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The Behavioural Abilities of Meteorus versicolor Wesm. and Rogas rossicusKok. (Hymenoptera, Branconidae) Parasitoids of Tephrina arenacearia Den.Et Schiff. (Lepidoptera, Geometridae)

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Abstract: This paper concerns with the behavioural abilities of *Meteorus versicolor* Wesm. and *Rogas rossicus* Kok. (Hymenoptera, Braconidae)-internal parasitoids of *Thephrina arenacearia* Den. et Schiff. (Lepidoptera, Geometridae) as well.

Periods of development phases and searching, ovipositional and mating behaviour of both parasitoids have been investigated.

Key Words: *Tephrina arenacearia, Meteorus versicolor, Rogas rossicus,* parasitoid, behaviour

Tephrina arenacearia Den. Et Schiff. (Lepidoptera, Geometridae) Parazitoitleri olan *Meteorus versicolor* Wesm. ve *Rogas rossicus* Kok.'un (Hymenoptera, Braconidae) Davranış Özelikleri

Özet: Bu makalede, *Tephrina arenacearia* Den. et Schiff., (Lepidoptera, Geometridae)'in ic parazitoiti olan *Meteorus versicolor* Wesm. ve *Rogas rossicus* Kok. (Hymenoptera, Braconidae)'un bazi biyoekolojik özellikleri verilmiştir. Her iki parazitoit türünün gelişme evrelerinin süreleri, yumurtlama ve çiftleşme davranışları tesbit edilmiştir.

Anahtar Sözcükler: *Tephrina arenacearia* Den. et Schiff., *Meteorus versicolor, Rogas rossicus,* parazitoit, davranış

Introduction

Application of pesticides during long years to control of pests is one of the principal causes of the pollution of environment in Azerbaijan. The biological suppresion and management of pests must occupy a chief condition in such situations. Some works have been done in this direction in Azerbaijan. *Trichogramma evanescens* Westw., *Bracon hebetor* Say applied to control of *Heliothis armigera* Hb. (1,2).

Material and Methods

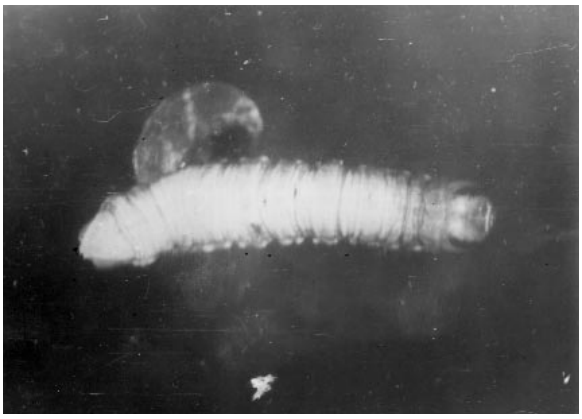
This investigation has been conducted between the years of 1992-1994. Both the parasitoids and host have been collected from the alfalfa fields of Absheron peninsula and Kuba-Khachmaz zone of Azerbaijan Republic. Parasitoids have been catched in butterfly-net or raised from parasitized host caterpillars according to the Fasulaty method (3). The parasitoids and host have been reared under the laboratory condition before using in the present investigation. Field collected host caterpillars have been kept in the jars. They have been fed on fresh alfalfa. The food has been changed every day. Caterpillars with the obvious signs of parasitisation (such caterpillars were yellow and fed very little) have been kept in the separate vials. Raised adult parasitoids have been fed on honey syrup (50%).

Different agricultural crops and their different organs have been offered to parasitoids to study their host habitat searching behaviour.

The fodder crop of the host (alfalfa) have been offered to parasitoids in defeated, indefeated conditions, with the host excrements and without of them to study its host selection behaviour (4).

The method of studying of mating behaviour includes the visual observations and description of courtship and copulation of parasitoids with the registration of the seperate acts and whole processes completely (5,6).

In order to calculate the eggs laid by parasitoid's female the parasitized host caterpillars have been dissected and examined under magnifying glass.



