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Leaf-Eating Insect Pests of Ornamental Trees (Coleoptera: Chrysomelidae) and their Bioecological Features

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Abstract: ***The article describes the results of research on the development, damage and prevalence of poplar leaf beetles (Melosoma populi L.) and willow leaf beetles (Galerucella luteola) in Tashkent and Khorezm regions of the country. It has been found that the development of poplar and willow leaf beetles depends on the type of trees and the air temperature. The average number was determined in the branches of the trees, in the first generation it was found that the number of beetles increased from an average of 14.2 to 19.3. In the Tashkent region, the total egg-laying period of poplar leaf beetle females increased to the first period of May, and the total flight period of beetles increased to 22.3 in June. The female-male sex ratio of the beetle (males: females) was found to be on average 3: 6. It was found that the development of poplar and willow leaf-beetles populations mainly coincides with the first and second period of May, when the female beetle lays eggs. At the same time, during the development of poplar and willow leaf beetles, it was found a sharp slowdown in the rate of laying eggs and in the feeding of larvae at high temperatures. It was found that 75% of the leaves of the trees die as a result of the damage of the first generation worms of the willow leaf beetles.***

Keywords: insect pests, ornamental trees, willow, poplar, elm, Melosoma populi, Galerucella luteola, population, level of development.

1. Introduction

Coleopteran insects have a wide spectrum in the entomofauna of the world, of which more than 360,000 species are dangerous for agriculture [1], which makes up 40% of all insects on earth and 25% of living organisms [2]. Because most bugs are phytophagous, they cause great damage in agriculture, forestry, and horticulture. In terms of ecological and morphological diversity, it has always attracted the attention of entomologists and biologists [3]. Researchers conduct phylogenetic and phylogeographic studies of coleopteran insects based on molecular markers [4]. GenBank stockpiles of this type of insect have been accumulated from such studies in recent years.

In Uzbekistan, bugs (Coleoptera: Chrysomelidae) as leaf pests of ornamental trees cause great damage highly harmful species include Poplar leaf-beetle (*Melosoma populi* L.), willow leaf beetles (*Plagiodera versicolora* Laich.) and oriental leef-beetle (*Agelastica alni orientalis* Baly.) [5]. Poplar leaf beetles are a serious pest of willow and elm, in addition to poplar. The worms of the pest beetles eat the epidermis part of the leaves of the tree. As a result, the leaf falls off completely. The worms initially develop in groups and then spread out. They emit an odor on themselves during feeding on the leaves. Females lay up to 500 eggs. Other species of the leaf beetle Chrysomelidae can also be found in areas where it is present. Because the ecological characteristics of these pests will be adapted to one group [6].

The Chrysomelidae family is one of the largest insects in the world, covering 35,000 species and 2,500 generations, and is a major pest of agriculture and forestry. One of these species, *Chrysomela* (= *Melasoma*) *populi*, is one of the main and dangerous pests of poplar [7].

Today, one of the main control measures in reducing the damage of this pest is the chemical control method. However, biological control measures for the pest have a broader and longer-lasting mechanism of action than other methods. Unfortunately, data on natural enemies of the species *Melosoma populi* L. are insufficient [8]. But some researchers have given brief data on these. In Romania, Theodorescu cited entomophages of poplar leaf beetles [9], in Turkey, Zeki and Toros [10] cited Hexamermis albicans (Mermithidae) [11] and Linobia coccinellae (Hemisarcoptidae) from the Tachinidae family as parasitic entomophages of poplar leaf beetles [12]. It was mentioned that *Schizonotus sieboldi* (Ratz.) (Pteromalidae) is also one of the most common species as a parasite of pupa [13]. The effectiveness of the predatory species Symmorphus murarius (L.) and *Ancistrocerus nigricornis* (Curt.) (Eumenidae), common in Kazakhstan, has been demonstrated [14].

