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# Role of Biofertilizers in Turmeric Production

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## Introduction:

*Curcuma longa* L., commonly known as turmeric, is a rhizomatous herb of the family Zingiberaceae. Turmeric is also called as "The Golden Spice "and "Indian Saffron". It's originated from South-east Asia and has been used for centuries in traditional medicine and culinary purposes. Turmeric is renowned for its vibrant golden-yellow colour and distinct flavour, which adds depth and warmth to various dishes. The active compound responsible for turmeric's characteristic colour and numerous health benefits is called curcumin. It is one of the ancient and sacred spices of India.

## Why use of biofertilizers in turmeric?

- Bio -fertilizers play an important role as they are capable of fixing atmospheric nitrogen and solubilising the phosphorus to make it available to the plants.
- Helps to improve yield attributes, yield and net return.
- Influence on soil texture and structure, better water holding capacity and drainage which in turn help for better growth and development of rhizomatous crop like turmeric.
- Influenced microbial biomass C, N mineralization, soil respiration and enzymes activities.

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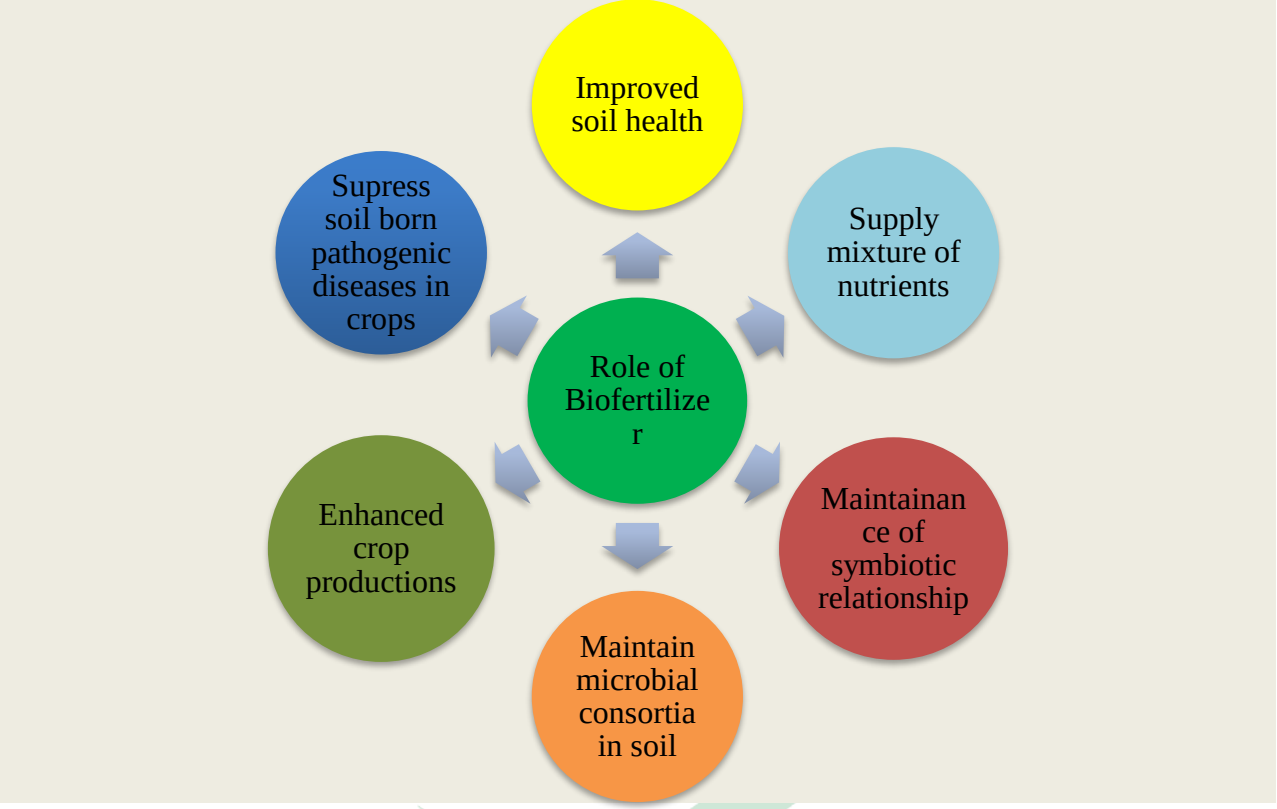
- **Biofertilizer:** A substance which, when applied to seed or plant surface or soil, promotes growth by increasing the supply or availability of primary nutrient to the host plant. Nitrogen fixing bacteria, phosphate solubilizing microorganisms, vesicular arbuscular mycorrhizae and plant growth promoting rhizobacteria (PGPR) are included. The consistent performance of these PGPR strains *Bacillus spp*. indicates their potential to be used as commercial biofertilizer for the enhancement of growth and yield of turmeric.

