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Study of the Development Cycle of Cotton Bollworm Helicoverpa Armigera

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Annotation: The cotton bollworm Helicoverpa armigera (Hübner) is a widespread genus of Lepidoptera insects found on various crops throughout the world. This type of insect causes great economic damage as an agricultural pest. During the researches, the morphological characteristics of eggs, larvae, cocoons and imagos were studied during the development cycle of the cotton bollworm.

Keywords: Helicoverpa armigera (Hübner), pest, egg, larva, fungus, imago, insecticide, cotton.

Introduction. The cotton bollworm Helicoverpa armigera (Hübner) (Lepidoptera: Noctuidae) is one of the most economically damaging pests of global agriculture. This is an exotic pest that spreads in all regions of the Republic of Uzbekistan and causes great damage to the main crops, such as beans, beans, corn, cotton and tomatoes. It is a polyphagous pest, and its larvae have been identified on more than 180 cultivated and wild plants, with high reproductive potential and a high ability to disperse and survive (3,4). Even under unfavorable conditions, it can complete several generations per year, completing the period from egg to adult moth in 4-6 weeks.

In order to protect crops from this type of pest, various pesticides are used, but resistance to insecticides applied to crops is common (6-8). A scientific study of the set of characteristics described above will facilitate understanding of the potential economic damage caused by cotton bollworm H. armigera (6). This fact worries the manufacturers, as well as the scientific communities of our Republic and the world (3,4).

Insect rearing in the laboratory is the study of basic practical experiments to solve basic and applied entomological problems. The maintenance of insect colonies in the laboratory is essential to modern pest control strategies, and advances in artificial feeding have made it possible to culture insects in large numbers (1,2). This will pave the way for great progress in the study of integrated pest control through experiments. Therefore, in order to study pests such as cotton bollworm H. armigera, it is important to understand the development of the pest not only in field conditions, but also in laboratory conditions and how to keep it in its colony. Although it is possible to maintain insects continuously with natural food throughout the year, it takes extra work to manage the biological material and plant species used to feed the insects. Alternatively, in laboratory conditions, in addition to providing constant care of insects, artificial food can be used, which allows to reduce the labor spent on their care (7). Artificial feeds based on different ingredients are used to monitor the development of the cotton bollworm H. armigera in the laboratory. It contains: wheat flour 15 g, beans 17 g, peas and tomato paste 18-20 g, yeast and sucrose 21 g. At the same time, methods of breeding insects, especially artificial feeding, should be constantly updated (9).

Material and methods

During the experiments, the studied insects were observed to develop under natural light at room temperature. The tunnels are kept in special boxes (diameter 80 cm, height 60 cm). The boxes are lined with kraft paper on the inside as a substrate for laying eggs, and the top is covered with fabric.

This method was developed by modifying methods presented in a literature review (Specht et al. 2006; Mironidis & Savopoulou-Soultani 2008; Wang et al. 2008). For nutrition, a kraft paper cover coated with a 10% honey solution in distilled water was changed every 48 hours. The number of pairs was 24 and four parties were formed. During the research, ten individual larvae from each selected pair were transferred to 70% ethyl alcohol. The remaining larvae were kept alive to study further stages of development. Larvae were kept in plastic containers (diameter 2.5 cm, height 7 cm) to protect them from various mechanical effects.

Cottonworm butterflies (Helicoverpa armigera (Hübner)) are divided into two groups; 1- was fed with salad leaves; For group 2, using a bean-based artificial diet (Montezano et al. 2013), after moulting each larva, the old post-shell was removed from the containers and stored dry. Before sponging, a small amount (5 cm thick) of autoclaved vermiculite was added. Adult specimens were preserved in a container of ethyl acetate to check for the preservation of further morphological exoskeletal structures. The wings were removed and bleached to study the butterfly's wings. The head, thorax, abdomen, and appendages were immersed in 10% potassium hydroxide solution (KOH) and placed in a warm bath until the tissues softened and the exoskeleton appeared translucent. Then it was separated for observation under a light microscope.

Measurements of immature stages (eggs, larvae, and pupae) were made using a Wild Heerburg stereomicroscope with a micrometric scale. The width of the head capsule corresponds to the greatest distance between the genae in each period. Body length is the distance from the front of the larva to the last abdominal segment. Measurements are determined based on the standard deviation of (n) from multiple samples.

