

Bioecology and Damage of Tomato Moth

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Abstract: This article analyzes the literature data on the origin planes of the tomato moth (*Tuta absoluta* Mer). Tomato moth (*Tuta absoluta* Meyr) is a fully-developed pest belonging to the family Lepidoptera (Gelechiidae). The presence of coins and circular black spots on the moth's wings is one of the most important (identifying) signs to be considered for its detection. Such signs include the fact that the first segment of the head of the tomato moth worm of all ages is black. Mature (female) varieties of tomato moth lay their eggs mainly on the growth points of the plant, on the lower, upper part of the leaf, and sometimes on the surface of the soil. The oval-shaped egg is white, rainbow-colored, and orange-yellow before the worms hatch. Tomato moths hatch after 4-7 days, depending on the external environment. The larvae are white-gray and the head is dark (diagnostic mark). The fungus is light brown, about 6 mm long, passes into the soil in the pores of the leaves, or between plant debris, sometimes in the form of silky cocoons on damaged and twisted leaves. The experiments were performed in 3 variants. In variant 1, the moth eggs developed on days 7-8 with an average temperature of 18-20 °C and a relative humidity of 50-65%. Butterflies fly for 11-12 days for the development of 1-2 year old worms and 12-13 days for the development of 3-4 year old worms, and 16-17 days for the development of moths. The larvae of the tomato moth damage the plant, feeding on the parenchymal tissue of the leaf (flat), leaving only the epidermal layer on the back and front of the leaf. When the infestation of tomato moth was 1 point, the yield per 1 bush plant decreased by 13.7% compared to the control. At the level of 2 points, the yield decreased by 30.6% compared to the control, and at the level of 4 and 5 points with pest damage, the yield decreased by 77.9-88.9% compared to the control.

Keywords: Plant, tomato, pest, tomato moth, bioecology, pest, egg, worm, fungus, butterfly, greenhouse, control measures, efficiency.

According to an analysis of the literature data [1,2], this pest was first found in 1917 in the state of Peru. Until the 1960s, it was again prevalent in Chile, Colombia and Argentina, and after the 1970s, in Bolivia, Paraguay and Uruguay. In Brazil, however, it first appeared in 1979 and in 1990 became widespread in the country's vegetable growing areas, causing significant damage.

C.S. Izhevsky [3] noted that tomato moth is a dangerous pest that was not encountered in Europe until 2006. It first spread to Spain (2006), then to Morocco, Algeria and the Netherlands (2008), France, Italy, Portugal and the United Kingdom (2009), and since 2010 to all European countries [5]. It was first identified in November 2010 in the Krasnodar region of Russia and was included in the list of tomato moth and dangerous quarantine pests by experts [1-3,5].

MORPHOLOGICAL FEATURES OF THE DEVELOPMENTAL STAGES OF THE TOMATO MOTH.

Tomato moth (*Tuta absoluta* Meyr) is a fully-developed pest belonging to the family Lepidoptera, family Gelechiidae. The presence of coins and circular black spots on the wings of the moth is one of the most important (identifying) signs to be taken into account to identify it. Such signs include the fact that the first segment of the head of the tomato moth worm of all ages

is black. The mature species of this pest flies mainly at night and stays motionless in the lower part of the plant during the day. (Figure 1).



Figure 1. Tomato moth butterfly

The butterfly of the pest is very sensitive, and if the plant is shaken a little, it quickly flies to the side. Females of butterflies live 10-15 days, and males 6-7 days.

Eggs: Mature (female) varieties of tomato moth lay their eggs mainly on the growth points of the plant, sometimes on the surface of the soil, at the bottom and top of the leaf. The oval-shaped egg is white, with a rainbow glow, and the worms glow orange before they hatch. The worms are observed to move slowly and imperceptibly 4-6 hours before hatching. The worms gnaw on the inside of the egg and make a hole for themselves to come out, and a 0.1mm long worm emerges from the egg. One female butterfly lays 250-300 (average 260) eggs in 1 year.