In our country, among the deciduous pests of ornamental trees such as willow, elm and poplar, there are species Poplar leaf-beetle (*Melasoma* (*Chrysomela*) *populi*), elm leaf beetle (Gallerucella luteola Mule.), willow leaf beetle (*Pyrrhalta luteolla*), and their damage is high. Poplar leaf beetle – *Melasoma populi* is one of the most dangerous pests of young poplars and willows in the forests of our country. It is widespread in forest and foothills. The period of mass hatching of pest larvae is observed in the second decade of May. The pest is widespread in CIS countries, Southern Europe, China, Korea, Japan and India and is listed as the

main pest of ornamental trees [6]. The elm leaf beetle (*Gallerucella luteola* Muel.) Is widespread in all regions of Central Asia. The pest mainly infects willow and elm leaves, the affected leaves shed [15]. In the conditions of our country, leaf-eating insect pests and their damage on ornamental and forest trees are relatively little studied. For this reason, the goal is to study coleopteran leaf-eating insect pests of ornamental and forest trees and to study their bioecological indicators, such as damage, development speed, distribution and changes in the number of populations.

2. Materials and Methods

The study was conducted in 2018-2019 in the Tashkent and Khorezm regions of the country on the biology of coleopteran leaf-eating insect pests (Coleoptera: Chrysomelidae) and their development levels. The laboratory of the Department of Plant Protection of Tashkent State Agrarian University was used in the research.

The territory of Khorezm region consists of low plains and small hills. Geographically located between 40 - 42 ° north latitude and 60 - 62 ° east longitude, the climate is dry, from decorative trees mostly planted elm, willow, poplar. Most of the Tashkent region is mountainous and foothill territories. Geographically located between 41-10° north latitude and 69°-45° east longitude, from decorative trees the region is mostly planted with a large number of willows and poplars.

Identification of affected trees and development of poplar leaf beetle (*Melosoma populi* L.) and willow leaf beetle (*Galerucella luteola*) begin in April. After wintering, the beetles were collected from the trees and delivered to the laboratory, where their development and species system were analyzed.

In laboratory studies, a Memmert IPP IPP55 plus thermostat, an XSZ-152 binocular microscope for separating morphological labels, and a 70% alcohol liquid for insect storage were used. In late April and early May, the eggs and larvae of the beetles were collected and they were additionally fed in special glass jars. In studying the development of the pest in the field, the relative humidity and air temperature were noted separately.

3. Results and Discussion

The research was conducted to study the development and damage of coleopteran leaf-eating insect pests in ornamental and forest trees in Tashkent and Khorezm regions. Initially, the incidence rate of the pest was analyzed in Tashkent region. In Ortachirchik district of Tashkent region, a systematic analysis of coleopteran pests of willow and poplar was carried out and samples were collected from them. According to the collected specimens and tree damage, the most common species were poplar leaf beetle (Melosoma populi L.) and willow leaf beetle (Galerucella luteola). In terms of their population and damage to tree species, poplar leaf beetles were found to be more common in Tashkent region, while in Khorezm region, damage of willow (elm) leaf beetles and its population were higher. The time of emergence of the first beetles from the wintering period was observed when the air temperature warmed up to +18°C, ie in late March and the first ten days of April.

The size of the poplar leaf beetle is 10-14 mm, the male is 8-10 mm, dark red in color, with a black spot on the upper part of the wing. The head is bluish black. The eggs are yellow, the body of the worm is white-yellow, and the legs and head are black. The body is 7.3 mm, covered with black spots. It emits a pungent odor. It winters as a beetle in cracks in tree bark or under fallen leaves. Overwintering beetles emerge from hibernation in late March. After 8-10 days, the beetle emerges from the wintering and begins to lay 50-60 eggs on the backs of newly emerging leaves, the egg-laying period of which lasts until the end of May. Females are larger than males. Female beetles lay from 200 to 500 eggs.

