-lant ($2x10^8$ CFU/ml) in 400 ml water, coat 10-15 kg seeds, dry in shade (10-15 min), and sow immediately.

Seedling/Root treatment: Prepare suspension (1 kg inoculant ($2x10^8$ CFU/ml) in 10-15 L water) and dip roots for 15-30 min before transplanting.

Soil treatment: Mix 2-3 kg career based bioformulation ($3x10^7$ CFU/g) with 40-60 kg soil/compost and broadcast in one

Precautions to be taken during application of biofertilizers

- ◊ Store biofertilizer packets in a cool, dry place, away from direct sunlight.
- ◊ Always check the expiry date on the biofertilizer package and use it before it expires.
- ◊ Follow the manufacturer's instructions for the recommended method of application (e.g., seed treatment, seedling dip, soil application).
- ◊ Do not mix biofertilizers with chemical fertilizers, insecticides, or fungicides.
- ◊ Ensure adequate soil moisture for the biofertilizer application.
- ◊ Avoid applying biofertilizers during the hottest part of the day or under intense sunlight, as this can reduce their effectiveness.

Table: Recommendation of Biofertilizers for various crops

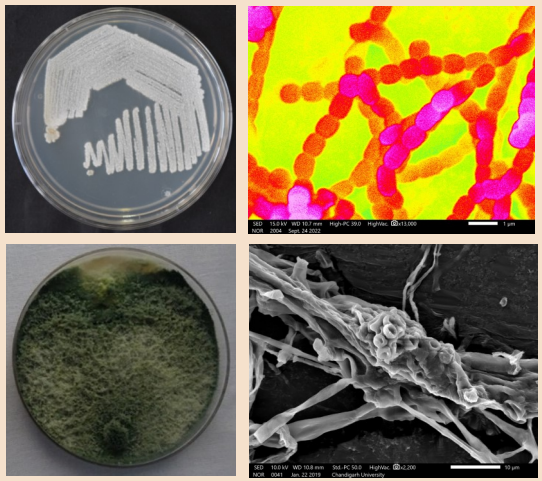
Crops	Biofertilizers	Functions (Reference)
Legume (Peas, beans)	*Rhizobium*	N_2 fixation (Neha et al., 2024)
Non-legumes (Tomato, Capsicum, Rice)	*Azotobacter*, *Azospirilum*	N_2 fixation (Prusty et al., 2023)
All crops	PSB* and KSB*, Arbuscular Mycorrhiza (AM)	Solubilize P and K enhance uptake of P, Zn, and others
Fruit crops (Papaya, Sugarcane, apple, mango, guava, strawberry, citrus)	PSB, KSB,AM and *Azotobacter*	Uptake of P, Zn and other nutrients and improves plant growth and yield (Seetha (1999; Hzarika & Ansari, 2007)
Floriculture crops (Chrysanthemum, Dahlia Gerbera & Marigold)	PSB, KSB, N_2 fixing, PGPR	Enhance nutrient acquisition (Airadevi., 2012; Mittal *et al.* 2010)
Vegetable crops (Tomato, Cauliflower)	*Streptomyces* sp. AC40, and *Trichoderma* sp. T5	PGP activities and disease suppression, respectively (research trials conducted at CoHF, Neri, Hamirpur HP, (2022-2024)

*Phosphate solubilizing bacteria and potassium solubilizing bacteria
**Plant growth promoting activities

क्रमांक: COOP/2023/KOTA/201080/25/14

AGRICULTURE FORUM FOR TECHNICAL EDUCATION OF FARMING SOCIETY (AFTEFS)

Organic Cultivation of Horticultural Crops in Himachal Pradesh



Opting Biofertilizers and Biocontrol Agents

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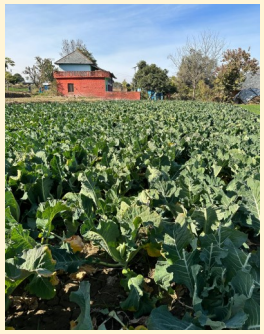
Biofertilizers

In Himachal Pradesh, horticultural produce contributes as a major share of the state domestic products as well as the main source of income. Himachal Pradesh is known as the "Fruit Bowl of India" due to production of fruits



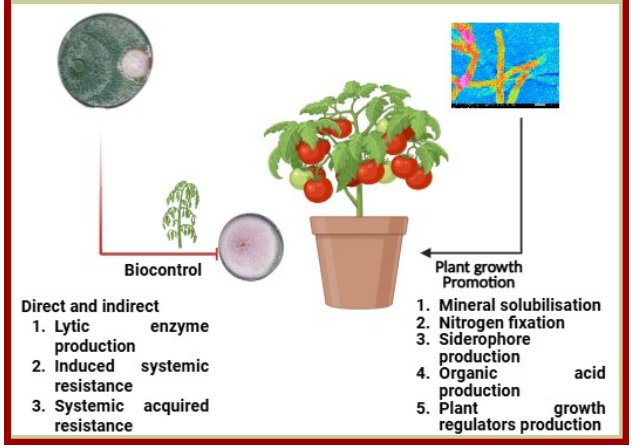
such as apple, pear, peach plum, etc. Furthermore, the state is a major supplier of off-season vegetables to the other states of India. However, abiotic and biotic stresses leads to monetary losses in terms of yield and quality. To counter the issue, farmers are using heavy doses of agro-chemicals which deteriorates soil quality, enhancing cost of cultivation and even raising biosafety issues. In this regard, the application of biofertilizers is a promising approach to increase the nutrient availability in agricultural soils.

Benefits of plant growth promotion

- Bioformulations containing effective microbes can supply:
  - ⇒ Essential nutrients (P, K, N)
  - ⇒ Indole Acetic Acid (IAA)-like growth hormones for plant growth
- Promote sustainability in agriculture as a supplement to chemical fertilizers, fully aligned with organic farming.
- Strengthen ecosystem services such as:
  - ⇒ Restoration and remediation of degraded soils
  - ⇒ Mitigation and adaptation to climatic stresses

In disease suppression (Biocontrol)

- ⇒ Biological management of pests and diseases
- ⇒ Secondary metabolites, Volatile organic compounds (VOCs) and antibiotics inhibit growth and spore germination.



Types of Biofertilizers

Nitrogen fixing biofertilizers: Bacteria, like *Rhizobium* and *Azotobacter*, convert atmospheric nitrogen into ammonia, a form usable by plants.

P-Solubilizing biofertilizers: Fungi and bacteria can dissolve insoluble phosphate compounds in the soil, making them available to plants.

Biofertilizers for potassium and micro-nutrients: Fungi and bacteria can solubilize potassium and micro nutrients like silicate and zinc in the soil and make them available to plants.

Plant growth promoting rhizobacteria: microbes with multiple plant growth promoting benefits viz. nitrogen fixation, phosphorus solubilization, antibiotics, hormones, and other hydrolytic enzymes.

Biocontrol agents: suppress plant diseases by producing antimicrobial compounds or competing with pathogens.

Methods of Application:

The effectiveness of biofertilizers depends on method adopted for application.

Seed treatment: Mix 200 g inocu-