- **Role of biofertilizers in turmeric:**




- **Classification of Biofertilizers:**

| Classification of Biofertilizers | | |
|---|---|---|
| **Sr. No.** | **Group** | **Examples** |
| **A.** | **Nitrogrn fixing biofertilizer** | |
| | 1. Free - living | *Azotobacter, Clostridium, Anabeana, Nostoc* |
| | 2. Symbiotic | *Rhizobium , Anabaena azollae, Frankia* |
| | 3. Associative symbiotic | *Azospirillum* |

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| | | |
|---|---|---|
| **B. (a)** | **Phosphate solubilizing biofertilizer** | |
| | 1. Bacteria | *Bacillus subtilis, Pseudomonas striata* |
| | 2. Fungi | *Penicillium sp., Aspergillus awamori* |
| **B. (b)** | **Phosphate mobilizing biofertilizer** | |
| | 1. Arbuscular Mycorrhiza | *Glomus sp., Scutellospora sp.* |
| | 2. Ectomycorrhiza | *Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.* |
| **C.** | **Potassium mobilizing biofertilizer** | |
| | 1. Bacteria | *Frateuria aurentia* |
| **D.** | **Plant growth promoting rhizobacteria** | |
| | 1. Pseudomonas | *Pseudomonas fluorescens* |

**A. Nitrogen-Fixing Bacteria (NFB):**

- ✓ Improve the soil microbiological activities and hence the plants show improved growth and yield.
- ✓ Produce hormones and some other growth factors which are needed for the plant growth and development.
- ✓ Free living as well as symbiotic nitrogen fixing bacteria plays an important role to improve the structure of the soil.
- ✓ Is a one way of converting elemental nitrogen into plant usable form.

1. **Azotobacter:** It is a heterotrophic free living nitrogen fixing bacteria mostly found in neutral to alkaline soils. *Azotobacter chrococcum* is the most commonly occurring species in arable soils of India. *A chroococcum* is the first aerobic free-living nitrogen fixer. *Azotobacter chroococcum* in the turmeric increased number of leaves, shoot height, shoot biomass, rhizome biomass and curcumin content. Capable of fixing an average 20 kg N/ha/year. *A. chroococcum* most 5$^{th}$ commonly inhabiting in various soils all over the world.
2. **Azospirillium:**
   - ✓ Fix a substantial amount of atmospheric nitrogen and supplies to the plant.

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- ✓ Enhances the fertilizer use efficiency, soil fertility status and ensures partial saving of nitrogenous fertilizer.
- ✓ Nitrogen fixing ability of 20-40 kg/ha.
- ✓ Increase mineral and water uptake, root development, vegetative growth and yield.
- ✓ Turmeric growth, yield and quality parameters such as plant height, shoot length, oleoresin and curcumin contents were higher in plants grown with phosphobacteria and *Azospirillum*.

**B. (a) Phosphate Solubilizing Biofertilizer:**

- ➢ Phosphorus is one of the most important plant nutrients and may be critical nutrient for the optimum growth of plants.
- ➢ A group of heterotrophic microorganisms possesses the ability to solubilize inorganic phosphorus from insoluble sources to soluble forms i.e., *Bacillus magatherium phosphobacterium*, *Bacillus polymyxa* and *pennicillium*.
- ➢ *Pseudomonas*, *Bacillus* and *Rhizobium* are among the most powerful.
- ➢ PSB are essential to sustain crop production, preserve soil health and biodiversity.
- ➢ Seed inoculation of PSB- 30 kg $P_2O_5$/ha. Solubilize the insoluble phosphates and make them available for crop plants in the rhizosphere region.
- ➢ Found to increase crop growth and yield.
- ➢ Soil and seed inoculation with phosphate solubilizing bacteria (PSB) improves solubilization of fixed soil phosphorus and of applied phosphates, resulting in higher crop yields.
- ➢ To enhance the plants capacity to utilize such nutrients effectively including in the soil, PSB and VAM inoculation have been considered to be effective.

**B. (b) Phosphate Mobilizing Biofertilizer:**

- **Vesicular Arbuscular Mycorrhiza (VAM):**
  - ✓ Colonize the plant root system and increase the growth and yield of crop.
  - ✓ The VAM forms an association with plant roots.
  - ✓ Help in nutrient transfer mainly of phosphorus, zinc, and sulfur.
  - ✓ It increase growth rate in plants.

