

## Biopriming in Vegetable Crops

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### SUMMARY

Biopriming involves the use of micro-organisms to enhance crop yield and quality. This technique, applied across various crops, involves inoculating hydrated seeds with beneficial microbes, which activates metabolic processes without triggering actual germination. These microbes stimulate the release of plant growth hormones and volatile compounds, improve nutrient availability in the soil, and initiate defence mechanisms under stress. As a result, plants exhibit better quality and higher yields due to improved nutrient use efficiency, increased tolerance to biotic and abiotic stresses, and enhanced physiological and morphological traits in different vegetable crops. Among the various methods of microbe application, priming treatment stands out as a promising technique, also reducing the use of harmful chemicals. Consequently, biopriming serves as an effective, simple, and cost-efficient alternative to other seed treatment methods for crop improvement. This review discusses various microbes and their potential role as growth and development stimulators through priming treatment in vegetables.

### INTRODUCTION

Seeds are a primary vehicle for the transfer of novel technologies in agriculture. The availability of high-quality seeds is crucial, as issues like insufficient seed quantity, infected seeds, low viability, vigour, and poor germination can lead to poor crop stands. Therefore, using vigorous seeds is essential to ensure quality produce. Seed treatment with microbes has proven more effective than seedling or soil treatment, as it enhances the rhizosphere by increasing microbial populations. Biopriming, a novel seed treatment approach, involves treating seeds with beneficial micro-organisms while hydrating them under controlled conditions. Recently, biopriming has emerged as an alternative method to control seed and soil-borne pathogens and improve crop production economics. The main objectives of biopriming include increasing nutrient and water use efficiency, ensuring uniform plant emergence and development, improving yield quantity and quality, and reducing the impact of biotic and abiotic stresses.

### Types of Seed Priming and Procedures:

Various priming methods are used in different vegetable crops:

**Biopriming:** This involves seed imbibition combined with inoculation of biocontrol agents or plant growth-promoting rhizobacteria (PGPR).

**Hydropriming:** Seeds are soaked in pure water before sowing and re-dried to their original moisture content, making this process both cost-effective and environmentally friendly.

**Osmopriming:** Seeds are soaked in a saline solution with low water potential, allowing gradual imbibition and early germination stages without radicle protrusion.

**Solid Matrix Priming:** Seeds are mixed with a moist solid carrier for a set period, after which they are cleaned and dried, simulating natural imbibition.

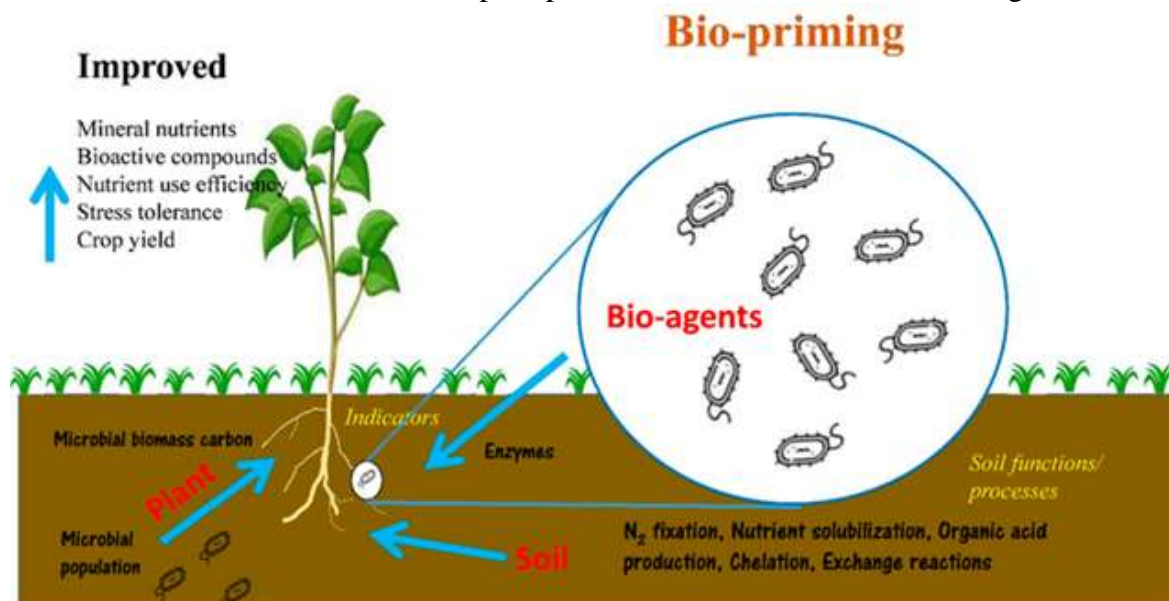
**Hormopriming:** Seeds imbibe in the presence of plant growth regulators, directly affecting seed metabolic processes. Common regulators include abscisic acid, auxins, gibberellins, and salicylic acid.

**Chemopriming:** Involves seed treatment with various chemical solutions, including natural and synthetic substances like antioxidants, hydrogen peroxide, and fungicides.

**Nutri-priming:** Seeds are soaked in solutions containing limiting nutrients, combining nutritional and biochemical priming effects to improve seed quality and seedling establishment.

**Biopriming and Nutrient Use Efficiency:** Nutrient use efficiency, defined as the crop output per unit of nutrient input, is enhanced by biopriming, as it increases nutrient availability and utilization in various vegetable crops.

Microbial inoculants enhance soil enzymatic activity, increasing nutrient content and potentially substituting inorganic fertilizers. For instance, *Trichoderma harzianum* NBRI 1055 has been shown to increase N, P, K, Fe, Zn, Cu, and Mn content in okra, while *Glomus* sp. improved nutrient content in red cabbage.



### Biopriming for Biotic Stress Management:

The use of chemicals for disease control poses risks to both the environment and human health, making microbial-based seed treatments a safer alternative against seed and soil-borne diseases. Biopriming is a simple and cost-effective method that helps plants adapt to stress conditions. For example, biopriming tomato seeds with *Trichoderma erinaceum* activated defense signaling against *Fusarium*, leading to the production of antioxidative enzymes and lignification of cells.

### Biopriming for Abiotic Stress Management:

Abiotic stresses negatively impact plant growth and yield, but biopriming can mitigate these effects by stabilizing membranes, increasing photosynthetic pigments, and improving sugar metabolism and ionic homeostasis. Studies have shown that PGPR can modify gene expression related to stress tolerance in vegetable crops, resulting in enhanced growth and stress relief.

### Biopriming and Improvement in Morphological and Physiological Traits:

In addition to growth parameters, biopriming improves vigour indices in crops like chili, tomato, brinjal, and onion, with treatments using *Pseudomonas fluorescens* and *Trichoderma harzianum*. Biopriming also enhances seedling vigour, germination percentage, and overall plant development in various crops, such as lettuce, coriander, and fenugreek.

### Biopriming and Phytochemical Quality Improvement:

Biopriming can enhance the nutritional quality of vegetable crops, which is crucial in providing essential nutrients to the population. This technique has shown positive effects on several biochemical properties of plants, such as carbohydrates, proteins, pigments, and enzymes, improving both the quality and quantity of yield.

### CONCLUSION:

Numerous studies have demonstrated the benefits of biopriming in improving crop production. It enhances nutrient uptake, manages biotic and abiotic stress, and improves both the quality and quantity of crop yields. Compared to other seed treatment methods, biopriming is economically viable, environmentally friendly, and effective in enhancing yield and yield-related parameters.

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