Table 1: Rate of occurrence of pests belonging to the Chrysomelidae family of the Coleoptera order on ornamental trees (Tashkent region, 2019)

№	Type of the pest	Order, family	Rate of occurance
Tashkent region			
1.	*Melosoma populi* L.	Coleoptera:*Chrysomelidae*	+++
2.	*Galerucella luteola* (*Chrysomela luteola, Pyrrhalta luteolla*) MÜLLER, 1766.		++
Khorezm region			
1.	*Melosoma populi* L.	Coleoptera:*Chrysomelidae*	+++
2.	*Galerucella luteola* (*Chrysomela luteola, Pyrrhalta luteolla*) MÜLLER, 1766.		+++

The elm leaf-beetle is distributed in all regions of Central Asia. The pest mainly infects willow and elm leaves, the affected leaves fall off. The size of the beetle is 4-6 mm, the color is pale yellow-brown, the back is covered with short feathers. The front shoulder has three stripes and a bulge across it. It has longitudinal stripes on its wings. It lays its eggs on the back of the leaves. The worms are yellow and have long stripes on either side of the body. The anterior segments of the larvae protrude 8-10 hairs on either side. The worms gnaw the leaf of the tree in various forms. Beetles hibernate under a separate bark and in its cracks, emerge from hibernation in the first half of March and lay their eggs in May. He laid 26-30 eggs in groups on the underside of the leaves. Worm hatch from eggs after 6–7 days.

It was observed that in July the first generation of beetles flew in large numbers and laid eggs in July, it died in August. Beetles of the second generation appeared in late August, and in September it was discovered that beetles hibernate under cracks or tree bark for the winter. The worm shed their skin twice during development. During the third bark shedding, the worm turn into a pupa in the soil around the tree root. By

August, they are fully developed and become beetles. This pest reproduces twice a year.

It was found that the beetles that came out of the wintering were mostly females. Their egg-laying period mainly coincided with the end of April and the first ten days of May. The period of hatching of larvae from eggs was 4–5 days. On average, their number increased from 0.7 per leaf in the first generation to 1.2 in June. For pests, an increase in air temperature (+35 ℃) was unfavorable and the number of larvae decreased sharply.

According to the study, by the population size of poplar leaf beetle in the Tashkent region, the period of gross laying of eggs of pest beetles was observed in late April and the first decade of May. Initially, the number of beetles was 1.3 per branch, but later their number increased to 14.2 in April. In late March and early April, the number of beetles that came out of wintering increased. Their total egg-laying period also increased when the air temperature rose to +24 ℃. In the first days of May, the number of pest eggs increased to 34.2 per branch. Up to 35-30 eggs were detected behind the leaves. Larvae increased in the second half and until the end of May. The period of gross pupation of the first generation larvae of poplar leaf beetles coincided with the second decade of June.

The egg-laying period of the first generation beetles was determined in the second decade of July. The period of the appearance of second-generation beetles from pupae began to be observed in the second half of August, during this period it was found that beetles spread in all directions to winter.

