

# Development of moths in tomato crop and methods of moth control

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**Abstract.** *Heliothis armigera* (cotton moth or cocoon worm) is considered one of the worst pests of tomatoes in Uzbekistan, in addition to cotton. All stages of the pest can develop in this crop. The pest lays its eggs individually on the body, flowers and blooms of the plant. Worms hatched from the eggs gnaw the plant body, flowers and fruits. Each worm can damage 10-12 tomatoes per plant. Damaged crops wither, and large ones rot. In some cases (mostly in the Yusupov variety), infected large fruits do not rot, but may form a scar, but the quality and appearance of the product will be lost. Not all varieties are equally affected by the cocoon worm: the Yusupov variety is the strongest, and the Volgograd 5/95 and Talalikhin varieties are less affected. But there is no type of tomato that is not damaged at all, and in some years the yield can decrease up to 50%. In this article, the species composition, distribution area, bioecology, development and damage caused by moths in the tomato plant are studied, and the level of harmfulness is studied. In this case, the length and weight of moths at different ages of moths were determined in laboratory conditions. When the first young worms of the moth were placed in the tomato plant, compared to the control option, it was found that the tomato yield decreased by 73.3% and the total yield decreased by 2.15 kg. During the fruiting period, the option affected by cocoon worm showed a 53.3% decrease in fruits compared to the control, and a loss of 1,400 kg of productivity per plant was observed as a result of the experiments.

**Keywords.** Pest, entomophagus, tomato, moths, pheromone trap, biological efficiency.

## 1 Introduction

The growth of the world's population and the year-by-year increase in the demand for food products require the further expansion of agricultural crops and the continuous supply of high-quality products [1]. Today, tomatoes are grown on 5.6 million hectares of land around the world, and the total yield is 281.5 million tons. Fruit and vegetable crops, which are the main branch of the world's agriculture, are food products that are in great demand by the human body, as they are rich in the most necessary vitamins, proteins and carbohydrates [2, 3]. Accordingly, one of the urgent tasks is to develop and implement effective measures to combat pests of fruit and vegetable crops based on the study of their species composition, biological characteristics, distribution and damage [4].

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The United States, Russia, Turkey and France are the leading countries in tomato production and export, while China, India and Uzbekistan are achieving high results from the Asian continent [5, 6]. As a food product in the world, tomato crop is grown in more than 100 countries of the world in vegetable agrobiocenosis and satisfies the food demand of the world population to a certain extent. In recent times, the loss of an average of 40-50% of the total crop due to damage caused by pests and diseases is observed in tomato cultivation. In order to prevent this failure, various methods and tools are used in world agriculture, which leads to an increase in the costs of tomato production.

The favorable climate of Uzbekistan allows to provide the population with fresh vegetables throughout the year. Today, vegetable cultivation areas in Uzbekistan are expanding more and more [7].

Among the vegetable crops in Uzbekistan, tomatoes are of great importance. According to the calculations of scientists in the field of health and hygiene, 120 kg of vegetables per capita should be consumed every year, of which 25-35 kg of tomatoes and cucumbers should be consumed. Tomato production per capita is 15-20 kg. This means 10-17 kg less than the recommended reasonable norm [8]. In Uzbekistan, great attention is being paid not only to the size of the areas planted with tomatoes and cucumbers, but also to constantly increasing their productivity.

The rapid growth of the population of Uzbekistan and the growing demand of the population for food products put a number of urgent issues before the representatives of the industry. These are: providing the population with ecologically clean agricultural products and increasing the export potential [9].

Agriculture is an important branch of the economy of Uzbekistan. This network satisfies the demand of the country's population for food products, and for raw materials of the processing industries. About 90 percent of food products are produced in the agrarian sector. Along with the supply of food products to the consumer market of Uzbekistan and raw materials for the processing industry, agriculture is also considered a guaranteed market for the products of a number of industries, such as agricultural machinery and the chemical industry. According to the information of the Ministry of Agriculture, this year, tomatoes were grown on a total of 75,500 hectares in Uzbekistan, of which 1.8 million tons of products were produced [10].

Many different rodents and sucking pests damage many agricultural crops in Uzbekistan. About 10 types of them cause serious damage to tomatoes and about 5 types to cucumbers. From rodent pests: root-gnawing moth (*Agrotis segetum* Den et Schiff) and cotton moth (*Heliothis armigera*), from sucking pests: plant aphids (*Aphis gossypii* Glow), mites (*Tetranychidae*), spider mites (*Aleyrodidae*) and it is mentioned in the literature that other underground and above-ground pests cause serious damage.

