AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 02, Issue: 05 (May, 2025)
Available online at http://www.agrimagazine.in

Role of Biofertilizers for Sustainable Farming in India

*Aurobinda Behera, Akash Kumar Parida and Avinash Kumar
Department of Vegetable Science, College of Agriculture, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, Odisha, India
*Corresponding Author's email: aurobinda1999@gmail.com

The growing demand for safe food, environmental conservation and soil health restoration has driven the agricultural community towards sustainable practices. One such eco-friendly innovation is the use of biofertilizers, which are naturally occurring microbial inputs that enhance nutrient availability to plants without harming the environment. They are emerging as a viable alternative to chemical fertilizers in achieving sustainable farming. India's agricultural sector, spanning over 146 million hectares of net sown area, is under pressure due to soil degradation, declining productivity and environmental stress. As per ICAR and FAO, nearly 30% of Indian soils are nutrient-deficient, with 89% and 80% lacking sufficient nitrogen and phosphorus, respectively. The skewed fertilizer use—particularly high urea consumption (35+ million tonnes)—has distorted the ideal N:P:K ratio to 6.7:2.7:1, compared to the recommended 4:2:1. In 2021–22, India used 62.98 million tonnes of chemical fertilizers, contributing to environmental issues such as nitrate leaching, loss of microbial diversity and greenhouse gas emissions. As an eco-friendly alternative, biofertilizers like *Rhizobium*, *Azospirillum* and phosphate-solubilizing bacteria have demonstrated 15–25% yield improvements in field trials and can boost nutrient use efficiency (NUE). Despite producing 109,000 tonnes of biofertilizers in 2021–22, their use accounts for less than 1% of total fertilizer consumption, revealing a massive untapped potential. With over 55% of Indian agriculture dependent on rainfed systems, biofertilizers can play a pivotal role in sustainable farming. Government initiatives like PKVY, the Soil Health Card and Natural Farming Missions are actively supporting their integration through Integrated Nutrient Management (INM).

What Are Biofertilizers?

Biofertilizers are compounds that boost plant development by making more nutrients available to the soil, and they often contain either active or dormant cells of beneficial microbes. In symbiotic partnerships, these microorganisms fix atmospheric nitrogen, solubilise phosphorus, or decompose organic matter after colonising the rhizosphere or the inside of plants.

Types of commonly used biofertilizers:

1. Rhizobium – Nitrogen fixation in legumes
2. Azospirillum & Azotobacter – Nitrogen fixers for non-legumes
3. Phosphate-Solubilizing Bacteria (PSB) – Make insoluble phosphorus available
4. Mycorrhizae – Enhance water and nutrient uptake
5. Blue-Green Algae (BGA) – Used in rice fields for nitrogen addition

Source: Tractor Junction

Benefits of Using Biofertilizers

1. Improved Soil Fertility: Biofertilizers help restore soil microbiota, increase organic matter decomposition and maintain long-term fertility.
2. Reduced Chemical Dependency: They decrease the need for synthetic fertilizers, thus reducing cost and environmental damage.
3. Enhanced Crop Yield and Quality: Crops treated with biofertilizers often show improved root growth, yield and nutritional value.
4. Eco-Friendly and Sustainable: Being non-toxic, biofertilizers do not pollute water bodies or affect soil biodiversity.
5. Cost-Effective for Farmers: Especially beneficial for small and marginal farmers due to lower input costs.

Application in Sustainable Farming

Biofertilizers are an integral part of organic farming, integrated nutrient management (INM) and climate-resilient agriculture. In vegetables, cereals, pulses and fruit crops, their regular use ensures better plant health, yield stability and lower ecological footprints.

- In vegetable crops, PSB and Azotobacter are widely used to enhance nutrient uptake.
- In paddy fields, BGA and Azospirillum are common.
- Mycorrhizal fungi help in horticultural crops like tomato, brinjal and capsicum under protected cultivation.

Barriers to Wider Adoption

a) **Short shelf life and poor-quality control in commercial biofertilizers:** Many biofertilizer products lose viability quickly and may contain insufficient live microbes, making them ineffective for farmers.
b) **Lack of awareness, especially in tribal and dryland regions:** Farmers in remote areas often lack training and exposure to the benefits and usage methods of biofertilizers.
c) **Incompatibility with fungicides and some agrochemicals**: The live microbial content of biofertilizers can be destroyed when mixed or applied alongside certain chemical pesticides or fungicides.
d) **Inconsistent results due to soil type, storage and application errors**: Variability in soil conditions, improper storage, or incorrect application methods often lead to poor or unpredictable field performance.

Future Thrust

a. **Strengthen extension**: Conducting field demonstrations and farmer trainings can build trust and practical knowledge about biofertilizer use.
b. **Promote decentralised production**: Establishing biofertilizer units at the panchayat level can ensure local availability and better-quality control.
c. **Government incentives**: Including biofertilizers in existing fertilizer subsidy programs can encourage their widespread adoption.
d. **Soil testing**: Tailoring microbial formulations to specific soil microbiomes can improve effectiveness and crop response.

Conclusion

While India's food security has been guaranteed by agricultural intensification in recent decades, this progress has come at the expense of soil health, ecological balance, and sustainability in the long run. Nutrient imbalances, decreased soil microbial diversity, and increased environmental contamination have resulted from the overuse and improper distribution of synthetic fertilisers, especially urea. In this regard, biofertilizers provide an alternative that is both sustainable and backed by science; they boost soil biological activity and long-term productivity in addition to supplementing plant nutrition. There is a lot of evidence that biofertilizers such arbuscular mycorrhizal fungi (AMF), phosphate-solubilizing bacteria (PSB), and Rhizobium and Azotobacter improve nutrient use efficiency (NUE), root

growth, and nutrient solubilisation and fixation. When used as directed, they increase crop output by 15–25%, decrease reliance on chemical inputs by 20–30%, and aid in carbon sequestration by improving soil organic matter dynamics. Product quality assurance, farmer training, region-specific microbial strains, and supportive governmental interventions are crucial obstacles that must be addressed in order to scale up the usage of biofertilizers. To achieve its objectives of sustainable agriculture, soil health restoration, and environmental conservation, India must incorporate biofertilizers into Integrated Nutrient Management (INM) and adopt climate-resilient farming techniques.

More responsible production is the way of the future for India's agricultural sector, and biofertilizers are an essential part of that transition.

References

1. ICAR-Indian Institute of Soil Science. (2020). Role of Biofertilizers in Sustainable Agriculture.www.iiss.nic.in
2. TNAU Agritech Portal. (2023). Biofertilizers. www.agritech.tnau.ac.in
3. Singh, R., & Sharma, P. (2021). Effect of microbial inoculants on growth and yield of maize, *Indian Journal of Agricultural Sciences*, **91**(7): 1021–1026.
4. ICAR-AICRP on Biological Inputs Annual Report (2022).
5. FAO (2019). Soil Biodiversity and Biofertilizers. www.fao.org