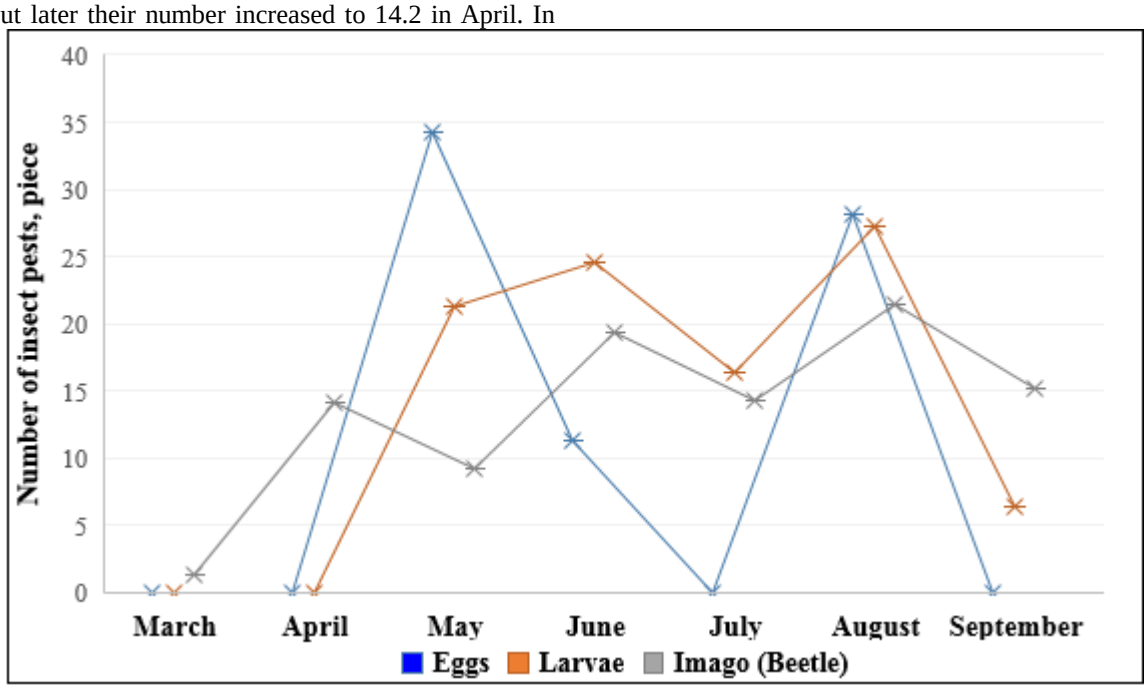

Figure 1: The population development of poplar leaf beetles (*Melosoma populi* L.) in poplar branches in Tashkent region.

Areas with a high reproduction period and high populations of poplar leaf beetles were identified along streams or irrigated poplar groves. The pest was mostly observed in the Bolle-*Populus bolleana* Louche species of poplar. Relatively rare in other poplars.

Our research on willow leaf beetles was continued in Khorezm region. In Khorezm, infested areas of elm and willow trees were identified and have been observed since March. After wintering beetles of the first willow leaf beetles began to be observed in late March. The beetles that came out of wintering were less mobile and they fed with willow leaves. Initially, their number was 4.6 per branch, but by mid-April it had risen to 8.2. The period of laying eggs of beetle females coincided with the first period of May. In late May, the larvae were found to be in a period of mass reproduction and feeding. Due to the high level of pest damage, 75% of the leaves on the trees were found to be damaged and shed. The first generation of beetles increased to 22.3 in June. Females and males were found to have an average sex ratio (male: female) of 3: 6. The sharp rise in air temperature affected the feeding of beetles and larvae, slightly weakened, and the rate of egg laying decreased sharply. Once fed, the larvae shed their bark twice and the pupation process begins in the soil around the tree. It was found that the period of mass flight of the first generation beetles was in August. During this period, the number of beetles was found to be 21.4.