The representatives of the *Noctuidae* family of the *Leridoptera* family were considered the most common wasps. For this reason, a number of scientists have conducted their research on moths in Uzbekistan. According to the results, moths are included in the species causing serious damage to vegetable crops.

## 2 Materials and methods

Distribution of moths was carried out according to the methods of Yaroslavsev, Bryansev, and Weiser [6-9]. An entomological comb was used to calculate the pest during the growing season of tomatoes. The damage caused by artificially infesting the plant with a pest in different growth periods in special sacrifices is compared to the damage caused to the crop. The development of the pest was studied according to the development phases of the tomato moth at different temperatures in laboratory conditions. The study of the biological effectiveness of chemical biopreparations against pests was carried out according

to Khojaev [6, 10]. Determination of the biological effectiveness of biopreparations against harmful organisms was carried out based on the formula of Abbot [7].

According to the results of scientific research, it is one of the common pests in irrigated cotton-growing districts. Its worms damage hundreds of crops belonging to 34 plant families. Cotton, alfalfa, sugar beet, corn, grain, oilseeds and sugarcane crops are the moth's favorite food. The pest is 12-18 mm long, the forewings are yellowish-gray in color, sometimes reddish-brown or pinkish, or bluish in color, and the wings have a dark streak pattern. There is an inconspicuous band just inside the third of the forewings and two spots in the middle of the wings.

Many literatures contain complete information about the distribution, feeding characteristics and migration of this pest, its natural entomophages, and the period of development. In the northern regions of Central Asia, depending on the weather conditions, the cotton moth gives 3-4 generations in a year, including the first generation, which is very small in number. As overwintering fungi enter the dormant period, about 85% of this pest leaves the winter. The cotton moth feeds on the plants in autumn, and its cones overwinter in the soil near those plants at a depth of 10-15 cm. The first adult butterflies appear in late April - early May. Butterflies lay their eggs on plant leaves and growth points.

Each butterfly lays 250-500 eggs in its lifetime, and some up to 1000 eggs. According to the observation results and information provided by the Plant Protection Station of Central Asia, the first flight period of cotton moth butterflies begins when the average daily air temperature is above +15 °C; wintering mushrooms develop well when the temperature is not lower than -15 °C.

Newly hatched worms are shiny with a light green color, and later the body begins to darken. At first, the young ones feed on the young leaves and twigs of the plant, while the older ones feed on tomato fruits. Depending on the type of plant the worm is eating, the color of the worm's body changes from gray-green blue to yellow-white.

The economic risk of cotton moth in agricultural crops - economic harmful quantity criterion (EHQC) was also determined in the field conditions in vegetables, cotton and other crops. Studies have also been conducted on the development, damage and control of moth pests in vegetable crops. In areas where the cotton moth is not controlled, it can multiply and destroy 70-80% of vegetable crops and 35-40% of cotton crops.

### 3 Results and discussion

Experimental work was carried out in 2021 to determine the size of the cotton moth developing in field conditions in different periods. At the time of damage to tomatoes, the second generation of cotton moth worms were collected from the fields where tomatoes were planted, fed with additional food, and observed in laboratory conditions. In this case, the length of the 1-year-old worm is 2-3 mm and the weight is 0.01 g, the length of the 2-year-old worm is 5-6 mm, and the weight is 0.09 g, the length of the 3-year-old worms is 10- 11 mm, weight 0.16 g, 4-year-old moth worms - 15-17 mm long, and weight 0.23 g, 5-year-old worms - 20-23 mm long, weight 0.28 g, and 6-year-old worms were observed to be 25-28 mm long and 0.33 g in weight (Table 1).

According to the results of the observation, in the fields planted with vegetable crops (tomatoes), the worms of the last age of the cotton moth, which have finished feeding, fall into the soil and turn into a tuber at a depth of 5-12 cm between the soil. In rare cases, it can become a tuber outside the nest, that is, in the leaf axil or inside the fruit. The color of the cocoon worm mushroom varies from light pinkish yellow to reddish brown. The length of the bulb is 17-21 mm. The last growth of the tenth abdominal segment has two parallel spines. A newly formed pupa has four dark black spots around the eyes, which are not fully colored.

