

QUARANTINE FOR THE MULBERRY MOTH AND DEVELOPING INTEGRATED METHODS AGAINST IT

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Abstract. The infection of mulberry moth by *Habrobracon* parasite and the effectiveness of biological and chemical preparations in the fight against it are discussed in the article. In the paper it is determined that the infection of mulberry moth caterpillars by *Bracon* parasite under natural conditions was between 10.0 - 30.0% during June-November. As a result of spraying with a 0.2% solution of biological Fitoverm on the 3rd and 6th days of registration, the mortality of young caterpillars was 38.0 and 22.0%, and medium middle-aged caterpillars formed 34.0 and 18.0%. Death of caterpillars under the influence of chemical preparations on the 3rd, 6th and 9th days of the accounting it ranged from 50.0-82.05; 42.8 to 85.7% and 18.8 to 100% respectively.

Keywords: *Mulberry tree, quarantine mulberry moth, stages of development, Habrobracon parasite, caterpillar infection, agro-technical measures, biological and chemical preparations, biological efficiency.*

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Received: 18 August 2020;

Accepted: 20 October 2020;

Published: 16 December 2020.

1. Introduction

Silkworm breeding has been formed in Azerbaijan for a long time, it has undergone a great development during the Soviet era, a strong unity of action, science and industry has been established in this field, and a great researcher-practitioner has achieved success. After the republic regained its independence in 1991, the decline was inevitable here, as in other agricultural sectors related to the transition to a market economy. However, as a result of the consistent state policy on the development of the non-oil sector, the development of silkworm breeding began in 2016. Thanks to the state's care, the fodder base is being rapidly restored and strengthened, and hundreds of hectares of mulberry plantations have been established as a result of planting mulberry seedlings imported from China and distributed free of charge to farmers. The undamaged part of the former mulberry orchards is also cultivated and used for cocoon production. It is planned to increase cocoon production to 800 tons in 2019, and 20,000 boxes of silkworms imported from China have been distributed free of charge to coppersmiths in 38 regions of the country. The protection of such a fodder base from diseases and pests is the most pressing issue facing science.

Our research is devoted to the study of quarantine mulberry moth, a dangerous pest of the mulberry plant, and the development of comprehensive control measures against it.

The mulberry moth belongs to the group Lepidoptera, the family Uponomeutidae, the genus *Glyphodes*, and the species *G.pyloulis marus* Lesser. The pest goes through the stages of butterflies, eggs, caterpillars, pups and causes serious damage to mulberry

trees in the caterpillar stage, is monophagous, feeds on the leaves of all varieties and hybrids. Mulberry moth gives 6 full generations in the western region, the development of each generation lasts 28-30 days. Most damage occurs in June-October. Generational mixing is observed in all months. It should be noted that moths are the insects that cause the most damage to agricultural crops. Apple moth, little curved apple moth, tomato moth, chestnut moth, potato moth, mulberry moth, etc. are widespread in our country and has caused significant crop losses (Huseynov *et al.*, 2019; 2018; Mammadova & Mammadova, 2012; Mammadova & Khalilov, 1986; Mammadova & Sadikhov, 2018). Therefore, the fight against these pests is always in the centre of attention.

Our previous article provided detailed information on the bioecological properties of mulberry moth, leaf damage and egg infertility. This article lists the main pests and beneficial entomophages observed in mulberry trees. Detailed information is provided on the activity of *Habrobracon* parasite and the effectiveness of biological and chemical preparations in the fight against mulberry moth, as well as the necessary agro-technical measures.

Studies have shown that there are more than 30 pests that cause the significant damage to mulberry. In our country, the American white butterfly, mulberry lepidoptera, pseudococcus comstocki, tetranychus urticae, pseudolaspis pentagona, hermes, mulberry moth, etc. cause the most damage. Quarantine mulberry moth was imported to our republic from Uzbekistan in 2007 with planting material, and began to spread and cause damage. Therefore, the investigations starting from 2009 under supervision of academician S.R. Mammadova and senior researcher S.M. Mammadova had a great impact in this field.

Taking into account the great role of entomophagous in the quantitative reduction of mulberry pests, we consider it expedient to name the parasite and predatory insects observed in mulberry trees. Thus it was determined that particular 2; 5; and 7-pointed lady-birds, 14-point propylia, common anthocorus, common gold-eyed, changeable lady-bird, dotted steturus, predatory thrips, predatory ticks, hemimerina, habrobracon, various types of spiders, ants, bees, etc. are spread on mulberry trees. They are widespread and play an important role in the diminishing of various pests, as well as mulberry moth. Small larvae of mulberry moth were observed to be eaten by larvae of red-eyed lady-birds.

