Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 05, Issue: 06 (NOV-DEC, 2025)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Commercialization and Constraints of Biopesticides in Horticulture Crops Production

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Biopesticides are eco-friendly alternatives to conventional chemical pesticides and play a vital role in sustainable horticultural crop production. Their commercialization has increased significantly in recent years; however, several constraints still limit their widespread adoption. This article discusses the current status, scope, commercialization potential, and major limitations associated with biopesticides in horticulture. It also highlights strategies to improve their utilization among farmers and enhance sustainable crop protection.

Introduction

Horticultural crops—fruits, vegetables, spices, flowers, and plantation crops—face substantial yield losses due to insect pests and diseases. While chemical pesticides provide immediate relief, they also lead to problems such as pesticide residues, environmental pollution, pest resistance, and soil health degradation.

Biopesticides, derived from natural organisms like bacteria, fungi, viruses, and plant extracts, offer a safe and sustainable pest control alternative. Increasing consumer demand for organic and residue-free produce, especially in horticulture, has boosted the adoption of biopesticides in India. Despite this growth, commercialization is still constrained by issues related to production quality, shelf life, market awareness, and regulatory challenges.

Types of Biopesticides

1. **Microbial Biopesticides**
- Bacteria: *Bacillus thuringiensis* (Bt), *Pseudomonas fluorescens*
- Fungi: *Trichoderma spp.*, *Beauveria bassiana*, *Metarhizium anisopliae*
- Viruses: Nucleopolyhedrovirus (NPV)

2. **Botanical Pesticides**
- Neem formulations, plant extracts, essential oils

3. **Biochemical Biopesticides**
- Pheromones, attractants, growth regulators

4. **Plant-Incorporated Protectants (PIPs)**
- Genetically engineered crops expressing pesticidal traits (limited in India)

Commercialization Of Biopesticides

The biopesticide industry in India is expanding due to:
- Growing demand for residue-free horticultural produce
- Promotion of organic farming and IPM programs
- Export requirements that restrict chemical pesticide use
- Rising farmer awareness of eco-friendly practices

Key Stages in Commercialization

1. Production Technology

- Mass multiplication requires advanced fermentation systems, sterile culture media, and proper quality control.

2. Formulation and Packaging
- Common formulations: Liquid, wettable powder (WP), granules
- Packaging improvements needed due to sensitivity and short shelf life.

3. Market Distribution Channels
- Agri-input dealers, FPOs, cooperatives, e-commerce agri platforms.

4. Regulatory Approval
- Mandatory registration under CIB&RC (Central Insecticides Board & Registration Committee).

Status of Biopesticide Use in Horticulture

Biopesticides are widely adopted in horticultural crops due to higher export value and the need for chemical residue-free produce. They form a key component of Integrated Pest Management (IPM).

Major crops using biopesticides include:
- Vegetables: Tomato, brinjal, chilli, cucurbits
- Fruits: Mango, citrus, apple, grapes
- Spices: Turmeric, chilli
- Floriculture: Rose, marigold, chrysanthemum

Constraints In Commercialization Of Biopesticides

1. Low Shelf Life
- Microbial viability decreases under high temperature, humidity, and UV exposure.

2. Slow Action Compared to Chemicals
- Farmers prefer quick knockdown pesticides.

3. Quality Issues
- Poor-quality or counterfeit products reduce farmer confidence.

4. Lack of Farmer Awareness
- Incorrect dosage and application methods reduce effectiveness.

5. Variable Field Efficacy
- Sensitive to environmental conditions such as temperature and moisture.

6. Insufficient Research & Extension Support
- Need for demonstration plots and field-level training.

7. High Production Cost
- Small-scale industries face difficulties in maintaining purity and quality.

8. Regulatory Challenges
- Long approval time and high registration cost.

9. Storage and Transportation Problems
- Many biopesticides require cold storage, increasing logistics cost.

Strategies To Overcome Constraints

1. Improved Formulation Technology
- Nano-encapsulation, UV protectants, microencapsulation techniques.

2. Stronger Quality Control Measures
- Mandatory certification and product standardization.

3. Farmer Awareness Programs
- Demonstration trials, mobile advisory apps, FPO-based training.

4. Government Support
- Subsidies, start-up incentives, simplified registration procedures.

5. Integration in IPM Programs
- Promoting combined use with mechanical, cultural, and biological control.

6. Research and Development

- Development of heat-tolerant strains and longer shelf-life formulations.

7. Strong Branding and Marketing

- Ensuring farmer trust with reliable companies and result-oriented products.

Conclusion

Biopesticides hold immense promise for sustainable horticulture, offering safer, eco-friendly, and residue-free pest management solutions. However, commercialization faces challenges related to quality, awareness, regulatory delays, and storage conditions. By improving formulations, strengthening policy support, enhancing farmer training, and promoting research, biopesticides can become a dominant tool in horticultural crop protection. With appropriate strategies, India can lead in the global biopesticide market while advancing environmentally sustainable agriculture.