

From Egg To Eradication: A Comprehensive Look At Tobacco Caterpillar Biology And Management

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Manuscript No: KN-V3-09/007

Abstract

The tobacco caterpillar is an invasive and polyphagous insect pest. Female adult moth deposits its eggs on the underside of a leaf in two to three layers, followed by covering the eggs with its abdominal hairs. This pest has six larval instars: the first and second instars live in groups and feed by scraping on the leaf surface, while the third to sixth instar larvae are dispersive and consume softer tissues of the leaf entirely, causing a skeletonization symptom that resembles damage caused by grazing animals. This article explains the biology, recommended pesticides, biocontrol agents, and integrated pest management practices.

Keywords: biology, management

Introduction

The tobacco caterpillar, *Spodoptera litura* (Fabricius, 1775), is an invasive, notorious, omnivorous, cosmopolitan, and polyphagous pest of many cultivated crops. Across the world, it is known by various names, including tobacco leaf caterpillar, common cutworm, tobacco cutworm, cluster caterpillar, armyworm, cotton leafworm, cotton worm, rice cutworm, tobacco budworm, and tobacco caterpillar. This insect exhibits nocturnal behaviour; its larvae and adults are active at night and hide during the day. The species is native to Southeast Africa and has since spread to Western Asia, Australia, New Zealand, and most of the Pacific islands. Currently, it is present in most of Southeast Asia, Oceania, Hawaii, and African islands. It's estimated that this insect has a host range of approximately 120 plant species. It is a significant pest of many cultivated crops, including cotton, tobacco, groundnut, jute, maize, rice, soybean, taro, cabbage, brinjal, potato, and sweet potato. Similar to other lepidopterans, this insect undergoes complete metamorphosis with egg, larval, pupal, and adult stages. The adult female moth chooses the undersurface of young leaves as an oviposition site. She deposits eggs in groups, laying them in two to three layers and covering them with her yellowish-brown abdominal hair as a protective layer (EFSA and Maes, 2014).

Life Stages of *Spodoptera litura* (Kaleka and Kapoor, 2024)

Egg: The eggs are creamy and spherical, measuring approximately 0.6 mm in diameter with an overall egg mass size is 3 to 6 mm. Initially, their colour ranges from yellow or pale orange to brown or pinkish, turning black as the embryo develops inside. The egg duration is 2 to 6 days.

Larval Instars: This insect undergoes six larval instars.

First Instar: The first instar is tiny, measuring about 1.3 to 1.6 mm in length. Instar has a black head, a distinctive black band on the first abdominal segment and a brown body. The body is covered with black hairs. The first instar duration is 2 to 4 days and is changed to the second instar after the first moult.

Second Instar: Second instar larvae transform to a pale green colour, retaining a black head, and develop a black spot on the first thoracic segment. They grow to a length of 2.5 to 3.0 mm with a 3 to 5-day duration. The second instar transformed to the third instar after the second moult.

Third Instar: The third instar also exhibits a pale green colouration but is devoid of body hairs, reaching a length of 4.0 to 4.8 mm with a duration of 2 to 5 days. Notably, while the first and second instars are gregarious, third instar larvae begin to disperse.

Fourth Instar: Fourth instar larvae are darker in colour and possess three pale yellow longitudinal lines: one centrally located (medial) and two on the lateral sides of the dorsal body surface. Fourth instar larvae reach 10.5 to 10.8 mm in length with a 3 to 6-day duration. Additionally, the 1st and 8th abdominal segments have a dark black colour spot, and the remaining segments have c-shaped (crescent) spots.

Fifth Instar: After fourth moulting, fourth instar larvae transform into fifth instar larvae, characterised by a dark green body. Their longitudinal lines change from yellow to a pale orange. Black spots are present on the first and eighth abdominal segments, with the first abdominal segment appearing darker. This instar can grow up to 12.8 to 13.4 mm in length with a 5 to 9-day duration.

Sixth Instar: The fifth moult of the fifth instar larva results in the formation of the sixth instar. This stage is dark greenish to brown, with a single mid-dotted stripe, and grows significantly, reaching 30.8 to 31.2 mm in length with a 2 to 3-day duration. Among the six instars, the first and second instars primarily scrape the chlorophyll content from leaves. However, from the third to the sixth instars, they feed on the leaf completely, causing leaf skeletonization by consuming only the softer tissues between the veins. Once the final instar achieves maximum growth, it ceases feeding and undergoes pupation in the soil.

Pupa: The pupa is initially yellow and subsequently changes to a dark reddish-brown. It features two small, spine-like structures at the tip of the abdomen. Pupa has an X-shaped mark on the ventral surface of the ninth abdominal segment that distinguishes male pupae. At the same time, females possess an inverted V-shaped structure on the ventral surface of the 8th abdominal segment. The pupal length is approximately 11.5 to 13 mm with an 8-to-12-day duration.