It is defined that *Habrobracon* parasite is one of the most effective entomophagous of mulberry moth. From June to early November, the Bracon infects the adult caterpillars of the mulberry moth to varying degrees, and in some cases the infection is up to 50-70%. 5-7 larvae of *Habrobracon* develop on each caterpillar. Infection of mulberry moth with Bracon parasite was studied in the laboratory and the results are given in Table 1. As can be seen, in June-November, a different number of adult caterpillars were collected once every ten days, brought to the laboratory, where they were studied to be infected with Bracon parasite.

Thus, it was found that 2 out of 10 adult caterpillars collected in the first decade of June, 5 out of 15 caterpillars collected in the second decade, and 3 out of 10 caterpillars collected in the third decade were infected with Bracon. So, in June, 10 out of 35 caterpillars were infected by a parasite, which formed 28.6%. It is clear from the table that 7 out of 30 adult caterpillars collected in three decades in July, i.e. 23.3%, were infected with Bracon.

Observations showed that in August, only 4 out of 40 adult caterpillars were infected with Bracon in three decades, which is 10.0%.

Table 1. Infection of quarantine mulberry moth with *Habrobracon* under natural conditions

Months	June			July			August			September			October			November		
Decades	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Number of web caterpillars, numbers	10	15	10	10	10	10	10	15	15	10	15	15	10	15	15	15	20	25
Number of infected caterpillars	2	5	3	2	3	2	2	-	2	3	4	4	4	5	3	5	2	-
The sum of the collected caterpillars	35			30			40			40			40			60		
The sum of infected caterpillars	10			7			4			11			12			7		
Infection,%	28,6			23,3			10,0			27,5			30,0			11,7		

As can be seen, in September and October, the activity of *Bracon* intensified again. Thus, 11 out of 40 adult caterpillars collected in three decades in September were infected with *Bracon*, which is 27.5%. In October, 12 out of 40 adult caterpillars were infected with *Bracon* in three decades, and the infection rate was 30.0%. As can be seen from Table 1, the activity of the *Bracon* weakened significantly in November. Thus, only 7 out of 60 adult caterpillars were infected in November, which is 11.7%. Observations have shown that the *Bracon* plays a special role in annihilating of mulberry moth. Therefore, in order to control mulberry moth, it is considered a very useful measure to grow *Bracon* in the laboratory, to spread it in mulberry orchards and to achieve a higher mortality rate.

Great importance is attached to the use of biological preparations in the scheme of quarantine mulberry moth control. For this purpose, small and middle-aged caterpillars were sprayed with a 0.2% solution of 5% e.c. Fitoverm biological preparations, dead worms were recorded 3 days, 6 days and 9 days after spraying, and the results are shown in Table 2.

Table 2. Study of biological efficiency of preparation Fitoverm in the fight against quarantine mulberry moth

Catastrophe of the preparation	Caterpillars by age	Number of 100 caterpillars before treatment, units	Pest reduction, by days, units			Percentage of pest deaths by days			Total death%
			3rd	6th	9th	3rd	6th	9th	
0,2	small	50	19	11	-	38,0	22,0	-	60,0
0,2	medium	50	17	9	-	34,0	18,0	-	52,0
0,2	big	50	-	-	-	-	-	-	-

Fitoverm is a biological preparation belongs to the chemical class Avermectins. Streptomyces derived from the microorganism avermectilis and the active ingredient is called aversectin-C. Table 2 shows that spraying with a 0.2% solution of the 5% e.c. Fitoverm biological preparation had a lethal effect on small (I, II) and middle-aged (III, IV) caterpillars of the mulberry moth and the duration of action was 6 days. It became clear from the observations that 19 caterpillars out of 50 young caterpillars on 100 leaves, died on the 3rd day and 11 caterpillars died on the 6th day due to spraying with Fitoverm solution, which accounted for 38.0% and 22%, respectively, and commonly it formed 60.0%. 50 middle-aged caterpillars on 100 leaves were affected by a 0.2% Fitoverm solution, 17 on the 3rd day and 9 on the 6th day, which was 34.0% and 18.0% respectively, in total mortality formed 52.0%. As can be seen from the table, the given dose did not have a lethal effect for adult (V) caterpillars. Therefore, it is recommended to use Bracon against adult caterpillars and, if necessary, chemicals against caterpillars at all ages. It should also be noted that the use of chemicals is not recommended during the feeding of mulberry silkworms and fruit ripening. Therefore, chemical control against mulberry moth is acceptable only for III-VI generations and gives good results. For this purpose, 0.8 and 1.0 l / ha of 10% e.c. Fastak, 0.6 and 0.8 l / ha of 40% e.c. Rogar (new), Consumption norms of 0% of 5% e.c. Cornuron 0,4; 0.6 and 1.2 l / ha were tested. The results of the experiments are presented in Table 3.