Results.

Adults (Fig. 1A-D) were observed to be inactive for most of the day and become active at night, after the cool of the evening when mating usually begins. Matings last from a few hours to three days. Spawning begins a day or two after mating, when females spread their wings and lay small egg masses of three eggs each.

Figure 1. Helicoverpa armigera. A - dorsal view of a female butterfly. B - Female butterfly seen from ventral. C - Dorsal view of a male butterfly. D - Ventral view of a male butterfly.

It was observed that mating lasts up to 15 days, after which the females die of exhaustion. In the first days, about 13 to 27 eggs were laid per day, for a total of 218, gradually increasing towards the end of the egg-laying period. Based on observations of samples in the laboratory, eggs did not hatch from the first two batches of eggs.

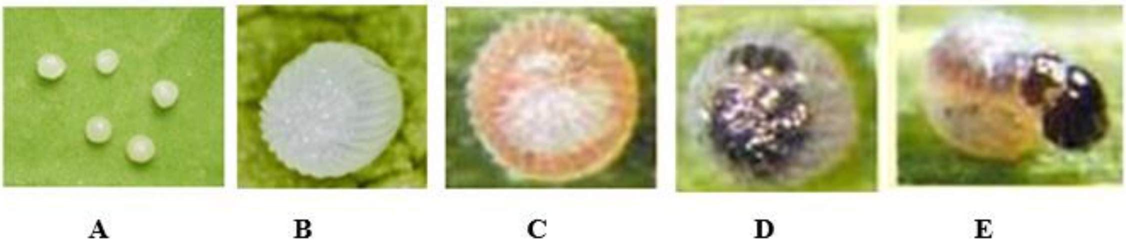

Figure 2. Helicoverpa armigera. Egg development. From left to right, larva hatching from an egg A view of a moth egg on a leaf. B- Enlarged view of the egg. C- 1-day-old developing egg. 2 day old developing egg. E-3 day old larva hatching from an egg.

It was observed that the larvae of the first stage feed on the eggshell, and then start to crawl separately in search of food. In addition, it is observed that larvae feed on newly laid eggs and less mobile larvae when they cannot find food. To prevent this, the larvae were isolated in their first instar. To test the emergence of cannibalism, pairs of larvae were placed in containers with food. Cannibalism was not observed under these conditions;

Before each molt, the larvae are motionless, pushing the head capsule forward and then the body backward through stretching and contracting movements. Larvae do not eat the droppings. First and second stage larvae are wrapped in silk before molting.

After the fourth instar, the larvae raise their head and thoracic segments, then lower their head and remain in this position for several seconds. Sixth-stage larvae stop feeding in the period before pupation.

They secrete a reddish secretion before dropping into the soil to build a sponge chamber with silk (Figure 2). The sides and upper parts of the body enlarge and remain motionless for the next six days until the end of the dome. After shedding its sixth integument, it is free in its special shell for sponging, and when it can move, it rotates its body 360° while moving through only five posterior abdominal segments.