Figure 2. Tomato moth eggs

Worms: Tomato moths hatch after 4-7 days, depending on the external environment. The worms hatch from eggs are whitish-gray in color and the head is dark in color (diagnostic sign) (Fig. 3).



On the shoulder side of the worms there is a semi-circular black spot in the first breast segment. It is with this mark that it differs from the potato moth.

The vegetative and generative organs of the plant are mainly damaged by the worms of the

tomato moth.

The worms turn into mushrooms when they are 4 years old and are full of food. The length of the first-year worm is 1.0 mm, the second-year worm is 2.5-4.0 mm, the third-year worm is 4.5-6.0 mm, and the four-year-old worm (adult) is 7-8 mm. .

Depending on weather conditions, the larvae that hatch from the eggs stop feeding for 15-20 days and go to the fungus on the surface of the leaf or sometimes on the damaged and twisted leaves, as well as in uncomfortable soil.

Fungus: Yellowish-silvery in color. It is very mature compared to other insect fungi and is difficult to damage. The worms first weave a silk net, then weave the inner layer. The worms cook the cocoon for 20-26 hours and turn into a mushroom (Fig. 4). The cocoon is 5-6 mm long and 4 mm wide. The male's dome is usually smaller than the female's dome. The fungus is light brown in color, about 6 mm long, and passes in the form of a silky cocoon on the damaged or twisted leaves, sometimes in the soil or between plant debris, in the pores of the leaves.



Figure 4. Tomato moth fungus

BIOECOLOGICAL DEVELOPMENT FEATURES OF TOMATO MOTH.

One of the main conditions for ensuring high and quality yields of agricultural crops is the protection of crops from pests. To do this, it is necessary to correctly identify pests and pathogens, to have information about their biology, their development, distribution, as well as damage, to determine the effective timing of crop protection and to apply methods of control.

Laboratory experiments on the biology of tomato moth under different conditions were carried out. To do this, tomato seedlings were transplanted into pots and stored in frames wrapped in special air-permeable gauze, and the development of the moth was monitored daily under equipment measuring air temperature and relative humidity (thermometer) (see Figure 5).

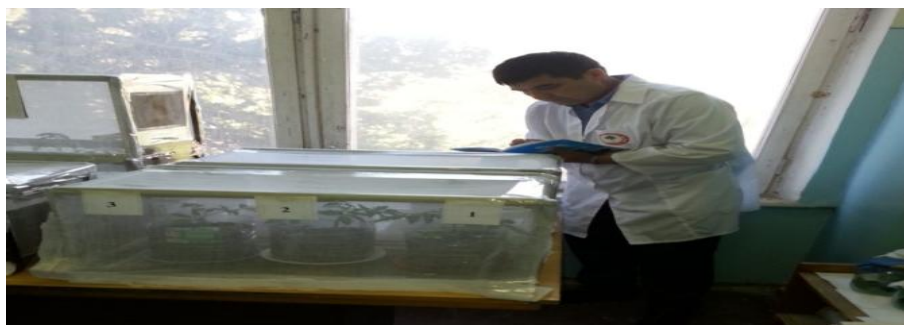


Figure 5. Experiments on the development of tomato moth in the laboratory 2020.

The experiments were performed in 3 variants. In variant 1, the moth eggs developed on days 7-8 with an average temperature of 18-20 °C and a relative humidity of 50-65%. Butterflies fly for 11-12 days for the development of 1-2 year old worms and 12-13 days for the development of 3-4 year old worms and 16-17 days for the development of moths.

It took 46-50 days for one generation to fully develop at 18-20 °C (50-65% humidity). In our variant 2, when the average temperature was 20-25 °C and the relative humidity was 55-60%, the days required for the development of the moth were reduced, i.e. it took 20-25 days for the development of the 1st generation. In option 3, full development of 1 generation was observed in 15-19 days at a temperature of 25-30°C and a relative humidity of 50-40% (Table 1).

Table 1.