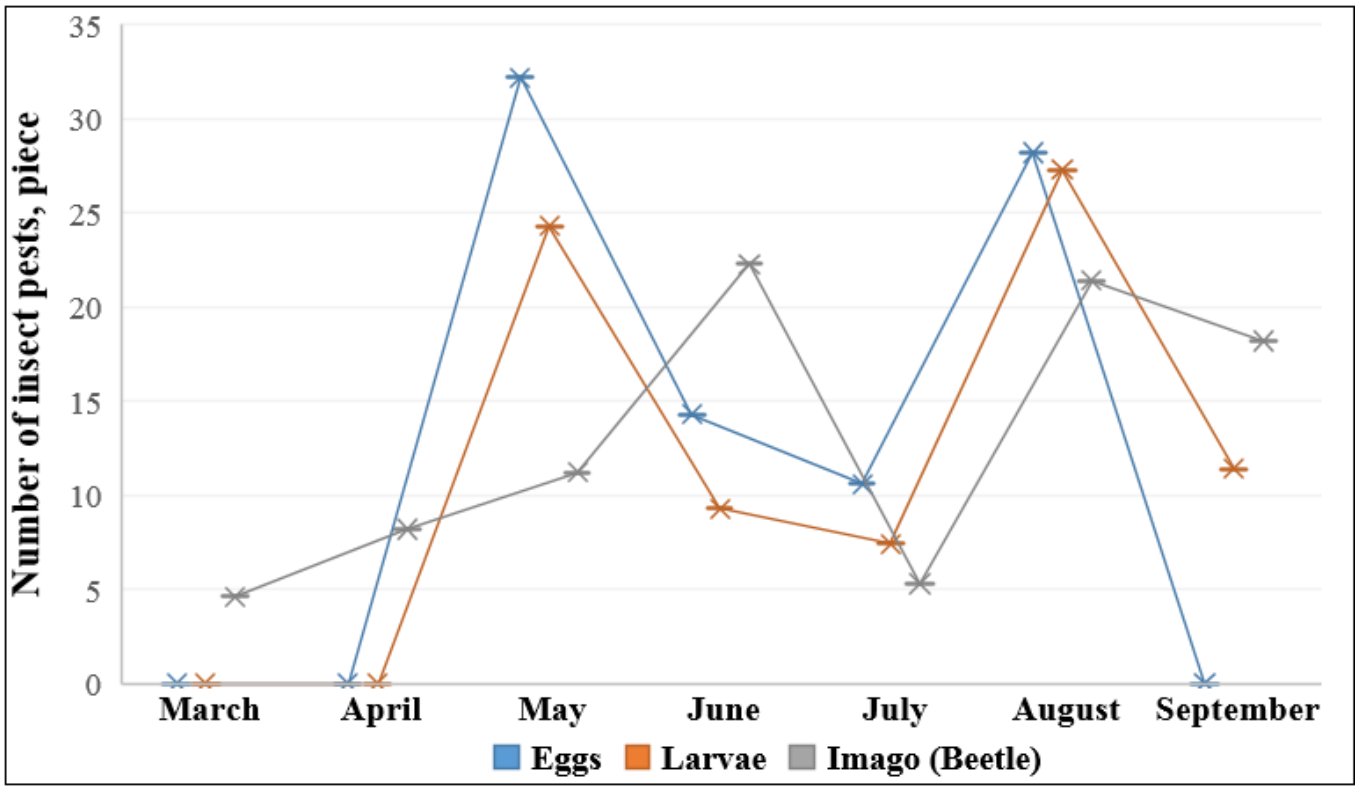

Figure 2: Development of elm leaf beetle (*Galerucella luteola*) in the branches of an elm tree in the conditions of the Khorezm region

The egg-laying period of second-generation beetles was determined in the second decade of August, and larval damage increased in late August. The average air temperature during this period was + 28 ℃, while the relative humidity was RH 61%. Feeding of elm leaf beetles and its larvae depended on relative humidity, and it was found that the germination rate of beetles of the first generation was higher than that of the second generation. The second generation of beetles massively flew in the second half of September and gathered around different trees for wintering. It was found that wintering sites accumulate in large numbers between cracks or tree bark. Because these areas were xerophilic, the number of beetles was low in the second generation and the damage was found to be an average of 44%. During this period, the number of natural enemies of the beetle and its larvae increased. It was found during this period that birds feed mainly on pest larvae and most of its beetles. It was noted that 89% of the larvae hatch from eggs laid on the leaves of the tree, and 64% of the larvae survive to the state of the beetle. Most poplar and willow leaf beetles have been found to die under the influence of natural enemies. In our next study on this, it is planned to conduct research on the species of natural enemies and their role in the management of the number of leaf beetles.

4. Conclusion

The development of poplar and willow leaf beetles was based on two generations, and the population size was found to be high in irrigated areas, along streams. In the Tashkent region, the period of laying eggs by females increased to the first period of May, and the total flight period of beetles in June increased to 22.3. During this period, it was found that the ratio of females to males was 3 : 6 on average (male : female). The poplar leaf beetles mostly damages the Bolle-*Populus bolleana* Louche variety of poplar. The development of willow leaf beetles coincides with the first period of May, when the female beetles lay their eggs, and the first generation of beetles coincides with the end of June. During the development of the leaf beetles, they were found to have a low fertility at high temperatures, a sharp decrease in egg laying and larval feeding.

References

[1] N.C. Sheffield, H. Song, S. L. Cameron, M. F. Whiting, “A comparative analysis of mitochondrial genomes in Coleoptera (Arthropoda: Insecta) and genome descriptions of six new beetles”, Mol. Biol. Evol. No 25, pp. 2499–2509, 2008.