Adult: Adults are pale yellowish-orange. Their forewings display dark brown to light brown stripes, and the hind wings are greyish-white with dark brown borders. Females are typically slightly larger than males, allowing for differentiation based on size.

Agricultural Impact (EPPO, 2025).

This pest is estimated to cause substantial damage to numerous cultivated crops. For instance, in tobacco, a population of 8 larvae per plant can lead to a significant 50.4% yield loss. In Chinese cabbage, damage reached 66.3% with 40 larvae per 100 plants. A density of 4.8 larvae per taro plant can result in a 10% yield reduction, while just 1.5 larvae per capsicum plant can cause a 10% yield loss.

CIB&RC Recommendations

The Central Insecticides Board and Registration Committee (CIB&RC) has approved a comprehensive list of insecticides for effectively managing tobacco caterpillar (*Spodoptera litura*) infestations in various crops. These recommendations include Broflanilide, Chlorantraniliprole, Chlorfenapyr, Chlorfluazuron, Cyantraniliprole, Flubendiamide, Indoxacarb, Novaluron, Quinalphos, Spinetoram, Tetraniliprole, Acephate, and insecticide mixtures include Acetamiprid+Chlorantraniliprole, Chlorantraniliprole+Fipronil, Chlorantraniliprole+Lambda-cyhalothrin, Chlorantraniliprole+Novaluron, Chlorpyrifos+Cypermethrin, Emamectin benzoate+Lufenuron, Emamectin Benzoate+Permethrin, Flubendiamide+Deltamethrin, Flubendiamide+Hexaconazole, Flubendiamide+Kresoxim Methyl, Fluxametamide+Pyridaben, Lufenuron+Emamectin Benzoate, Methoxyfenozide+Chlorantraniliprole, Novaluron+Emamectin Benzoate, Novaluron+Indoxacarb, Novaluron+lambda-cyhalothrin.

Biocontrol approaches (Maes, 2014 and EFSA, 2025). Globally, approximately 131 species of natural enemies have been identified and reported as potential biocontrol agents against *Spodoptera litura*. These include a diverse array of organisms: 10 species function as egg parasitoids, 7 as egg-larval parasitoids, 58 as larval parasitoids, 8 as pupal parasitoids, 36 as predators, and 11 as entomopathogens. Among the most extensively utilized egg parasitoids are *Telenomus remus* and *Trichogramma chilonis*. Key larval parasitoids reported for *S. litura* include *Cotesia glomerata*, *Apanteles colemani*, and *Bracon brevicornis*. Effective insect pathogens known to infect *S. litura* include *Metarhizium anisopliae*, *Bacillus subtilis*, *Bacillus thuringiensis*, *Aspergillus flavus*, and Granulosis virus. In India, the Central Insecticides Board and Registration Committee (CIB&RC) specifically recommends several bioinsecticides for managing *S. litura*. These approved agents include Azadirachtin 05.00% w/w, *Bacillus thuringiensis* var. *galleriae*, *Bacillus thuringiensis* var. *kurstaki*, and *S. litura* Nuclear Polyhedrosis Virus 0.5%.

Integrated Pest Management (IPM) approaches (Maes, 2014)

Since *Spodoptera litura* pupates within the soil, certain agricultural practices are highly effective in its management. Deep ploughing, for instance, is recommended as it exposes pupae to harsh sunlight and natural enemies, such as predatory birds, significantly reducing their survival. Beyond cultivated crops, *S. litura* also infests various weeds, including *Amaranthus* species and plants from the Poaceae family, which serve as alternate host plants. Consequently, the timely removal of weeds is crucial for managing the pest population by eliminating these alternative food sources and breeding grounds. Given that egg masses and larvae are visible, manual collection of these stages is a feasible and direct method of pest reduction. Adult moths of *S. litura* are nocturnal and strongly attracted to light. Therefore, deploying light traps in fields serves a dual purpose: it aids in monitoring pest population levels, informing timely management decisions, and facilitates the mass collection of adults, thereby contributing to a reduction in overall pest numbers.

Additionally, setting up synthetic pheromone traps containing lilture in the field can selectively attract male moths. This strategy not only assists in estimating the pest population density but also reduces the male population, ultimately leading to decreased reproduction rates among females. For major crops, strategically planting trap crops like sunflower, taro, and castor can divert the pest's attention. These plants act as preferred feeding or oviposition sites, concentrating the pest population in specific areas. This concentration makes it much easier to target and eliminate the pest from a few designated plants, rather than dealing with a widespread infestation across the entire field. Furthermore, implementing crop rotation practices, particularly by incorporating non-host plants into the sequence, effectively disrupts the continuous life cycle of the pest, preventing its buildup from one season to the next.

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