***Euzophera Punicaella Mooze* (Lepidoptera) bioecology and development of host entomophagic equilibrium in biocenosis**

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Abstract. Pomegranate (*Punica granatum L.*) is grown in tropical and subtropical regions of the world. Pomegranate has been grown in Central Asia for almost 2,000 years. More than 25% of pomegranates in Central Asia are located in Uzbekistan. Pomegranate fruit pest (*Euzophera punicaella Mooze*) is one of the main pests that reduce the basic quality and export yield of pomegranate. When chemical control measures are applied against them, pomegranates lose their quality and export character and do not always give the expected results. The larvae develop inside the fruit, which is why the effectiveness of medicines is low. We used entomophagous biological agents against this pest, such as *Trichogram pintoi*, *Trichogram chilonis*, *Trichogram evanescens*, *Trichogram dendrolimi*, and *Trichogram ostrinae*. For pomegranate fruit worms, *Bracon hebetor* Say entomophagy was highly effective when used in the laboratory in a ratio of 1:10. It is obvious that biological control measures provide high quality and high efficiency.

1 Introduction

Pomegranate (*Punica granatum L.*) is a low-growing shrub belonging to the Lythraceae family, grown mainly for its fruits. It has been cultivated in the Middle East, South Asia and the Mediterranean for thousands of years [1].

Today it is widespread throughout the Middle East and Caucasus region, northern and tropical Africa, the Indian subcontinent, Central Asia, the arid part of Southeast Asia. It is also distributed in Azerbaijan, Krasnodar Krai (Sochi), Crimea, South Kazakhstan and Dagestan. Ripe fruits contain 15-19% sugar, 1.2-2.6% acids, and the juice contains healing iron and a large amount of tannins [2].

For many years, pomegranate plantations have been planted in all regions of Uzbekistan and special varieties have been planted. In particular, it is located in the Fergana Valley, Mirzaabad of Syrdarya province, Dashnabad and other districts of Surkhandarya province. At present, pomegranate plantations are built on large areas in the Fergana Valley and Tashkent province [2, 3].

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The benefits of pomegranate to human health are important, and consumption like pomegranate, quince, and lemon can cure many diseases. Tannin is extracted from pomegranate peel and citric acid from fruit juice. In addition to eating pomegranate fruit, the bark and root are boiled and its juice is used in medicine to treat gastrointestinal diseases. Pomegranate extracts and citric acid are used in skin rejuvenation. Its wood is a valuable material. Pomegranate is also grown as an ornamental plant. Pomegranate fruit, its stem and root peel, and fruit peel are a cure for various diseases. Pomegranate roots are widely used in folk medicine [4-7].

Pomegranate peel contains alkaloids, additives, resins, dyes and other compounds, the fruit peel contains large amounts of additives, and its fruit contains organic acids, sugars, vitamin C and other compounds. Pomegranate flowers, fruits and even decoctions are widely used in medicine [5]. A drip prepared from the root removes wounds. Abu Ali ibn Sina, the father of medical science, used the pomegranate fruit in the treatment of spitting blood, bleeding gums, urinary incontinence in diseases of the stomach (diarrhea and bloody diarrhea), wounds and other diseases. In folk medicine, pomegranate peel ash is mixed with butter or beef oil and used to correct pus on the skin. Decoction of the fruit peel is enough to rinse the mouth with a decoction of diseases caused by inflammation of the oral cavity [5, 6].

In order to get a high and quality crop of pomegranates from the garden, as well as to meet the needs of the population, it is necessary to take effective care in the cultivation of this tree and its fruit, timely feeding and protection from various pests [7].

In addition, the production of high quality ecologically pure fruit from the pomegranate plant is a topical issue today. Based on an in-depth study of the biological properties of pomegranate fruit, it is necessary to create a system and methods of scientifically based methods of control against it and give practical recommendations. There are more than 40 varieties in Uzbekistan, which are resistant to frost, so they are buried in the winter, open in the spring and continue to bear fruit. Depending on the age and variety of orchards, 5-6 tons can be harvested per hectare. Due to the presence of many biochemical substances in the fruit, it is widely used for consumption and in medicine [8-10].

At the same time, experts are well aware that the pomegranate tree bush is mainly affected by the following insects: aphids (*Aphidinea*), comstock worms (*Pseudococcus comstoci* Kuw), spiders (*Tetranychus urticae* Koch), and pomegranate fruit pest (*Euzophera punica*), which are difficult to control. Among these, the influence of the pomegranate fruit pest (*Euzophera punicaella* Mooze) has intensified in recent years, and the urgency of the issue has risen to the point where even pomegranate cultivation is no longer possible. This is evidenced by the fact that the pest spreads rapidly in the farms of Tashkent province, damaging from 70% to 95% of the affected trees [11-13].