Table 3. Study of the effectiveness of chemicals in the fight against quarantine mulberry moth

Options of experiment	Consumption norms of drugs, l / ha	Number of caterpillars per 100 leaves before spraying	Death of the pest on accounting days						Total death of caterpillars	
			3rd day		6th day		9th day			
			unit	%	unit	%	unit	%	unit	%
Fastak 10% e.c.	0,8	65	37	56,9	12	42,8	3	18,8	52	80,0
	1,0	70	47	67,2	10	43,5	4	30,7	61	87,1
Rogar (new) 40% e.c.	0,6	71	47	66,2	13	54,2	4	36,4	64	90,1
	0,8	74	52	70,3	14	63,6	3	37,5	69	92,7
Cornuron 5% e.c.	0,4	32	16	50,0	10	62,5	5	83,3	31	96,8
	0,6	36	29	80,5	6	85,7	1	100,0	36	100,0
	1,2	39	32	82,0	3	42,8	1	25,0	36	92,3
Control	-	+70	+77	-	+82	-	+88	-	-	-

The + sign indicates the number of pests.

It is clear from the figures in Table 3 that the pest mortality rate when applying 0.8 l / ha of 10% e.c. Fastok was 56.9% on the 3rd day, 42.8% on the 6th day, and 18.8% on the 9th day. As can be seen, 52 out of 65 caterpillars died after spraying, which forms 80%. Mortality rates for the reporting days were calculated for each surviving caterpillar. As can be seen from Table 3, the mortality of mulberry caterpillars at the consumption rate of Fastak at 1.0 l / ha was 67.2% on the 3rd day; 43.5% on the 6th

day; 30.7% on the 9th day of accounting, and 61 out of 70 caterpillars died, which forms 87.1%. As can be seen from the table, the preparation 40% e.c. Rogar (new) was highly effective in combating mulberry moth. Thus, the death rate of caterpillars at the consumption rate of 0.6 l / ha on the 3rd day of accounting was 66.2%; 54.2% on the 6th day; 36.4% on the 9th day, and 64 out of 71 caterpillars died, which forms 90.1%. As can be seen, the mortality of moth caterpillars at the consumption rate of 0.8 l / ha of the spoken preparation was 70.3% on the 3rd day of registration; 63.6% on the 6th day; 37.5% on the 9th day, and only 69 caterpillars died, which means 92.7% biological efficiency. 0.4, 0.6 and 1.2 l / ha consumption norms of Cornuron preparation were tested. It was determined that the mortality of mulberry moth caterpillars when spraying with the consumption rate of 0.4 l / ha of this preparation according to the accounting days was 50.0; 62.5 and 83.3%, and the total mortality equaled 96.8%. Caterpillar mortality at the rate of 0.6 l / ha of Cornuron on the 3rd day of registration was 80.5%; 85.7% on the 6th day; 100.0 on the 9th day and at the end it also formed 100.0%. It was found that the death rate of caterpillars at the rate of 1.2 l / ha of Cornuron was 82.0 according to the accounting days; 42.8 and 25.0%, and 92.3% in total. Therefore, the consumption rate of 0.4 l / ha of this preparation can be considered as the most effective dose in the fight against mulberry moth, because the biological efficiency is quite high, but also economically viable. It should be noted that depending on the age of the trees, the development of the umbrella, spraying with these preparations consumes between 400-600 liters of working solution per hectare.

Agro-technical measures carried out in time and with high-quality are also of great importance in protecting mulberry orchards from diseases and pests. Quarantine measures, removal and burning of fallen leaves, dry twigs in autumn and spring, cultivation of midrows, softening of tree trunks to a depth of 15-20 cm in autumn and spring, as well as when each generation of pests pupates, regular destruction of weeds, the application of organic and mineral fertilizers, compliance with the rules of operation, the provision of sufficient water and irrigation during vegetation periods, increase the resistance of trees by ensuring their normal development and reduce diseases and pests.

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