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Sustainable Management of Gram Pod Borer (*Helicoverpa armigera*) for Enhancing Chickpea Productivity

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Introduction

Chickpea (*Cicer arietinum* L.) is one of the most important pulse crops cultivated worldwide, particularly in India, which contributes nearly 70% of global chickpea production. The crop is valued for its high protein content (18–24%), ability to fix atmospheric nitrogen through symbiotic association with Rhizobium and its role in sustainable agricultural systems. According to the latest FAOSTAT (2024) estimates, chickpea is cultivated on approximately 14.5 million hectares globally, producing about 16.1 million tonnes with an average productivity of 1.11 t ha^{-1}. India is the largest producer of chickpea, accounting for nearly 70% of the global cultivated area and more than 72% of total production. During 2024, chickpea occupied approximately 9.59 million hectares in India, with a production of about 11.04 million tonnes and an average productivity of 1.15 t ha^{-1}. Major chickpea-growing states include Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka and Andhra Pradesh. Despite its leading position in global chickpea production, the productivity of the crop in India remains relatively low compared to that in several major chickpea-producing countries. This yield gap is primarily attributed to various biotic and abiotic constraints, including insect pests, diseases, drought, and temperature extremes. Among the insect pests, the gram pod borer, *Helicoverpa armigera* is considered the most destructive and economically important pest of chickpea. Infestations of this pest can cause yield losses ranging from 20 to 80%, depending on pest population density, crop growth stage and prevailing environmental conditions. Therefore, sustainable management of gram pod borer is essential for minimizing yield losses, reducing dependence on chemical insecticides, conserving natural enemies and ensuring environmental safety. Integrated Pest Management (IPM) strategies that combine cultural, mechanical, biological, botanical and need-based chemical control measures provide an effective, economically viable, and environmentally sustainable approach for managing *H. armigera* and enhancing chickpea productivity.

Gram Pod Borer: Distribution, Importance and Host Range

Helicoverpa armigera is a polyphagous pest attacking more than 180 plant species including chickpea, pigeonpea, cotton, tomato, maize, sunflower and vegetables. In chickpea, larvae feed on leaves during early stages and later bore into developing pods, consuming seeds and causing significant yield losses.

Economic Importance

- Yield losses: 20–80%
- One larva can damage 30–40 pods during its life cycle.
- Causes direct reduction in grain yield and quality.
- Increases production costs due to pesticide applications.

Identification and Biology

Egg

- Spherical, creamy white, laid singly on leaves, flowers and pods.
- Incubation period: 3–5 days.

Larva

- Green, brown, yellow, or black.
- Distinct longitudinal stripes on body.
- Most damaging stage.

Pupa

- Develops in soil at 5–15 cm depth.
- Pupal period: 7–15 days.

Adult

- Medium-sized moth with yellowish-brown forewings.
- Female lays 500–1500 eggs during lifetime.

Nature of Damage

Vegetative Stage

- Feeding on tender leaves and shoots.
- Irregular holes in foliage.

Flowering Stage

- Damage to flowers and buds.
- Flower drop resulting in reduced pod formation.

Pod Formation Stage

- Larvae bore into pods.
- Head remains outside while feeding on seeds.
- Multiple pods damaged by a single larva.

Damage Symptoms

- Skeletonization of leaves – feeding chlorophyll only leaving veins by young larvae Defoliation
- Feeds flower and green pods
- In green pods – make circular holes and feed the grains and make empty.

Sustainable Management Strategies

1. Cultural Control

Cultural practices create unfavorable conditions for pest multiplication.

Timely Sowing

- Early sowing during October–November helps escape peak pest incidence.

Deep Summer Ploughing

- Exposes pupae to predators and sunlight.

Crop Rotation

- Avoid continuous cultivation of host crops.

Intercropping

- Chickpea + Mustard (4:1)
- Chickpea + Coriander (4:1)
- Chickpea + Linseed (6:1)

Resistant Varieties

- Adoption of tolerant varieties where available.

2. Mechanical and Physical Control

Hand Picking

- Collection and destruction of larvae during early infestation.

Bird Perches

- Install 50 bird perches per hectare.
- Attract predatory birds such as:
    - Drongo
    - Mynah
    - King crow

Light Traps

- Useful for monitoring adult moth population.

Pheromone Traps

- Install 5 traps per hectare for monitoring.
- 10–12 traps per hectare for mass trapping.

3. Biological Control

- Biological control is the backbone of sustainable pest management.

Egg Parasitoids

Trichogramma chilonis

- Parasitizes eggs before hatching.
- Reduces larval population.