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- ✓ Protect plants from pathogens and adverse environmental conditions, especially drought.

**C. Potassium Mobilizing Biofertilizer:**

- ✓ Potash mobilizing bacteria (*Frateuria aurantia)* :
- ✓ Beneficial free living soil bacteria isolated from the rhizosphere of plant, which have shown to improve plant health or increase yield.
- ✓ *Frateuria aurantia* also to be considered as plant growth promoting rhizobacteria (PGPR).
- ✓ Potash mobilizing bacteria mobilize potassium from soil. This principle is employed in isolating KMB from soil (Chandra *et. al*., 1995).

**D. Plant Growth Promoting Rhizobacteria (PGPR):**

- ➢ PGPR are also known as rhizosphere bacteria that exert beneficial effect on plant growth, belong to several genera viz., *Pseudomonas, Agrobacterium, Bacillus, Azotobactor, Zantomonas* etc.
- ➢ Species of Pseudomonas and *Bacillus* can produce phytohormone or growth promoters.
- ➢ They produce include indole-acetic acid, cytokinins, gibberellins and inhibitors of ethylene production.
- ➢ PGPR strains *Bacillus spp.* indicates their potential to be used as commercial biofertilizer for the enhancement of growth and yield of Turmeric.
- ➢ Bacterial inoculants are able to increase plant growth and germination rate, improve seedling emergence, responses to external stress factors and protect plants from disease
- ➢ PGPR strains improved seed germination, shoot length, root length, leaf numbers and root dry weight over the control.

***Pseudomonas fluorescens:***

- ✓ Use for seed treatment with @ 20 g/kg.
- ✓ Have shown to be potential agents for the biocontrol which supress plant diseases by protecting the seeds and roots from fungal infection.

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- ✓ They are known to enhance plant growth promotion and reduce severity of many fungal diseases.
- ✓ *Pseudomonas fluorescens* and *Bacillus megaterium* strains all used for the improvement of curcumin content.

**Why we need of biofertlizers in turmeric?**

- ❖ Continuous use of chemical fertilizers adversely affects the soil structure whereas biofertilizers when applied to soil improve the soil structure.
- ❖ The effects of chemical fertilizers are that they are toxic at higher doses. Bio-fertilizers, however, have no toxic effects.
- ❖ Bio-fertilizers are used extensively as an ecofriendly approach to minimize the use of chemical fertilizers, improve soil fertility status and for enhancement of crop production by their biological activity in the rhizosphere.
- ❖ Fertilizer prices are increasing day by day so becoming unaffordable by small and marginal farmers.
- ❖ The long term use of biofertilizers is economical, eco-friendly, more efficient, productive and accessible to marginal and small farmers over chemical fertilizers
- ❖ Biofertilizer is a natural product carrying living microorganisms derived from the root or cultivated soil. So they don't have any ill effect on soil health and environment.

**Importance of biofertilizers:**

- ✓ Effectively enrich the soil and cost less than chemical fertilizers, which harm the environment and deplete non renewable energy sources.
- ✓ Supply the nitrogen continuously throughout the entire period of crop growth in the field under favourable conditions.
- ✓ Improve soil physical properties, tilth and soil health in general.
- ✓ Improves soil fertility by fixing atmospheric nitrogen, solubilizing insoluble phosphates, producing plant growth-promoting substances in the soil.

**What precautions one should take before using biofertilizers?**

- ❖ Biofertilizer packets need to be stored in cool and dry place away from direct sunlight and heat.
- ❖ Right combination of biofertilizers have to be used.

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- ❖ Other chemicals ((fertilizers and pesticides) should not be mixed with the biofertilizers.
- ❖ Seed treatment chemicals like Bavistine etc. should mix 3 days prior to mix with biofertilizer treatment.
- ❖ The packet has to be used before its expiry, only for the specified crop and by recommended method of application.

## Conclusion:

Bio-fertilizers in different combinations improve growth and yield of turmeric which can improve the economics of cultivation of farmers. The potential nitrogen fixing biological systems like Azospirillum, phosphorus-solubilizing bacteria such as Bacillus and Pseudomonas and the vesicular arbuscular mycorrhizae plays a triggering role in nitrogen and phosphorus nutrition of horticultural crops. The effective utilization of bio-fertilizers for crops not only provide economic benefits to the farmers but also improves and maintain the soil fertility and sustainability in natural soil ecosystem. Maintenance of plant health is enhanced by the addition of balanced nutrients. Biofertilizers plays role in improvements on the capacity of nutrients' exchange in the soil. Biofertilizers are the need of modern horticulture. The use of biofertilizer could be the proper option for better soil structure and sustainable agriculture.