Integrated Pest Management for the Gram pod borer in Chickpea

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ABSTRACT

Chickpea (*Cicer arietinum* L.) is a major pulse crop of semi-arid and subtropical regions, valued for its role in nutritional security, soil fertility improvement, and farm income. However, its productivity is severely constrained by the gram pod borer, *Helicoverpa armigera* (Hübner), a highly polyphagous and destructive insect pest with a wide host range and global distribution. The pest remains active throughout the year and causes serious damage to chickpea during the rabi season (November–March) by feeding on leaves, flowers, and developing pods, resulting in yield losses of 20–50% under moderate to severe infestations. Owing to its high reproductive potential, migratory behavior, and ability to develop resistance, sole dependence on chemical insecticides has become ineffective and environmentally unsustainable. Integrated Pest Management (IPM) offers a holistic and eco-friendly approach by combining cultural, mechanical, biological, host plant resistance, and need-based chemical control strategies. Important IPM components include summer deep ploughing, timely sowing, crop rotation, intercropping, installation of bird perches, use of light and pheromone traps, conservation and augmentation of natural enemies, application of biopesticides such as *HaNPV*, *Bacillus thuringiensis*, botanicals, and selective insecticides.

Adoption of resistant and tolerant chickpea varieties further enhances pest suppression. The integration of these management practices helps in reducing pest population below economic threshold levels, minimizing pesticide load, conserving beneficial organisms, and ensuring sustainable chickpea production.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is one of the most important pulse crops cultivated in semi-arid and subtropical regions, contributing significantly to nutritional security, soil fertility improvement, and farm income. However, its production is severely constrained by the gram pod borer, *Helicoverpa armigera* (Hübner), a highly polyphagous and destructive insect pest. The larvae initially feed on vegetative parts and flowers and later bore into pods, feeding on developing grains, which may result in yield losses ranging from 20–50% and even higher under severe infestation (Sharma *et al*., 2021; Kumar *et al*., 2023). Farmers have traditionally relied on repeated applications of broad-spectrum insecticides for managing this pest, leading to serious issues such as insecticide resistance, pest resurgence, elimination of natural enemies, and environmental contamination (Kambrekar *et al*., 2022). In view of these limitations, Integrated Pest Management (IPM), which emphasizes pest monitoring, cultural and mechanical practices, conservation and augmentation of biological control agents, use of botanicals, resistant varieties, and judicious application of selective insecticides, has emerged as a sustainable and eco-friendly approach for effective management of *H. armigera* in chickpea, ensuring long-term productivity and environmental safety (Patil *et al*., 2024).

Host plants

Chickpea, Pea, Cotton, Pigeon pea, Maize, Sorghum, Tomato, Tobacco, okra, sunflower and safflower

Distribution

Helicoverpa armigera (Hübner) is a cosmopolitan pest widely distributed across Asia, Africa, Australia, and Mediterranean Europe. In the American continent, closely related *Helicoverpa* species occur, and *H. armigera* is commonly referred to as the cotton bollworm due to its severe damage to cotton and other crops (Fitt, 2018; Sharma *et al*., 2021). In India, this pest is widely prevalent in major chickpea-growing regions, particularly in states such as Madhya Pradesh, Uttar Pradesh, Rajasthan, Punjab, Bihar, Maharashtra, and parts of central and southern India, where chickpea is cultivated on a large scale. Its wide distribution and adaptability to diverse agro-climatic conditions are attributed to its polyphagous nature, high migratory ability, and continuous availability of host plants throughout the year (Kumar *et al*., 2023; Patil *et al*., 2024).

Nature of Damage

Helicoverpa armigera (Hübner) remains active throughout the year on different host crops; however, it causes severe damage to gram/chickpea during the rabi season from November to March. In the initial stages, the young caterpillars feed on green leaves and tender seedlings, resulting in poor crop establishment. After pod formation, the larvae bore circular holes into the pods and feed on the developing grains by thrusting their head inside the pod while the rest of the body remains outside, which is a characteristic feeding behavior of this pest (Sharma *et al*., 2021). A single caterpillar is capable of

damaging 30–40 chickpea pods during its lifetime, and the overall yield loss due to infestation may range from 20–50%, depending on pest population and crop stage (Kumar *et al*., 2023). After the harvest of chickpea during March–April, *H. armigera* migrates to summer crops such as tomato, where the larvae feed on ripening fruits by boring into them and consuming the pulp and seeds. This feeding damage often leads to secondary infections and fruit rotting, resulting in significant yield and quality losses and ultimately affecting market supply and consumer demand for tomato (Fitt, 2018; Patil *et al*., 2024).

