

REVIEW ARTICLE



An insight into black cutworm (*Agrotis ipsilon*): A glimpse on globally important crop pest

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Many agricultural pests create problems for farmers leading to production loss. Since agriculture plays an important role in the economy of a nation, controlling and management of such pests is of great importance. Cutworms are notorious agricultural pests infesting a wide variety of crops leading to production loss. Cutworms are distributed worldwide and many species of cutworms have also been reported feeding on all kinds of crops. *Agrotis ipsilon* is one of the most common cutworm species prevailing in different continents. Understanding the biology and management of these pests will be of great use for farmers. In this article, brief information on cutworms; specifically *A. ipsilon* species is highlighted. A brief description of host, migration, control and management of *A. ipsilon* are also highlighted.

Keywords: Caterpillars, infestation, host, parasite, economy, control-management.

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Introduction

Cutworms are caterpillars belonging to the order Lepidoptera and family Noctuidae; a large family of moth.¹⁻⁴ Cutworms got their names from their feeding habit of "cutting-off" a seedling at ground level by chewing through the stem. Most noctuid species are cutworms. However, there are also species under the family Noctuidae that have the same feeding habit as cutworms but are not considered as cutworms.¹⁻⁴ Some of the common cutworms are army cutworm, black cutworm, bristly cutworm, bronzed cutworm, claybacked cutworm, dingy cutworm, pale western cutworm, sandhill cutworm and variegated cutworm.⁵⁻⁸ They may be grey, brown, green or yellow.¹⁻⁸ Cutworms are having longitudinal stripes and the length of the larval form

may extend up to 1 inch (2.5 cm).⁴ There are variations within the genera and may differ depending on the region where they are found.¹⁻⁴ Most common cutworm species are *Agrotis ipsilon* and *A. segetum*.¹⁻⁸

The life cycle of cutworm consists of egg, pupa, larva, pupa and adult.⁹⁻¹⁴ Newly laid eggs are about 0.5 mm in diameter and are cream coloured and turn into reddish-yellow to blackish colour on hatching.⁹⁻¹⁴ A female cutworm may lay around 2000 eggs and are usually laid singly or in groups on the roots, stems and on the low growing vegetation of the host plant and eggs usually hatch within 10-28 days. The larva is 4-5 cm long, pale, yellowish-green and possesses a blackish head.⁹⁻¹⁴ Newly hatched larvae



Figure 1 | Male black cutworm (*Agrotis ipsilon*) (left; Jacy Lucier, commons.m.wikimedia.org CC-BY SA 4.0). The larva (right; Rasbak, commons.wikimedia.org CC-BY SA 3.0).

usually feed on the leaves and then feed on the stem of the host plant in the later stage of larva and pupa is having two dark stripes around the abdomen, which are smooth and reddish-brown in colour.⁹⁻¹⁴ During their late-stage they appear to be blackish in colour just before the moth emerges. The adult moth has greyish-brown forewings with black lines and kidney-shaped markings along the side margins.⁹⁻¹⁴ The hindwings in adult moth are whitish with brownish margins and veins and the entire cutworm life cycle is completed within 6 weeks under warm condition and are having one generation per year.⁹⁻¹⁴

Cutworms are notorious agricultural and garden pests. As noctuids they are nocturnal and active at night.⁹⁻¹⁴ The larvae of cutworms are the most damaging and active feeders of the voracious leaf bud and stem and could potentially destroy entire plants if not controlled.⁹⁻¹⁴ However, some species are subterranean and root feeders. Variegated cutworm (*Peridroma saucia*) can defoliate an entire garden and fields in a matter of days.⁹⁻¹⁴ During daytime, adult moths hide at the bases of the host plant and grassy weed. Neonate larvae can be found under leaf littering on the ground in the dry land field while in wetland habitat they are found on the host plant, above the water surface.⁹⁻¹⁴ Cutworms are known to attack cultivated plants belonging to at least 15 families viz., Poaceae, Malvaceae, Brassicaceae, Solanaceae, Euphorbiaceae,

