AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 02, Issue: 11 (November, 2025)
Available online at http://www.agrimagazine.in
©Agri Magazine, ISSN: 3048-8656

Role of Biopesticides in Integrated Pest Management (IPM) of Horticultural Crops

*Harshit Malu and Tikam Das Vaishnav
Assistant Professor, Department of Horticulture, RNT College of Agriculture, Kapasan (MPUAT, Udaipur), Rajasthan, India
*Corresponding Author's email: mmaluharshit@gmail.com

Horticultural crops such as fruits, vegetables, flowers, and spices hold high economic and nutritional value. However, they are highly prone to pest infestations that reduce yield, quality, and market value. Traditionally, chemical pesticides were the main tools for pest control, but excessive reliance has caused pesticide resistance, environmental hazards, health risks, and residue problems. Biopesticides have emerged as sustainable and eco-friendly alternatives in Integrated Pest Management (IPM) strategies. Derived from natural organisms and plant sources, biopesticides help reduce chemical usage, protect beneficial organisms, enhance crop quality, and ensure residue-free produce suitable for export. This article explains the types, role, advantages, challenges, and future prospects of biopesticides in IPM for horticultural crops.

Introduction

Horticultural crops are highly sensitive to pest and disease attacks. Farmers often use chemical pesticides for immediate control, but long-term dependency has led to:

- Resistance development in pests
- Threats to pollinators and natural enemies
- Residue problems in food
- Soil toxicity and water pollution
- High production costs

Integrated Pest Management (IPM) promotes combining biological, cultural, mechanical, and chemical methods in a balanced way. Biopesticides are central to IPM because they offer safe, selective, and environmentally friendly pest control without harming natural enemies. IPM aims to manage pests—not eradicate them completely, and biopesticides align perfectly with this principle.

What Are Biopesticides?

Biopesticides are pest control substances derived from living organisms such as bacteria, fungi, viruses, and plants. They are classified into three major groups:

Microbial Biopesticides

Made from microorganisms (bacteria, fungi, viruses):

- *Bacillus thuringiensis (Bt)*
- *Beauveria bassiana*
- *Trichoderma spp.*
- *Metarhizium anisopliae*
- *NPV (Nuclear Polyhedrosis Virus)*

Botanical Biopesticides

Extracted from plants and their oils:

- Neem (Azadirachtin)
- Karanj oil

- Pyrethrum
- Lemon grass, garlic extract

Biochemical Biopesticides

Modify pest behavior:

- Pheromones
- Repellents
- Anti-feedants
- Growth regulators

Need for IPM in Horticultural Crops

Challenges in Horticulture	Role of Biopesticides
Rising chemical resistance	Alternative control
Residue problems in food	Safe & residue-free
Environmental pollution	Biodegradable
Death of pollinators	Selective action
High cost of pesticides	Cost-effective
Soil health degradation	Eco-friendly

Role of Biopesticides in IPM of Horticultural Crops

Biological Control of Insect Pests

Several microbial biopesticides control pest populations:

Biopesticide	Target Pests
Bt	Caterpillars, borers, DBM
Beauveria bassiana	Whiteflies, aphids, thrips
Metarhizium anisopliae	Locusts, termites
NPV	Fruit borers in tomato, brinjal

These biopesticides reduce early pest pressure and reduce chemical dependence.

Control of Soil-borne Diseases

Diseases like Fusarium wilt, Pythium rot, Rhizoctonia damping-off affect horticulture severely.

Biopesticides for soil application:

- *Trichoderma harzianum / T. viride*
- *Pseudomonas fluorescens*

Methods in IPM

- Seed treatment
- Nursery bed application
- Soil drenching
- Mixing with FYM
- Drip irrigation application

Role of Botanical Biopesticides

Plant-based extracts act through:

✔ Repellency
✔ Anti-feeding
✔ Growth inhibition
✔ Oviposition deterrence

Common Examples:

Neem oil, Karanj oil, Pyrethrum, Garlic extract, Lemongrass extract

Pheromones & Trap Technology

Uses in IPM:

- Monitoring pest population
- Mass trapping
- Mating disruption

- Early pest prediction

Examples of use:

- Fruit fly traps in mango, guava, cucurbits
- DBM pheromone in cabbage
- Brinjal fruit & shoot borer traps
- Pink bollworm traps

Protection of Natural Enemies

Biopesticides do not harm beneficial organisms such as:

- Ladybird beetles
- *Chrysoperla*
- *Trichogramma*
- Parasitic wasps
- Predatory spiders

Reduction in Chemical Pesticide Use

Using biopesticides leads to:

✔ Fewer chemical sprays
✔ Reduced production cost
✔ Lower risk of resistance
✔ Cleaner soil and water
✔ Safe working conditions for farmers

Residue-Free & Safe Production

Horticultural crops are consumed fresh; chemical residues are dangerous for health. Use of biopesticides ensures:

- Export-quality produce
- Zero-residue farming
- Higher market value
- Consumer safety

Promotion of Sustainable Agriculture

Biopesticides in IPM support:

✔ Biodiversity
✔ Soil health
✔ Climate-smart farming
✔ Organic certification
✔ Long-term sustainability

Practical Uses in Horticultural Crops

Crop	IPM Strategy
Tomato	Bt + NPV for fruit borer
Cabbage	Bt for DBM
Chilli	Neem oil + Beauveria
Mango	Fruit fly pheromone traps
Grapes	Trichoderma + Pseudomonas
Banana	Seed rhizome treatment with Pseudomonas

Challenges

- Slower action compared to chemicals
- Effectiveness depends on weather
- Need for proper application knowledge
- Limited commercial availability
- Short shelf-life of some products

Solutions & Way Forward

✔ Farmer training & awareness
✔ Use of certified biopesticides
✔ Nano-formulation technology
✔ Government subsidies & IPM schemes
✔ Combination with cultural control methods

Conclusion

Biopesticides are a cornerstone of Integrated Pest Management in horticulture, offering sustainable, eco-friendly, and residue-free pest control. Their inclusion reduces chemical usage, preserves biodiversity, and enhances crop health and productivity. To promote wider adoption, efforts must focus on farmer education, commercial availability, improved formulations, and supportive government policies. Future farming will rely heavily on biopesticide-based IPM, aligning with organic, natural, and climate-smart agriculture systems.

References

1. ICAR-IPM Guidelines (2023)
2. FAO Report on Biopesticides and Sustainable Agriculture (2022)
3. Copping, L.G. *The Biopesticide Manual* (2020)
4. Shukla et al. (2021) Journal of Horticultural Science