Life history of fruit borer

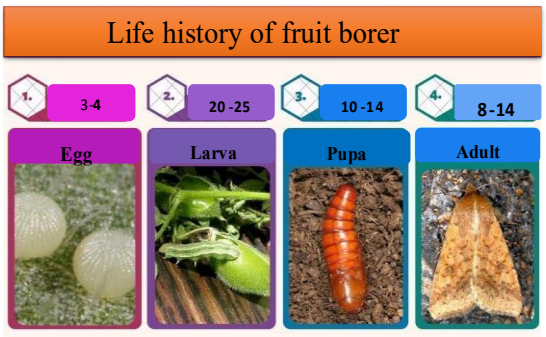
The life stage of *Helicoverpa armigera* is passes through egg, larvae, pupae and adult. Total life cycle should be completed in about 4-6 week depending on environmental conditions such as light, temperature, humidity etc. which detailed below (Ali *et al*., 2009):

- **Egg Stage(3-4days):** Female moths lay eggs on the surface of host plants, usually near the flowers or pods of gram (chickpea) plants. The egg is yellowish- white but change into shady brown prior to hatching and the size of the eggs varied from 0.42-0.60 mm in length and 0.40-0.55 mm in width usually, 0.5mm. The egg hatch in 3 to 4days.

- **Larval Stage (20-25days)**: After hatching a small neonates caterpillar emerges from the eggs. The body colour of the caterpillar varies from green, yellow, pink, and reddish brown to almost black with a broad cream stripe running over spiracles along each side. Fully grown larvae are up to 40mm long. 1st to 3rd instar larvae generally feed on leaves, twigs and flowers. In later stages larger larvae (4th to 6th instar caterpillars) shift to developing pods by making holes/bores and consume entire developing seeds. This stage is the most damaging to the crop. The larval period is completed through six distinct instars. The length of fully grown larva is 30.50-34.50 mm.

- **Pupal Stage (10-14 days):** The pupa is obtect type, dark brown in colour and 15-20 mm in length. After completing their feeding, the larvae pupate by forming cocoons in the soil at depth of 4-10cm.

- **Adult Stage (8-14):** The moth is light brown in colour, shouted bodied with broad thorax, 35-40 mm wingspan and 12-20 mm long. The fore wing has black spot at the margin and however, the hind wings were lighter in colour with a broad dark brown border at the apical end. The colour of the female is orange brown and were also identified by the presence of tuft of hair on the abdomen. These moths emerge from the pupal stage and mate to continue the life cycle.



Integrated management of Gram Pod Borer

Best way to control gram pod borer usually involves a combination of cultural, mechanical, biological, and chemical methods.

Here are some strategies to control Pod borer:

- Deep ploughing in summer helps to expose pod borer pupa (NIPHM, 2016)

- Timely planting and harvesting can also help minimize infestation.

- Rotate crops to disrupt the life cycle of the pest.
- Inter crop of linseed/ mustard/ wheat/ coriander /rabi sorghum. Fix bird percher 20/ha. Mix 5g of Rabi sorghum or Sunflower seeds with Chickpea seeds while sowing to serve as bird attractants.
- In smaller infestation handpicking is effective way to supress the population especially in small scale farming (NIPHM, 2016).
- Use of Light trap to attract adults in night.
- Use Pheromones traps (5 traps/ha) for monitoring of moth and 15/ha for the management.
- Install T shaped perches for birds @ 25-30/ha, 20-30cm above the crop height.
- Utilize gram varieties that are resistant or tolerant to gram pod borer damage like ICC 5264, ICC 506, ICC 10 Dulia (Lateef, 1985), GNG 469 (higher yield), BG 372, BG 390, GNG 469, PDE 2-1, and PDE 3-2 w (Chauhan and Dahiya 1994).
- Introduce natural predators or parasites of the gram pod borer, such as *Trichogramma spp*., *Campoletis chloridae* and *Bracon brevicorins* (Braconid wasps) to reduce their population (Singh *et al.,* 2024).
- Incorporation of Trichoderma viride @ 5kg/ha. multiplied on decomposed FYM @100kg/ha under moist soil condition in wilt/root rot affected areas.
- Spray of *HaNPV* @ 250-350 LE/Ha in 500-750 lit. water at weekly interval.
- Spray of *Bt.* formulation @ 2.0g/l is effective to control pod borer
- Spray of NSKE @ 5%. or Azadirachtin 3000 ppm @ 3ml/l or Profenofos 50 EC @ 2.0ml/l or Emamectin benzoate 25 WG @ 0.4 g/l or Indoxacarb 15.8 SC @ 50 g a.i/ha+ chlorantraniliprole 18.5 SC @ 30 g a.i/ha

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