Development of tomato moth at different temperatures

Variant	Average daily temperature	Relative humidity, %	The development period of the moth, day				
			egg	1-2 years old worms	3-4 years old worms	fungus	For the 1st generation
1	18-20	50-65	7-8	11-12	12-13	16-17	46-50
2	20-25	55-60	4-5	3-5	5-6	8-9	20-25
3	25-30	50-40	3-4	3-4	4-5	5-6	15-19

Analyzing the above experiments, we studied the sum of useful temperatures for different phases of tomato moth (eggs, worms, fungi). In this case, based on the data of the literature and our observations, the development of tomato moth, ie the yield from the winter was taken as 10.1°C. From our experiments, it was found that the sum of useful temperatures for the oviposition period of tomato moth is 75-78 °C, 102-105 °C for 1-2 year old worms, 108-110 °C for 3-4 year old worms and 137-140°C for the beneficial period for the fungus period. Thus, the sum of useful temperatures for the period from tomato moth to egg to butterfly was confirmed to be 427-433°C.

Table 2.

The sum of useful temperatures in the developmental stages of tomato moth

In the developmental stages of tomato moth	Egg	1-2 years old worms	3-4years old worms	Fungus	From egg to butterfly
°C	75-78	102-105	108-110	137-140	427-433

It was confirmed in our laboratory observations that the useful temperature sum of the tomato moth from egg to butterfly is 427-433 °C, and it takes an average of 46-50 days at 18-20 °C, 20-25 days at 20-25 °C, and 15-19 days at 25-30 °C for the full development of a single generation.

Plant species affected by tomato moth. In recent years, the yield in Uzbekistan has decreased

due to pests and diseases, leading to a deterioration in product quality. One of the main conditions for ensuring high and quality yields of vegetables, potatoes and melons is the protection of crops from pests. This requires accurate identification of pests and pathogens, knowledge of their biology, development, distribution, and damage, and on this basis to determine the effective timing of crop protection and the use of control methods.

In order to obtain high yields from vegetable crops, it is important to identify and analyze strong pests in terms of time of occurrence, development and infestation of pests and diseases, and timely and quality implementation of control measures in a coordinated manner. According to the results of monitoring conducted in the open field in recent years, strong damage was observed by pests of tomato aphid (*Aphis gossypii*) from 18.0% to 21.0%; algae (*Trialeurodes vaporariorum*) from 62.0 to 64.0%, caterpillars (*Helicoverpa armigera* Hb) from 71.0% to 75.0%, porous mosquitoes (*Agromyzidae*), 32.1% to 53.4%. Experts say that since 2016, vegetable farms in the country have been infected with a new pest of tomato crops - tomato moth - *Tuta absoluta* Meyr.

Damage similar to that of the tomato moth on the leaf is also observed in a plant infested with mosquitoes that form pores. This pest belongs to the family of two-winged *Agromyzidae* (porous mosquitoes G'HQP), the damage of which differs from the appearance (carefully) of the damage caused by tomato moth. GHQP slides between the tissues at the top of the leaf, forming a distinctive porous path, and this damage is visible only from the top of the leaf (Fig. 6).



Figure 6. The damage of *Liriomyza bryoniae*



Figure 7. The damage of *Tuta absoluta*. (in the leaf of tomato).

The tomato moth feeds on the parenchymal tissue of the leaf (flat), leaving only the epidermal

layer on the back and front of the leaf (see Figure 7).

Damage to the yield of tomato moth. This pest breeds in greenhouses and damages crops. At the end of the greenhouse season, when the air temperature reaches 15–18 degrees, it begins to damage the tomatoes in the open fields. Tomato moth mainly damages the worm stage, which lasts an average of 3-12 days, depending on the air temperature.

As mentioned above, the worm of the tomato moth damages the plant and feeds on the parenchyma tissue of the leaf (flat), leaving only the epidermal layer on the back and front of the leaf (Fig. 8).



A



B

Figure 8. Damaged (a) and undamaged leaf (b) by tomato moth

In some cases, it has been observed that it spreads to other leaves without completely damaging the leaf. As a result of the worms entering the fruit of the green tomato, the fruit of the plant (Fig. 9) begins to rot due to the excrement they produce and various pathogenic microorganisms.