Asteraceae, Theaceae, Fabaceae, Rubiaceae, Cucurbitaceae, Rutaceae, Rosaceae, Apiaceae, Fabaceae, Lamiaceae.²³⁻⁵⁸ Common host plants are rice, maize, cotton, potato, tomato, cotton, pea, okra, cabbage, cauliflower, bell pepper, mustard, coffee.⁹⁻¹⁴

Cutworms are distributed at various places throughout the countries of the continents of Africa, Asia, Europe, North America, Oceania and South America.²³⁻⁵⁸

Biology and Description Black Cutworm

Systematic classification

Domain: Eukaryota
Kingdom: Animalia
Phylum: Arthropoda
Class: Insecta
Order: Lepidoptera
Superfamily: Noctuoidea
Family: Noctuidae
Genus: *Agrotis*
Species: *A. ipsilon*

Description

Black Cutworm (*A. ipsilon*) common name – dark sword-grass, greasy cutworm, floodplain cutworm,

or *ipsilon* dark are noctuid that are found to be distributed throughout the globe and possess serious threats to agricultural crops nearly in all varieties of vegetables and many important grains.¹⁶⁻²¹ When fully grown, larvae can measure up to 40 mm in length.¹⁶⁻²¹ The larvae of *A. ipsilon* are black-pale grey with a greasy appearing texture possessing convex granules on the abdominal segments. When touched, the larvae have the tendency to roll becoming thread-like in appearance.

Life cycle

Like other cutworms, *A. ipsilon* life cycle consists of egg, larva, pupa and adult.¹⁶⁻²¹ The larval form of *A. ipsilon* is the most active and feed on the vegetative parts of the host plants, mainly the stem and roots. Small irregular holes are found on the leaves of the host plant and the later instar may cut the stems below the soil surface resulting in plant death.⁵⁻⁸ Wilting of the host plant may be observed due to partial cutting. Larvae are destructive, as single larvae may cut one plant and quickly moves to other plant. Such feeding habit results in disproportional damage to crops and may damage the entire stands of the crops such as cotton and maize.⁵⁻⁸

A. ipsilon are known to cause the most economic damage of all the cutworm species. In India, *A. ipsilon* is a notorious agricultural pest infesting *Zea mays* (maize) and other important agricultural crops throughout the year.²² They are active during the month of October to March in the Indian plains and during summer in the mountainous regions. *A. ipsilon* is a serious insect pest of maize in Himachal Pradesh causing 23.92 percent of production loss of this crop.²² Since maize is a Kharif crop mostly grown during the rainfed season, *A. ipsilon* cause serious damage during the early stage of growth (up to 4 leaf growth).²²

Host

A. ipsilon feed on a wide variety of crops, seedling plants are most seriously damaged.¹⁻⁴ They also feed on grass and weeds. Some of the main host plants of *A. ipsilon* are *Triticum* (wheat), *Zea mays* (maize), *Solanum tuberosum* (potato), *Solanum lycopersicum* (tomato), *Musa* (banana), *Gossypium* (cotton), *Cucumis sativus* (cucumber), *Brassica nigra* (black mustard), *Abelmoschus esculentus* (okra), *Saccharum officinarum* (Sugarcane), *Brassica oleracea* (cabbages, cauliflower), *Camellia sinensis* (tea), *Coffea* (coffee), *Daucus carota* (carrot), *Mentha* (mints), *Pisum sativum* (pea), *Nicotiana tabacum* (tobacco), *Papaver somniferum* (opium poppy), *Phaseolus* (beans), *Raphanus sativus* (radish), *Sorghum bicolor* (sorghum), *Trifolium* (clovers), *Prunus domestica* (plum).²³⁻⁵⁸

Distribution

A. ipsilon is widely distributed across the globe and is known to damage crops in North, Central, and South America, Asia, Europe, Oceania, Middle-East and Africa.²³⁻⁵⁸ *A. ipsilon* is a serious agricultural pests in the tropical and subtropical regions of the world, causing significant loss in crop production in countries such as Chile, Brazil, Egypt, India, Myanmar, Poland, Spain, and USA.¹⁻¹⁴