Thus, the aim of the study was to control the number of pomegranate plant pests using biological entomophagous (*Trichogram ostrinae*, *pintoi*, *chilonis*, *evanescens*, *dendrolimi*) against one of the main pests (*Euzophera punicaella* Mooze) of the pomegranate plant.

2 Materials and methods

The object of our research is the pomegranate fruit pest (*Euzophera punicaella* Mooze), which belongs to the family of insect moths or moths (*Lepidoptera*), the family of leaf beetles (*Tortricidae*).

In our study, data were recorded using a Motic B1-253 microscope to isolate pomegranate fruit imagoes, eggs, and larvae.

Pomegranate fruit pest (*Euzophera punicaella* Mooze) identification studies were performed on days 1, 3, 7, and 14 before and after entomophagous application. Biological efficacy of chemicals was calculated using the equation of W.S. Abbott [14] (1):

$$E = A_B - B_A / A_B \times 100 \quad (1)$$

Where: E - biological efficiency,%; A - number of pests in the experiment before spraying; A₁ - number of pests in the experiment after spraying; B - number of pests in the control variant before spraying; and B₁ - number of pests in the control variant after spraying.

Trichogram entomophagous pests were used in ratios of 1:10, 1:15, 1:20. The effectiveness of *trichogram entomophagous* was calculated based on the amount of lesions among pomegranate fruits.

3 Results and discussion

The pomegranate fruit pest (*Euzophera punicaella Mooze*) belongs to the family of insect moths (*Lepidoptera*), the family of leaf beetles (*Tortricidae*), and is a typical carpophagus (*fruit leaf beetle*) and monophagous (Figure 1).

Fig. 1. Pomegranate fruit pest's (*Euzophera punicaella Mooze*) fungus and larva

It overwinters mainly in the form of worms (partly sponges) on fruits left on the tree, on fruits spilled on the ground, and in other sheltered places. In the spring, mainly in April, the moths begin to fly, turning into a mushroom state. The same moths begin to lay eggs when they are supplemented and mature. Each female lays a total of 80-120 eggs in her lifetime, usually 1 to 5 on the pomegranate flowerpot. The worms that hatch from the eggs pass through the cocoon into the pomegranate and begin to feed by damaging the fruit seeds. When the worm is 6 years old, it returns to the flower bed again and coils inside a soft cocoon.

After 7–8 days, the moth flies out of it and continues to breed. In total, it takes 21 to 32 days to pass a generation. In one season, according to our many years of research, mainly 3, in some years (when autumn comes hot) 4 generations can also develop.

After all, the natural development of the pomegranate fruit is closely related to the growth and fruiting of this plant, only to damage it. We had similar results in our previous controls over the years. Our research in several regions of Tashkent province (Kibray district) showed that in these conditions, the pomegranate fruit moth flies 10 days earlier

than in the Tashkent province (Boka, Akkurgan and Lower Chirchik districts). However, even there, the season continues to develop, giving the base 3 (partially 4) generations.

Pomegranate fruit moths’ special inspections were carried out to determine where it was important to lay eggs. These observations were conducted in 2019-2020 in Kibray district of Tashkent province, in areas where pomegranates are mostly grown (Table 1).

Table 1. Areas prone to damage the pomegranate fruit by the pomegranate pest (Field observations, Tashkent province, 2020)

#	Control point	Total percentage of damaged fruit, %	Including different damaged parts of the fruit, %		
			Fruit shell	From side	Cracks
1	Kibray district, ‘Ochilov’ farm	39.0	79.5	5.6	9.7
2	Kibray district, ‘Jalilov’ farm	50.0	76.0	7.4	8.3
3	Kibray district, ‘Usmonov’ farm	56.0	78.6	7.1	7.8

The following conclusions can be drawn from the results given in the table:

1. In the monitored areas, 39-56% of the crop was damaged in the bushes infested with pomegranate fruit pests.
2. The pomegranate fruit pest lays its eggs mainly on the pomegranate flower buds (76-79%), 14% near the fruits and where the fruits touch each other and another 7.8-9.74% on the various damaged (cracked) areas.

The pomegranate fruit, which is damaged by the fruit pest, goes unnoticed for a long time, and only then can it turn yellow, turn red, crack, spill, and rot. 1-2 generations of fruit are almost unknown, and only in the latter can the damage be felt. The damage is felt more and more from generation to generation. By autumn, often latent damage is observed, i.e., although no damage is noticeable from the appearance of the fruit, it is damaged from the inside and may appear over time (1-2 months) (Figure 2).

Fig. 2. Pomegranate fruit pest (*Euzophera punicaella* Mooze)

We studied the degree of pomegranate infestation in the Tashkent province. As a result, it became clear that in the farms of Tashkent province pomegranates are most affected (79-87%).

