UDC 595.7 -- 632.12

Mulberry Scale (*Pseudaulacaspis pentagona* Tar. Tozz) and Rearing of its Entomophagues in Azerbaijan

Mustafayeva Gulzar Aligeydar

PhD, Institute of Zoology, Azerbaijan National
Academy of Sciences, Baku c, Azerbaijan
AZE -1073, pr.1128, bl.504
E-mail: zoolog88@mail.ru

Abstract: The article provides research data on biological peculiarities of mulberry scale *Pseudaulacaspis pentagona* Tar. Tozz and on the role of local entomophagues in regulating population of that harmful pest. As a result of the research that was carried out, the following entomophagues have been detected: parasites *Aphytis proclia* Walker, *Aspidiotiphagus citrin*us Graw и *Encarsia aurantii* (Howard), predators *Rhizobius lophanthae* Blaisd, *Chilocorus bipustulatus* L., *Chilocorus renupustulatus* (Scriba). The technique of laboratory rearing of scales as well as of above mentioned entomophagues of scales was developed.

Key words: mulberry scale, entomophagues, predators, parasites, biological control, rearing technique.

Introduction

The scales (Homoptera, Diaspididae) play a great role among pests of agricultural crops. They affect trees and shrubs covering their all organs: trunks, leaves, branches and fruits. The sucking pests suck out plant juices causing dry-up of both branches and shoots. The leaves turn yellow, the fruits do not get fully developed; they fall out; both trees and shrubs are getting weakened. A strong infestation can lead to the total death of plants.

In the recent years, Azerbaijan has been affected by a widespread of mulberry scale (*Pseudaulacaspis pentagona* Targ.Tozz) which is a harmful pest of forest, fruit and decorative crops. Both polyphagy and high fertility of that pest allows it to pervade widely as well as to easily adapt to the new conditions. We pioneered the study of dissemination, of some biological features and of entomophagues present in

local aboriginal fauna (Mustafayeva, 2003; Mustafayeva, Ismailova, Mamedov, 2008) [4, 5]. Both exploration of bioecological features of pests and examination of species composition of their parasites and predators plays significant role in terms of carrying out biological control on scales.

Materials and methods of study

The faunistic material on both pests and entomophagues of the above mentioned pest were collected from different biocoenota, and handled according to the common technique (Borhsenius, 1950; Tryapitsyn, Shapiro, Shchepetilnikova, 1982; Yasnosh, 1978) [2,7,8]. The research work was carried out in both field and laboratory conditions. The identification of aphelinid species was performed by using the key to aphelinids by M.N. Nikolskaya and V.A. Yasnosh (1966) and the key to insects by V.A. Yasnosh (1978) [6,8].

Results and discussion

The studies that we carried out allowed us to learn about bioecologic peculiarities of the pest in focus and to identify its entomophagues. The laboratory rearing technique for effective species of entomophagues was developed.

The origins of mulberry scale is East Asia, China, Korea and Japan. The pest had spread out from East Asia to many countries with subtropical climate on the plant material. It showed up aggressiveness, and it was soon listed as one of the most harmful pests of all crops. At some point it became widespread in Europe. Its dispersion across the new regions was accompanied initially by rapid increase in population numbers and by high degree of harmfulness. Afterwards, the pest foci in Europe gradually subsided due to effective parasite *Encarsia berlesei*. The

countermeasures taken against that pest have decreased its geographic distribution area.

The clypea of female scales have wide elliptical and round shapes. They are white ones with dual larval skin; one larval skin has a flexen color, the other one has a luteous color. The body inside clypea is either oval or round. Neither extremities nor eyes can be seen. The body has usually xanthic color, but sometimes also citrine or sienna ones.

The nymphal clypeus of males is pale and has singular larval skin which is located in the upper part of the clypeus. There are two elongated longitudinal grooves on them. The larval skin is soft while males are developing. It has xanthic color. The adult males have wings, three pairs of extremities, antennae and eyes. The long copulatory organ can be clearly seen.