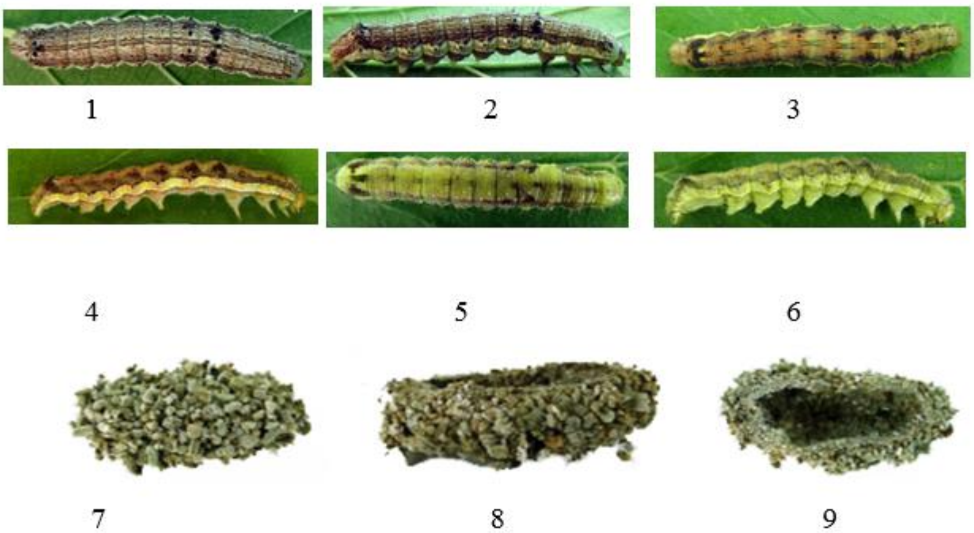

Fig. 3 Helicoverpa armigera larvae and budding capsule. 1- Fifth stage in dorsal view. 2- The fifth stage lateral view. 3- The sixth stage in the dorsal view. 4- sixth stage lateral view. 5- The sixth stage in the dorsal view. 6- The sixth stage in the lateral view. 7- dorsal view of the dome capsule. 8- pupal capsule in lateral view. 9- ventrall view of the capsule of pupal.

Pupa. When the larvae are fully developed and begin to pupate, their color initially takes on a soft, runny cream color (Figure 5). Over time, the color gradually changed to brown and began to harden. Because in the early days of pupation, it had a soft and smooth appearance (Fig. 4).

The genital organ of the female butterfly is located in the middle of the 8th abdominal segment, and the male genital organ, observed under a binocular magnifying glass, is located in the 9th abdominal segment (Fig. 3). The average weight of the pupa was 198.7 mg. Pupation lasted about 11 days (Table 3).

Figure 4. View of A) male B) female pupa of cotton worm (Helicoverpa armigera) butterfly, view of pupa.

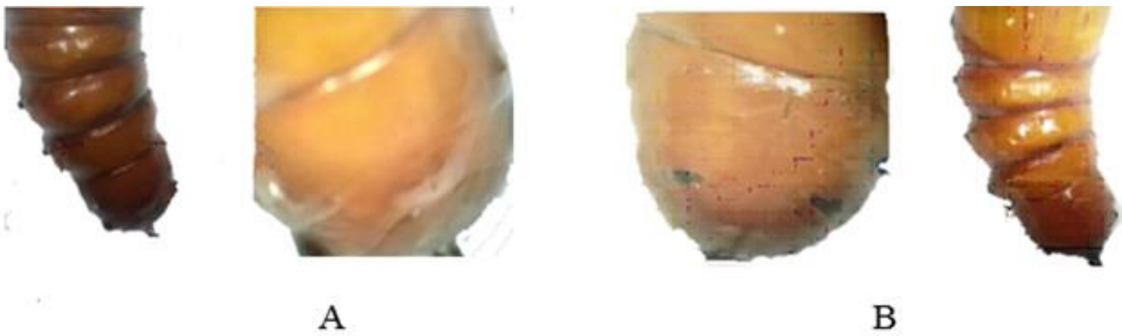

Figure 5. Magnified view of the ventral abdomen of a cottonworm (Helicoverpa armigera) butterfly pupa.

Table 1. Pupation of the cotton worm (Helicoverpa armigera) butterfly.

Mass (mg)	198.7±20.12
pupation duration (in days)	11.23±1.42
Number of male cottonworm (Helicoverpa armigera) butterflies (pieces)	44.00±0.00
The number of butterflies of the female Cottonworm (Helicoverpa armigera) (pieces)	38.00±0.00
The number of dead pupae (pieces)	18.00±0.26

Figure 6. Color change between new (left) and mature (right) pupae of the cotton bollworm Helicoverpa armigera.

Discussion of research results.

This species is an economically important agricultural pest due to the damage it can cause to crops worldwide (Matthews 1991; Scoble 1992; Kitching & Rawlins 1998). Emergence, feeding and egg-laying of cottonworm butterflies occur at night. Larvae of Helicoverpa species can feed either during the day or at night, regardless of age (Callahan 1958; Hardwick 1965). However, this behavior was not observed in post-instar H. armigera. Instead, when pairs of larvae of any age are placed in a common container, one can prevent the other from feeding, causing it to starve to death.

Distribution areas of H. armigera and H. zea around the world.