Migration

A. ipsilon is reported to be a seasonal migratory moth that travels North during the spring season and South during the fall season to escape the harsh hot and cold weather during the summer and winter season.¹⁶⁻²¹ A sudden increase in the population of *A. ipsilon*, often in large numbers and seasonal disappearances in countries like India, Egypt, Sulawesi and the Middle East was reported proving that this pest is a migratory moth. In many parts of the world, it has been suggested that migration is the main source for the black cutworm moth population ovipositing on early spring crops.²³⁻⁵⁸ Migration is influenced by both thermoperiod and photoperiod.¹⁶⁻²¹ Migration period also determines the reproductive behaviour of the moth. Before the moth migrates South during fall, the reproductive system of both males and females is shut down, thus preventing copulation during winter. During spring and early summer, before migrating north, females release sex pheromones soon after eclosion. The production and release of sex pheromone by females and pheromone responsiveness in males are dependent on the juvenile hormone (JH) and pheromone biosynthesis activating neuropeptide (BPAN).¹⁶⁻²¹

Control and Management

Cutworms are one of the most challenging agricultural pests when it comes to control and management due to their peculiar feeding habit and mode of infesting their host plant. Several management techniques and practices were reported to be successful in controlling cutworms such as host-plant resistance, chemical control, and biological control.²³⁻⁵⁸

In general, it was reported that cutworms can be managed by avoiding the plantation of crops in areas that are reported to have cutworm outbreaks. Regular ploughing of fields, especially during autumn has also been reported to be successful in controlling the pest. Traps also serve as a useful tool in controlling *A. ipsilon* population.²³⁻⁵⁸

Host-plant resistance is an effective method in controlling and managing the pest. This is achieved by the transfer of three genes cowpea trypsin

inhibitor (CpTi), barley trypsin inhibitor (Bti-me), and *Bacillus thuringiensis* cry1Ac gene (Bt) to the host plant of *A. ipsilon* making the host plant resistant to *A. ipsilon* as these genes code for the production of different insecticidal toxin.²³⁻⁵⁸

Synthetic insecticides such as clothianidine, common alum, aluminium potassium sulphate (solid), and aluminium oxide (liquid) were reported to be effective against *A. ipsilon* larva and egg. A recent study also shows that chlorantraniliprole, a novel anthranilic diamide insecticide is also effective for controlling *A. ipsilon*. In India, diazinon 20 EC, quinalphos 25 EC, chlorpyrifos 20 EC, fenitrothion 50 EC, deltamethrin 2.8 EC and malathion 5% activity was tested against *A. ipsilon* on potato among which chlorpyrifos 20 EC was found to be the most effective in controlling *A. ipsilon*.²³⁻⁵⁸

Natural insecticides such as neem products, methanol extract from *Melia azedarach* fruits, extract of *Bassia muricata*, extract of *Tephrosia nubica*, leaf extracts of *Lantana*, *Parthenium*, *Hypis* and *Ipomoea carne*, were found to be very effective in controlling *A. ipsilon*. Although chemical control is very effective with a high success rate for controlling and managing *A. ipsilon*, precautionary measures should be taken while using pesticides as other species of animals are also affected.²³⁻⁵⁸

Recent studies show that entomopathogenic nematodes, *Steinernema* spp. and *Heterorhabditis* spp. were an effective biological control against *A. ipsilon*.¹⁻⁴ Studies were also conducted in endemic nematodes in India for potential biological control against *A. ipsilon*. A parasite *Hexameris arvalis*, an entomopathogenic nematode, was reported in the U.S.¹⁶⁻²¹ This parasite is reported to infect 60% of cutworm larvae and killing the host.²³⁻⁵⁸ Cutworms have several enemies such as wasps, beetles, ants specifically *Lasius neoniger* species which feed on *A. ipsilon* larvae and eggs may also be useful for controlling the pest in agricultural fields and gardens. Volatile chemical substances that are extracted from *Populus nigra* leaves are used for attracting *A. ipsilon* which can be used for setting up traps.²³⁻⁵⁸

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