**Table 1.** Size of the cotton moth at different ages (Educational experiment station "Innovative development and consulting center in agriculture" SUE of TSAU, 2021).

Age of worms	Time observed: second generation	Length of worms, mm	Weight of worms, g
1	July 9	2-3	0.01
2	July 12	5-6	0.09
3	July 17	10-11	0.16
4	July 22	15-17	0.23
5	July 29	20-23	0.28
6	August 5	25-28	0.33

Butterflies lay one, sometimes two, eggs on the stems at the growing point of tomatoes. The 1st-year-old worms that hatched from the eggs first feed on the leaves at the point of growth, then the 2-3-year-olds damage the body and flowers, and the adult worms damage the fruit and make it unfit for consumption. The worm that hatched from the egg develops for 25-30 days and kills 20-25 plant bodies, flowers and fruits. This pest is especially dangerous for tomatoes planted in autumn and winter in the greenhouse.

From the results of the scientific research, it was found that the mature breeds of the cotton moth appeared in the tomatoes planted for the autumn-winter period in greenhouse conditions from the second and third ten days of August. In the third ten days of August and the first ten days of September, it was observed that mature breeds (male) began to lay eggs on the growth points of the tomato plant. The eggs hatched from September 10 to September 20.

In our experimental plots, the pest, which turned into a mushroom by the beginning of December, died due to the high humidity, under the influence of various entomopathogenic fungi. 3 of the female butterflies, which were flown from the mushrooms collected from nature and fertilized, were released into the pieces separated during the tomato picking season. In the rest of the pieces, the pollen of the next generation butterflies was studied.

The adult breeds were monitored every 3 days until they died after laying eggs. It was found out from the observations that the egg-laying of mature breeds continued in tomatoes for 15-20 days. At an air temperature of 27 °C and humidity of 60-65%, the average number of eggs laid by butterflies was 545-600 (Figure 1). To study the damage caused by the cotton moth in tomatoes, we conducted field experiments using general entomological methods.

According to the information of Mominov and other scientists, complete information is given about the distribution, feeding and migration of this pest, its natural entomophages, and the period of development. In the northern regions of Central Asia, depending on the weather conditions, it is mentioned in the sources that the cotton moth gives 3-4 generations in a year, counting with the first generation, which is very small in number.

As overwintering fungi enter the dormant period, about 85% of this pest leaves the winter. The cotton moth feeds on the plants in the fall, and its cones overwinter in the soil near those plants at a depth of 10-15 cm. The first adult butterflies appear in late April - early May. Butterflies lay their eggs on plant leaves and growth points. Our fields were covered with gauze from all sides with artificially infested plants (to prevent them from being infected by other insects).



**Figure 1.** Damage caused by the cotton moth and caterpillar to tomato.

During the flowering and fruiting periods of the plant, the first young worms of the moth were placed in 3 repetitions, and the plant in the control option was left pest-free. It was observed that the laid young worms begin to damage the leaves and growth points and plant bodies of tomatoes. Damaged bodies and flowers began to dry up, and the fruits were observed to rot under the influence of fungi and bacteria, and the results of the experiment are presented in Table 2.

**Table 2.** Damage caused by cocoon worm to tomato yield (Educational experiment station "Innovative development and consulting center in agriculture" SUE of TSAU, 2021).

Tomato varieties	Pest-infested growing season	Iterations	Harvest per plant, kg	Yield loss relative to control option	
				kg	%
Uzbekistan-178	Blooming	1	0.8	2.2	73.3
		2	0.9	2.1	70.0
		3	0.8	2.2	73,3
Average		-	0.83	2.15	72.2
Uzbekistan-178	Ripening	1	1.5	1.5	50.0
		2	1.4	1.6	53,3
		3	1.3	1.7	56.6
Average		-	1.4	1.6	53.3
Control		-	3.0	-	-
<b>EKF<sub>05</sub> = 1.2</b>					

## 4 Conclusions

It was found that the tomato yield was reduced by 73.3% in the option infested with pest worms during the flowering period of tomatoes compared to the control. It was found that the total yield decreased by 2.15 kg per plant. In the option affected by cocoon worm

during the fruiting period, 53.3% reduction of fruits compared to the control was observed, and 1.4 kg loss of productivity per 1 plant was observed as a result of experiments.

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