Figure 9. a - worm-infested tomato fruit b - worm and damage caused by tomato moth

One of the important tasks is to study the damage caused by pests to tomatoes during different growing seasons, for which we conducted special experiments to study the damage caused by tomato moth in the open field. Entomological sadoks (small perforated grids) of 1-1.5 m in size were used (picture is given in the methodological part of the report).

Tomato moth feeds on the parenchymal tissue of the leaf (flat), leaving only the epidermal layer on the back and front of the leaf (Fig. 9 b).

One or more worms can be found on a single leaf. In some cases, it can be transmitted to other leaves without completely damaging the leaf. As a result of the worms entering the green tomato fruit, the plant fruit begins to rot due to the excrement they produce and various pathogenic microorganisms (Fig. 8 A.). [5]

In 2020, we studied the contamination of tomatoes with tomato moth at different times, as well as the impact on crop yields in an area of 0.10 ha, allotted f / x “Ghulam Islam Fayz” in Qibray district.

Experiments on the effect of tomato moth on tomato yield were performed in 3 repetitions. Observation and calculations were carried out according to the method of Sh.T.Khadjaev [6].

Studies have been conducted to study the damage caused by tomato moth to 178 varieties of tomatoes in Uzbekistan during the growing season. This variant consisted of 3 replicates, in which 3 replicates were obtained, and the pest damage on the plant leaf surface was calculated on a 5-point scale. The pest in the control variant was chemically eliminated. The yield of cucumbers in each variant was measured and determined relative to the control, and the number of fruits in each bush was counted (Table 3).

Table 3

Influence of moth on yield during different growing seasons of tomatoes

location on the leaf surface, in terms of points	Average yield per 1 bush plant, kg.	Average weight of 1 fruit per plant, grams	Decrease in yield relative to control in a single plant	
			Kg	%
1	2,555	89,0	0,408	13,7
2	2.056	75,8	0,907	30,6
3	1.09	57,6	1,873	63,2
4	0.654	42,0	2,313	77,9
5	0,327	32,1	2,649	88,9
Control	2.963	110,0	-	-

As can be seen from the table, when tomato moth infestation was 1 point, a yield of 13.7% was observed from 1 bush compared to the control, yield per plant was 13.7% lower than the control. At the level of 2 points, the yield was 30.6% lower than the control, and at 4 and 5 points, the leaves were 77.9-88.9% lower than the control.

This means that in the tomato crop, tomato moth is severely damaged throughout the growing season, destroying up to 13.7-88.9% of the yield, and if the plant is damaged during young germination, there are cases of drying.

In order to prevent the damage caused by tomato moth and to obtain high and quality yields from these crops, the following control measures are recommended:

- Preparation of tomato seeds with chemicals in the prescribed manner before sowing;
- Selection of varieties and hybrids resistant to tomato moth, taking into account soil and climatic conditions, their placement on a scientific basis;
- Proper organization of crop rotation when planting tomatoes;
- Elimination of the phases leading to winter through the quality of autumn plowing;
- Organization of burial of plant remains in specially dug pits and bags, which will be removed after the end of the season in the greenhouse;
- Selection of seedlings from nurseries not affected by moths and other diseases, chemical treatment of seedlings before planting in the field;
- Organize the systematic use of pheromone traps (for knowing the timing of emergence and partial control measures) based on the timing of reproduction and reproduction. Currently, several types of sex pheromones are used against the butterflies of the tomato moth, with high results being achieved [4]. To apply these pheromones, they are placed in special devices in the middle of the aqueous container, to increase the viscosity of the water, 100 ml of liquid soap or oil is added to the water inside the container and placed 1 meter above the ground. When these pheromone traps were applied at 10-40 per hectare, thousands of butterflies were observed to fall in one day. Hanging screens with yellow glue at 35 per hectare will also catch the butterflies of the tomato moth and prevent it from spreading.
- Tomatoes are included in the list of drugs approved for use by the State Chemical Commission against these pests during the growing season, insect acaricides abamectin, 1.8% e.k. (0.3-0.35l / ha), indoxicarb 75g / l + abamectin 18g / l (0.15l / ha) and clotianidine (0.05-0.08kg / ha) should be used as needed and in the prescribed manner.

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