V.S. Borhsenius points out that mulberry scale is causing harm to plants that are parts of 54 families and 121 genera (Borhsenius, 1950) [2]. The mentioned pest lives on fruit trees (apples, pears, peaches, plums, cherries, and especially mulberries) in Azerbaijan thereby causing a big harm.

E. F. Kozarzewski and G. M. Konstantinova, while carrying out their research works on mulberry scale, discovered the specific parasite *Encarsia berlesei* which plays a significant role in decreasing populations of the pest in focus. The same authors offered a possibility of introducing the parasite under discussion (Konstantinova, Kozarzewski, 1990) [3].

In Lenkoran, they harm subtropical crops, such as lemons and oranges. They live on mulberries creating huge colonies on trunks and branches thereby causing death of those trees within three to four years. They also harm acacias, willows and decorative trees in Lenkoran.

The fecundated females of mulberry scales overwinter. This pest produces three generations on both mulberry and willow in Lenkoran. Around the mid-March, the pest comes out of wintering. Under the average daily temperatures 12 – 14°C, the insect individuals begin to grow with eggs being produced in their germaria. The females lay eggs during 2nd – 3rd decade of April. The eggs are oval-shaped and can be multi-coloured (flexen, orange and buff-coloured). The eggs with soft albescent wax on them get attached to each other thereby forming a chain system. Usually there is 10 – 12 single eggs on a chain. The oviposition continues for 30 – 40 days. The eggs can found underneath the clypeus until mid-May. After 6 – 8 days of embryonic development in eggs, the "vagabond" larvae exclude. The mass exclusion of larvae take place in the 1st decade of May. The larvae become active from several hours to 1 – 2 days. They search for a suitable place to attach on the plants and to begin sucking out their juices. When they find the right spot, they switch to the attached mode of life and begin oozing wax strands thereby making the initial clypeus. The females attach to the old offshoots and to the branches, and males – to the young offshoots. Sometimes the mulberry scales cover offshoots of trees thereby producing colonies. After 15 – 18 days the 1st instar larvae develop into 2nd instar larvae. By the end of May or by the beginning of June, females become looking quite distinctive from males. At that time, round-shaped females with their white clypeus can be effectively separated from males with their elongated clypeus which is free on one side. It must be noted that the mulberry scale is the only species that has multi-colored eggs: albescent, yellow, or xanthic. Depending on the color of eggs, the exluded "vagabond" larvae can also be multicoloured, such as yellow and orange. The clypeus of albescent and yellow larvae can be albescent-clear while the one of orange larvae can be aurous. Thus the 1st instar larvae clearly show sex dimorphism. During the 1st -- 2nd decade of June, the 2nd instar larvae develop into females. At that time,

the emergence of males begins. The mass emergence of males take place within 15 – 20 days. After their mating the males die out.

Since they don't have mouthparts, they live only for two to three days. Females lay eggs after mating with a male. Females of that generation begin laying eggs in 2nd and 3rd decade of June, and that process continues throughout the end of June. The development of the 2nd generation begins in the 2nd and 3rd decades of June. The 2nd generation males emerge in the beginning of August. The development of ootocous females start in the 2nd – 3rd decade of August. The emergence of males has been recorded in the end of September and in the first half of October.

In order to research the bioecological peculiarities of mulberry scales in lab conditions, we have developed a special technique of rearing the pest in question on potato tubers. Using that method, we were making the smooth potato tubers infested with mulberry scales. The branches of plants affected by mulberry scales in the nature were kept in the lab and consequently used for infesting potato tubers once the larvae of scales started their en-masse exclusion.

The "vagabond" larvae start actively moving around for 1 – 2 days getting attached to potato tubers. The potato tubers are getting covered with netting so as to activate the attached mode of life of the scales. Such larvae that get attached to potato tubers are losing both their extremities and antennae. In a short time, the larvae of scales exude filaments while producing the primary clypeus. Both ocher and xanthic larvae have ocher clypeus while sulfur larvae have aurous clypeus. In 15 – 16 days after the temperature reaches 22 -- 24^{0} C, the 1st instar larvae turn into the 2nd instar larvae. The sexual dimorphism can be clearly observed during this period. The males have elongated clypeus which is attached to tubers with one end with the opposite end being free. One can see multiple filaments around the females.

