



## Effect of Biofertilizers on Fruit Quality and Shelf Life in Mango, Banana, and Citrus

\*Tikam Das Vaishnav<sup>1</sup>, Shruti<sup>2</sup>, Sohini Hashmi<sup>2</sup> and Bhawna Kumari Ahir<sup>3</sup>

<sup>1</sup>Asst. Professor, RNT College of Agriculture, Kapasan (MPUAT, UDAIPUR), India

<sup>2</sup>M.Sc. (Hort.) Scholar, Dept. of Horticulture, SHUATS, Prayagraj (U.P.), India

<sup>3</sup>B.Sc. (Ag) Students, RNT College of Agriculture, Kapasan, India

\*Corresponding Author's email: [spstarpaval@gmail.com](mailto:spstarpaval@gmail.com)

**B**iofertilizers — living microbial inoculants that enhance nutrient availability and promote plant growth — are increasingly used in horticultural crops to improve yield, fruit quality, and postharvest shelf life, while reducing dependency on chemical fertilizers. This article reviews the effects of biofertilizers such as *Azotobacter*, *Azospirillum*, *phosphate-solubilizing bacteria (PSB)*, *arbuscular mycorrhizal fungi (AMF/VAM)*, *Trichoderma spp.*, and *plant growth promoting rhizobacteria (PGPR)* on the physicochemical and nutritional properties of fruits in mango (*Mangifera indica*), banana (*Musa spp.*), and citrus (*Citrus spp.*). It also summarizes mechanisms, research findings, practical applications, and recommendations for farmers to enhance organic production and postharvest handling.

**Keywords:** Biofertilizers, PGPR, Mango, Banana, Citrus, Fruit Quality, Shelf Life, Postharvest, Trichoderma, AMF, PSB

### Introduction

Fruit quality and shelf life are key determinants of profitability and consumer acceptance in horticulture. Excessive use of chemical fertilizers negatively impacts soil and environment. Biofertilizers provide a sustainable alternative that improves nutrient uptake, hormonal regulation, stress tolerance, and microbial balance in the rhizosphere. Their role is crucial in mango, banana, and citrus — high-value fruit crops with significant domestic and export demand.

### Common Biofertilizers and Their Modes of Action

Type of Biofertilizer	Examples	Mode of Action / Benefit
<b>Nitrogen-fixers</b>	<i>Azotobacter</i> , <i>Azospirillum</i>	Fix atmospheric nitrogen for plant use
<b>Phosphate Solubilizers (PSB)</b>	<i>Bacillus</i> , <i>Pseudomonas</i> , PSF	Convert insoluble phosphates into soluble forms
<b>AMF / VAM</b>	<i>Glomus</i> , <i>Gigaspora</i> spp.	Increase root surface area, water & nutrient uptake
<b>Trichoderma spp.</b>	<i>T. harzianum</i> , <i>T. viride</i>	Biocontrol + plant growth stimulation
<b>PGPR</b>	Multiple rhizobacterial strains	Produce IAA, siderophores, ACC deaminase, resist pathogens

These microorganisms enhance nutrient acquisition, strengthen antioxidant systems, modulate phytohormones, and improve fruit development and postharvest performance.

### Effect on Physico-Chemical Fruit Quality

#### Mango

- Increased fruit weight and size

- Higher TSS (°Brix), total sugars, and ascorbic acid
- Better peel colour and aroma development
- Combination of Azotobacter + PSB + AMF showed highest improvement
- Improved leaf NPK status leading to better biochemical composition

#### Banana

- Enhanced bunch weight and pulp:peel ratio
- Uniform ripening and reduced disorders
- Increased sugar content and vitamin level
- AMF and PGPR promote root proliferation and nutrient uptake

#### Citrus

- Improved fruit size, juice % and sugar–acid ratio
- Higher micronutrient uptake (Ca, Mg) leads to better firmness
- Reduced pre-harvest physiological disorders

### Influence on Shelf Life & Postharvest Behavior

Biofertilizers improve shelf life through:

- Better cell-wall stability (via enhanced Ca assimilation)
- Higher antioxidant activity → slows senescence
- Reduced weight loss during storage
- Lower incidence of postharvest rots and delayed decay
- Induction of **Systemic Acquired Resistance (SAR)**
- Strengthening of fruit tissues & delayed ripening

#### Example Findings:

- VAM + PSB in mango reduced physiological weight loss by 20–30%
- Trichoderma application reduced postharvest disease incidence in banana
- PSB + Azotobacter improved firmness and storage life in citrus

### Practical Application Methods

Method	Recommended Dosage	Remarks
Seed/Seedling Treatment	20–25 g/kg of seed	Enhances early root colonization
Root Dip	1–2% solution	For nursery or field planting
Soil Application	5–10 kg/acre + FYM	Enhances survivability
Drip/Fertigation	Liquid biofertilizer	Suitable for orchards
Consortia	Multiple strains	Gives better results than single strain

**Key Crops:** Mango, Banana, Citrus, Papaya, Pomegranate, Grapes, Strawberry, Tomato, Brinjal, Onion

### Limitations & Research Gaps

- Strain-specific responses depending on environment
- Short shelf life of some formulations
- Lack of farmer awareness & trained application
- Need for large-scale orchard trials
- Compatibility issues with agrochemicals

### Recommendations for Growers

- Use locally tested consortia rather than single strains
- Combine biofertilizers with organic manure for high effectiveness
- Maintain orchard hygiene and proper postharvest handling
- Apply during root flush or active growth period
- Maintain input documentation for organic certification

### Conclusion

Biofertilizers significantly improve fruit quality, nutritional value, and postharvest shelf life in mango, banana, and citrus. Their integration with organic manures and consortia-based

application results in enhanced TSS, antioxidant levels, sweetness, colour development, firmness, and storage behavior. Therefore, biofertilizers are highly recommended as a sustainable and economical alternative for achieving better fruit quality and extended shelf life under both conventional and organic horticulture.

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