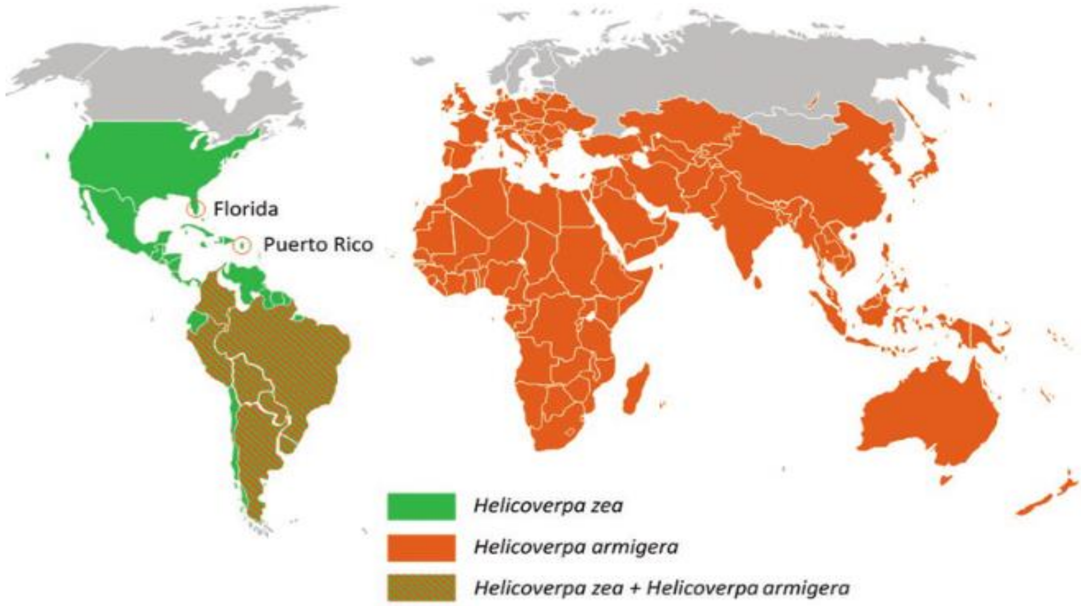

Figure 7. H. armigera and H. zea have been shown to be economically important pests worldwide. Currently, H. armigera and H. zea are distributed in most countries of Latin America, including Brazil, Argentina, Paraguay, Uruguay, Bolivia, Peru, Colombia. It can be observed that H. armigera is distributed in Asia, Africa and Australia. In particular, this type of pest is widespread in all regions of Central Asia. Although H. armigera larvae have been observed falling in pheromone traps, various measures are being taken to limit damage to agricultural crops. Sources: Retrieved from CABI (Center for International Agriculture and Biosciences). (Critics et al. 2015).

The larvae of the cotton bollworm Helicoverpa armigera are considered polyphagous and can feed on several different plants, demonstrating a high degree of nutritional flexibility. This study confirms that there is no significant difference in eggs, larvae, pupae and butterflies in naturally fed compared to laboratory reared and artificially fed larvae (Hardwick). 1965; Fitt 1989; Hamed & Nadeem 2008; Ali et al 2009; Assemi et al 2012).

Significant changes can be seen in the pupation processes of Lepidoptera species, which may be related to different preservation mechanisms at this stage.

The last stage prepares a special place in the soil for pupation. Helicoverpa may be a technique to increase species and survival. Pupation in soil has also been observed in field crops (Hardwick 1965; Karim 2000; Ali et al. 2009). Similar behavior has been reported in Schinia species (Hardwick 1958). It has been observed that the presence of special visible pores (stigma) facilitates underground respiration and is particularly important in their migration (Angulo et al. 2006).

Conclusion

The cotton worm butterfly Helicoverpa armigera is a polyphagous pest that causes great economic damage to various plants. Studying the biological characteristics of these pests is necessary for the development of effective strategies of complex control against them. Several samples were collected from "Maygir Yusufkhan" fields of Izboskan district, Andijan region.

The cotton worm (H. armigera) was grown in an artificial environment under laboratory conditions until it turned from a butterfly to a pupa. Thirty pairs of new cottonworm butterflies were selected for laying eggs and their development. Each female butterfly laid an average of 218 eggs, and 47% of the eggs hatched. After hatching, 100 larvae were selected to observe and characterize different stages of insect development. The observed time until the egg stage and emergence of cottonworm butterflies was 34 days. The mortality rate of young larvae was higher than that of other stages of insect development. The test for cannibalism was conducted on first and third stage larvae of H. armigera. The test showed that cannibalism is mainly observed in third-stage larvae. The test also showed an increase in mutual cannibalism with an overpopulation of larvae.

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