The female clypeus is elongated and oval-shaped with clearly seen aurous neanic skins. Within 28 – 30 days of the moment when larvae attach to potato tubers, the males begin to emerge. The 2nd instar female larvae turn into adult individuals during that period. Their clypeus is pale-orange coloured. The males die within 1 – 2 days after mating. The full development of males on potato tubers continues for 28 – 30 days. Within 8 – 10 days after mating, females form ovicells in their ovaries. The first egg-laying females appear on the 45th day of attached mode of life. The eggs can be xanthic and sulfur. The females inside clypeus happen to have two colours as well. One group of females has xanthic colour while another group has sulfur colour.

The embryonic development of eggs under the lab conditions has short term. It goes on from three to six days depending on the temperature. Both development and reproduction of mulberry scales on potato tubers provides an opportunity for gradation of its entomophagues under the lab conditions. In order to use the entomophagues that are found in local fauna so as to control the hazardous pest as well as to do the research, there has been developed a technique for their rearing and gradation.

As the result of the research that had been carried out, it has been discovered that mulberry scales have the following entomophagues in the local fauna: parasites *Aphytis proclia* Walker, *Aspidiotiphagus citrinus* Graw и *Encarsia aurantii* (Howard); and predators *Rhyzobius lophanthae* Blaisd, *Chilocorus bipustulatus* L., *Ch. renupustulatus* L.

The parasite *Aphytis proclia* plays a positive role in elimination of mulberry scales. As an oligophagous insect, this entomophague parasitizes on round scales. *Aphytis proclia* is an ectoparasite; the oviposition is taking place on the body of scale under the clypeus. The indicated parasite winters inside female scales in larvaceous or pupal forms. The hatched larvae feed on the body of a scale, grow and pupate. The

ectoparasites of the Aphytis genus have both black and dark-brown-coloured meconia. Every species has a specific external appearance of meconia as well a specific number of them. Depending on the species, scales produce black and dark-brown-coloured meconia at the final stage of their development. Those meconia look different depending on the species. One can recognize the species by colour and byn number of their meconia. The numbers of meconia vary between 12 and 41. The first generation parasites fly out during the month of May. The complete cycle of the first generation development takes 30 – 35 days during spring. The parasite has four – five generations in a year.

Its rearing in the lab conditions takes place on potato tubers infested with mulberry scale. The larvae burst out of eggs on the 4th – 6th day after the temperature goes up to 25^0 C and the humidity reaches 60 -- 65 %. Their pupation takes place after 20 – 22 days and lasts for six to eight days resulting in emergence of adult individuals. The development of one generation takes 32 – 36 days.

Aspidiotiphagus citrinus and *Encarsia aurantii* are endoparasites developing inside a scale. The parasite *Aspidiotiphagus citrinus* winters in a larval stage. The wintered individuals emerge throughout the 3rd decade of May. From four to five generations are being produced during the vegetation period. *Aspidiotiphagus citrinus* needs 25 – 30 days for development on potato tubers under the temperature of 25^0 C (and humudity of 60 -- 65 %). *Encarsia aurantii* is a fringe species. It plays an insignificant role in infestation of mulberry scale.

Kosztarb and Kozar in their book “Scale insects of Central Europe” have published the list of mulberry scale entomophagues in Central Europe (Kostarab, Kozar, 1988). They have described the following ones among them: 27 species of parasites, 20 species of predators, as well as two species of entomopathogenic fungi.

The coccinellid *Rhyzobius lophanthae* and the parasite *Encarsia berlesei* have been mentioned by them as especially effective entomophagues [9].

