurance protocols.

Unit 1 - Biofertilizer Systems (12 Hrs.)

Definition, types, symbiotic relationships. Chemical fertilizer alternatives. INM frameworks. Carbon sequestration, soil microbiome restoration. Multi-strain consortia development.

Unit 2 – Mycorrhizal Technologies (12 Hrs.)

Ectomycorrhizae, endomycorrhizae, AM fungi (*Glomus*, *Acaulospora*). Isolation, multiplication, root inoculation techniques. Nutrient uptake (P, Zn, Cu), drought tolerance, and phytoremediation roles. Commercial inoculum production.

Unit 3 - Cyanobacterial Biofertilizers (12 Hrs.)

Key genera: *Anabaena*, *Nostoc*, *Tolypothrix*. *Azolla-Anabaena* symbiosis. Mass cultivation: photobioreactors, *Azolla* ponds. Field application protocols. N-fixation quantification. Wetland restoration applications.

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

N-fixers: *Azospirillum*, *Azotobacter*, *Rhizobium*, *Frankia*. P-solubilizers: *Bacillus*, *Pseudomonas*. PGPR mechanisms: IAA production, siderophores, HCN, ACC deaminase. Liquid fermentation technology. Co-inoculation strategies

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

Carriers: peat, lignite, liquid formulations (oil/polymer-based). Shelf-life extension. FSSAI/BIS Standards. Application: seed/soil/foliar. Efficacy trials, farmer extension, policy frameworks.

Reference Books:

1. Subba Rao, N. S. (2020). *Soil Microbiology* (6th ed.). Oxford & IBH.
2. Kannaiyan, S. (2022). *Biofertilizers Technology* (2nd ed.). Scientific Publishers.
3. Maheshwari, D. K. (2023). *Bacteria in Agrobiolgy: Nutrient Management*. Springer.
4. Smith, S. E., & Read, D. J. (2017). *Mycorrhizal Symbiosis* (4th ed.). Academic Press.
5. Vessey, J. K. (2020). *Biological Nitrogen Fixation*. Wiley.