[2] T. Hunt, J. Bergsten, Z. Levkanicova, A. Papadopoulou, O.St. John, R.Wild, P.M. Hammond, D. Ahrens, M. Balke, M.S. Caterino, J. Gómez-Zurita, I. Ribera, T.G. Barraclough, M. Bocakova, L. Bocak and A.P. Vogler, “A comprehensive phylogeny of beetles reveals the evolutionary origins of a superradiation”, Science, New Series, Vol. 318, No. 5858, pp. 1913-1916, 2007.

[3] H. Zhang, N. Liu, Z. Han and J. Liu, “Phylogenetic analyses and evolutionary timescale of Coleoptera based on mitochondrial sequence”, Biochem. Syst. Ecol. No 66, pp. 229–238, 2016.

[4] C. Simon, T. R. Buckley, F. Frati, J. B. Stewart and A. T. Beckenbach, “Incorporating molecular evolution into phylogenetic analysis, and a new compilation of

conserved polymerase chain reaction primers for animal mitochondrial DNA", Annu. Rev. Ecol. Evol. Syst. No 37, pp. 545–579, 2006.
[5] Sh. Khujaev, "Fundamentals of general and agricultural entomology and a integrated protection system", "New edition", Tashkent, pp. 255-256, 2019.
[6] B.A. Sulaymonov, "Phytophagous species and their quantity management in forest biocenosis", NMIU of Uzbekistan, Tashkent, pp. 79-83, 2017.
[7] J. Urban, "Occurrence, bionomics and harmful-ness of Chrysomela populi L. (Coleoptera; Chrysomelidae)", J Forest Sci. No 52, pp. 255–284, 2006.
[8] M. Yaman, "Re-record and Spore Ultrastructure of Nosema melasomae Sidor & Jodal 1986, a Microsporidian Pathogen of *Crysomela populi* (Coleoptera: Chrysomelidae)", Iran J Parasitol, Vol. 13, No. 2, Apr-Jun, pp. 244-250, 2018.
[9] I. Teodorescu, "Beneficial insect fauna (predators) in the woods of northern Oltenia", Studii si Cercetari de Biologie, Biologie Animala, No 32, pp. 3–6, 1980.
[10] H. Zeki and S. Toros, "Determination of natural enemies of Chrysomela populi L. and Chrysomela tremulae F. (Coleoptera, Chrysomelidae) harmful to poplars and the efficiency of their parasitoids in Central Anatolia Region", In: Proceedings of the Second Turkish National Congress of Biological Control, pp. 251–260, 1990.
[11] G.O. Poinar, "Nematode parasites of Chrysomelidae", In: JOLIVET P., Petitpierre E., Hsiao T.H. (eds.), Biology of Chrysomelidae. Dordrecht, Boston, London, Kluwer Academic Publisher, pp. 433–448, 1988.
[12] R. Haitlinger, "Linobia coccinellae (Scopoli, 1763) (Acari: Astigmata: Hemisarcoptidae) a species new to the fauna of Poland, associated with *Chrysomela populi* L. (Coleoptera: Chrysomelidae: Chrysomelinae)", Przegląd Zoologiczny, No 43, pp. 181–182, 1999.
[13] H. Pettersen, "Schizonotus sieboldi Ratzeburg, 1852 (Hym., Pteromalidae) reared from Melasoma populi (L.) (Col., Chrysomelidae)", Norwegian Journal of Entomology, No 23, pp. 206–207, 1976.
[14] T.P. Marikovskaja and T.I. Šterbakova, "Wasps in artificial breeding sites", Zaštita Rastenij, No 6, pp. 29–31, 1989.
[15] I.K. Makhnovsky, "Pests of woody-shrubby vegetation of the Chirchik-Angren mountain massif and their control", Proceedings of the Central Asian Forestry Research Institute. Tashkent, Iss. V, pp. 79-93, 1959.
[16] J. Tarasi, A.R. Saboori and S.E. Sadeghi, "Report of an ectoparasitic mite on adults of Melasoma populi L. from Iran", Journal of the Entomological Society of Iran, No 21, pp. 107–108, 2001.