Trichogram species as *Trichogram ostrinae*, *Trichogram pinto*i, *Trichogram chilonis*, *Trichogram evanescens*, *Trichogram dendrolimi*, *Trichogram ostrinae* propagated in the pest biolaboratory in pomegranate orchard. Pomegranate fruit pest’s eggs were obtained under laboratory conditions and the effectiveness of trichogram species on eggs, bracon entomophagy against worms was studied. The results are given in Table 2. As can be seen from there, the bracon was highly effective against pomegranate fruit worms. The highest yield occurred when the ratio of male to female worms was 1:10. At the same time, eggs were not detected in all paralyzed worms. It was found that the bracon laid 4-5 eggs on only 5-7 worms.

In the 2020 season, field experiments using trichogram and poaching were conducted on farms in Kibray district (Table 2). At the same time, each variant was carried out in one yard (17-32 pomegranate bushes).

Table 2. Laboratory experiment against eggs of pomegranate fruit pests (TSAU, 2020)

Options	Trichogram/egg ratio	Number of eggs	7 days after the trichogram		Efficiency (7 days), %
			healthy*	damaged	
Trichogramma ostrinae					
1	1:10	100	4.06	96.1	96.1
2	1:15	100	5.06	94.9	94.9
3	1:20	100	10.1	90.6	90.6
4 (Control)	-	100	96.4	-	-
Trichogramma pintoii					
1	1:10	100	9.06	87.1	87.1
2	1:15	100	10.06	84.9	84.9
3	1:20	100	18.2	82.5	82.5
4 (Control)	-	100	95.8	-	-
Trichogramma chilonis					
1	1:10	100	6.04	93.9	93.9
2	1:15	100	8.4	91.6	91.6
3	1:20	100	17.3	83.4	83.4
4 (Control)	-	100	97.4	-	-
Trichogramma evanescens					
1	1:10	100	7.7	92.3	92.3
2	1:15	100	8.6	91.4	91.4
3	1:20	100	15.4	84.6	84.6
4 (Control)	-	100	96.2	-	-

<i>Trichogramma dendrolimi</i>					
1	1:10	100	5.4	94.6	94.6
2	1:15	100	6.6	93.4	93.4
3	1:20	100	12.1	87.9	87.9
4 (Control)	-	100	94.7	-	-
<i>Bracon hebetor</i> Say					
Options	Bracon/worm ratio	Damaging days from 20 worms			Percentage of damage, %
		3	7	12	
1	1:10	100	5.4	94.6	94.6
2	1:15	100	6.6	93.4	93.4
3	1:20	100	12.1	87.9	87.9
4 (Control)	-	100	94.7	-	-

In the first option, only a trichogram was used. At the same time, a trichogram was sent once every 6 days, 0.05 g (3,000 pieces) per bush. As of September 20, pomegranate infestation in these shrubs was 20% (under control - 44.0%). Thus, 45.4% had a biological efficiency

In the second variant, along with the distribution of the trichogram each time (0.05 g/bush), a bracon was also distributed. In this case, the norm of the bracon was taken from 20 females per 1 bush. The results show that as of September 20, fruit damage was only 8.9%, i.e., biological yield was 79.8% (Figure 3).

Fig. 3. *Trichogramma ostrinae* entomophagy pomegranate fruit pest (*Euzophera punicaella* Mooze): A- egg damage, B-infected egg

In conclusion from the above, it can be noted that the use of a biological method based on trichogram and bracon distribution was very effective in protecting pomegranate from worms and pests (Table 3).

Table 3. Effectiveness of the biological method against pomegranate fruit pests (Field experiment, Tashkent province, 2020)

#	Options	Degree of fruit damage, %	Efficiency, %
1	During the season, only trichogram (0.05 g/bush) was applied for 18 accounting days	20.0	45.4
2	During the season, trichogram (0.05 g/bush) and bracon (20/bush) were applied for 18 accounting days	8.9	79.8
3	Control (no bio-protection)	44.0	-

4 Conclusion

Concluding from our experiments, we can say that the healing properties of the fruit, flower, leaf, stem, and root of the pomegranate (*Punica granatum L.*) plant show how beneficial it is to the human body. In particular, in order to grow high-quality and export-oriented products, it is necessary to develop pest management and control measures. The most effective control measures against the eggs of pomegranate fruit pests (*Euzophera punicaella Mooze*), which cause great damage to this plant, give effective results from these entomophagous (*Trichogramma pinto*i, *Trichogramma chilonis*, *Trichogramma evanescens*, *Trichogramma dendrolimi*, and *Trichogramma ostrinae*). Among these entomophagous, *Trichogramma ostrinae* was observed to be the most productive.

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