Nowadays the scale pest is causing harm to many kinds of fruit trees along with other plants in Azerbaijan which is a big problem for our country. Its populations are snowballing because when the pest invaded our country, it found no natural enemy there. That is why in order to control the mulberry scale in Azerbaijan, it may seem both very important and desirable to introduce the parasite from outside.

The most effective predator is known to be *Rhyzobius lophanthae*, and the most effective parasite is considered to be *Encarsia berlesei*. As such, they both can be reared in the lab conditions and consequently released into the environment in order to suppress the mulberry scale populations. The entomophagues from local fauna that play a big role in decreasing mulberry scale's populations can be reproduced. The predator *Rhyzobius lophanthae* can play an immense role in biological control of mulberry scale. It has been also found to be an effective entomophague of other species of oval scales: oleander, olive, cactus, and Californian scales. The aforesaid predator stays clear of such scales that are infested with various parasites (*Aspidiotiphagus citrinus* и *Aphytis proclia*). Considering both all of the mentioned above and the irreplaceability of that unique predator, it would be very advantageous to rear it in the lab conditions and to begin releasing it into the environment in order to decrease the levels of mulberry scale populations, as well as to use it in biological control of all oval scales.

Conclusions

1. There have been studied bioecologic features of mulberry scales which harm agricultural, and park and decorative crops. It has been found out that the pest

produces three generations on mulberries and willows in Azerbaijan (both in Lenkoran and in Absheron peninsula areas). The female imagos winter.

2. There have been identified entomophagues of the scale pest in Azerbaijan. Three species of parasites along with three species of predators have been discovered among which coccinellids *Rhyzobius lophanthae* Blaisd., as well as parasites *Aphytis proclia* Walker and *Aspidiotiphagus citrinus* Graw., are showing to be the most effective in suppressing populations of the abovementioned scale.

3. There has been developed the laboratory methodology on rearing both pest and its effective entomophagues identified from local aboriginal fauna in order to study the bioecological peculiarities of mulberry scale.

References

1. Bazarov B., Shmelyov G.P. Stchitovki Tadzhikistana i Sopryedyelnykh Rayinov Sryedney Azii. Dushanbe, 1971, pp. 1 – 213.

2. Borhsenius N. S. Tchervetsy i Stchitovki SSSR. Moscow – Leningrad, 1950, pp. 178; 228.

3. Konstantinova G.M., Kozarzhewski Э.Ф. Stchitovki-vredityeli Plodovykh I Dekorativnykh Rastyeniy. Moscow, 1990, “Agropromizdat”, pp. 1 – 134.

4. Mustafayeva G.A. Opasnyy Vryedityel Tutovoy Stchitovki (*Pseudaulacaspis pentagona* Targ-Tozzetti) I Yeyo Entomofagi v Usloviyakh Lenkoranskoy Zony.// Nautschnyye Statyi po Ekologii, Filosofii I Kultury. Baku, 2003, pp. 92 – 95.

5. Mustafayeva G.A., Ismailova G.A., Mamedov Z.M. O Bioekologichyeskikh Osobyennostyakh Tutovoy Stchitovki (*Pseudaulacaspis pentagona* Tar.Toz.).// Trudy Obstchyestva Zoologov Azerbaydzhana. 2008, I Vol., pp. 251 – 256.

6. Nikolskaya M.N., Yasnosh V.A. Afelinidy Yevropeyskoy Chasti SSSR I Kavkaza. Moscwo – Leningrad, 1966, pp. 1 – 294.

7. Tryapitsyn V.A., Shapiro V.A., Shchepetilnikova V.A. Parasity i Khistchniki Vryedityeley S.-kh. Kultur.Leningrad: Kolos, 1982, pp. 1 – 256.

8. Yasnosh V.A. Opryedyelityel Nasekomykh Yevropyeyskoy Chasti SSSR. Leningrad: Nauka, T. 3, 1978, pp. 469 – 500.

9._Kostarab M., Kozar F. Scale insects of Central Europe. Budapest: Akad. Kiado, 1988, pp. 1- 442.