Larval Parasitoids

- *Campoletis chlorideae*
- *Carcelia illota*

Predators

- Ladybird beetles
- Lacewings
- Spiders
- Birds

Microbial Biopesticides

HaNPV (*Helicoverpa armigera* Nuclear Polyhedrosis Virus)

- Highly specific to gram pod borer.
- Safe for natural enemies.
- Applied at 250 LE/ha.

***Bacillus thuringiensis* (Bt)**

- Effective against young larvae.

Entomopathogenic Fungi

- *Beauveria bassiana*
- *Metarhizium anisopliae*

4. Botanical Insecticides

- Botanical pesticides offer environmentally friendly alternatives.

Neem Seed Kernel Extract (NSKE)

- 5% NSKE spray effectively suppresses larval population.

Resistance Management

- Rotate insecticides with different modes of action.

Azadirachtin

- Acts as:
  - Feeding deterrent
  - Growth regulator
  - Oviposition deterrent

Advantages

- Biodegradable
- Low mammalian toxicity
- Safe to pollinators and natural enemies

5. Need-Based Chemical Control

Chemical control should be used only when pest population exceeds the Economic Threshold Level (ETL).

Economic Threshold Level

- 1–2 larvae per meter row length.
- 5–8 eggs per meter row.

- Avoid repeated use of the same molecule.
- Use recommended doses only.

Integrated Pest Management (IPM) Module

Before Sowing

✓ Deep summer ploughing

✓ Crop rotation

✓ Timely sowing

Vegetative Stage

✓ Install bird perches

✓ Install pheromone traps

✓ Monitor pest population

Flowering Stage

✓ Release *Trichogramma chilonis*

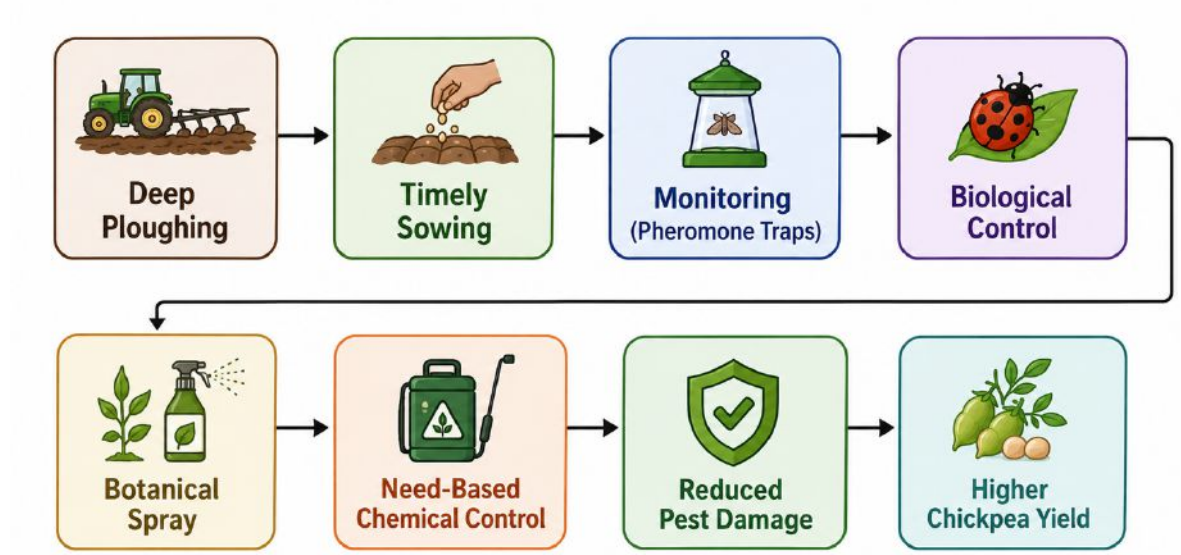
✓ Spray NSKE 5%

Pod Formation Stage

✓ Apply HaNPV or Bt formulations

✓ Need-based insecticide application

IPM Flow Diagram



Benefits of Sustainable Management

Economic Benefits

- Reduced pesticide expenditure.
- Higher net returns.
- Improved benefit-cost ratio.

Environmental Benefits

- Reduced pesticide residues.
- Conservation of biodiversity.
- Protection of pollinators.

Social Benefits

- Improved farmer health.
- Safer food production.
- Sustainable agriculture.

Conclusion

Gram pod borer (*Helicoverpa armigera*) remains the most destructive insect pest of chickpea worldwide. Excessive reliance on chemical insecticides has resulted in resistance development, environmental contamination and reduction of beneficial organisms. Therefore, sustainable management through an integrated approach involving cultural, mechanical, biological, botanical and need-based chemical control measures is essential. Adoption of IPM practices not only reduces pest damage and production costs but also enhances chickpea productivity, profitability and environmental sustainability. Such eco-friendly strategies are critical for ensuring long-term food security and sustainable pulse production under changing climatic conditions.