A

B

Figure 1. A- *M. versicolor* larva hatching from *T. arenacearia* caterpillar.
B- The larva of *M. versicolor*.

Results

The Life-Cycle Of *Meteorus Versicolor*

The development of the parasitoid's egg within the host body lasts 2-3 days. The parasitoid's larva completes its development during 7-12 days and hatches at near the end of the host body (Figure 1,A).

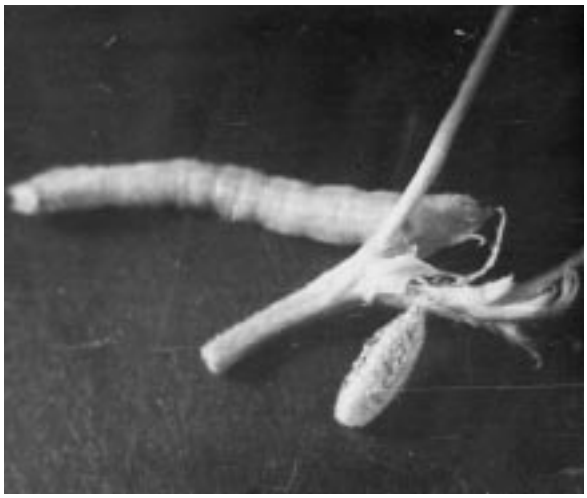
The host caterpillar lives another day after hatching of the parasitoid larva. But it does not feed and move.

As soon as larva leaves the host body, it begins to plait a cocoon (Figure 1, B; 2, A).

Larva plaits the cocoon not far from the host, at the end of the thread of 1-1,5cm long which it down through the alfalfa branch. Either going round its axis, or bending the larva at the first plaits the external wall. The cocoon is very soft, white and netted in this stage (Figure 2,B).

Then the larva stengthens the inside wall of the cocoon. It takes one day to complete the cocoon plait. Completely plaited cocoon is brown colour, oblong and

A



B

Figure 2. A- The larva of *M. versicolor* plating a cocoon.
B- The uncompleted cocoon of *M. versicolor*.

rather strong (Figure 3,A).

The period of development within the cocoon lasts 8-12 days. The average life longevity of the female is 13 days and of male 10 days. The period of the deveopment of one generation of *M. versicolor* lasts 25 days.

Adult insect flies out from the cocoon gnawing the end of it and opening the lid (Figure 3,B).

A B C

Figure 3. A- The completed cocoon of *M. versicolor*.
B- The cocoon of *M. versicolor* after hatching the imago.
C- The cocoon of *R. rossicus*.

The Searching and Ovipositional Behaviour Of *M. versicolor*

Attracting to alfalfa the female of *M. versicolor* oviposits into the body after finding it. *M. versicolor* is endoparasitoid and does not paralyzes its host.

The ovipositional behaviour includes the following behaviour acts: inspection with anntenae, feeling with ovipositer, collision with host, oviposition, cleaning, rest. *M. versicolor* can parasitise one host for several times. It parasitizes 4th and 5th instar caterpillars. The oviposition activities of females raise at the second part of the day.

The Mating Behaviour of *M. Versicolor*

The mating behaviour of *M. versicolor* consists of following acts: the meeting of the female and male, pursuing the female by the male, copulation, cleaning, the rest. The active role belongs to the male in the mating behaviour. Pursuing the female by the male may last from several minutes to several hours. It takes approximately 2 minutes for copulating.

The Life-Cycle of *R. Rossicus*

Parasitoid's egg is oblong and white. Its development within host body lasts 2-3 days. The development of the parasitoid's larva lasts 7 days. Pronimphal larva does not leave host's body. Pupation occurs inside of the host skin. This is a characteristic feature of Rogadinae subfamily. *R. rossicus* attaches its cocoon to the alfalfa branch. The cocoon is smooth and light brown colour, 7 mm long (Figure 3,C).

The development within the pupa lasts 8-10 days. Adult insect flies out from the cocoon gnawing the hole at the end of it. The life-span of the female is averagely 29 days, but male 25 days.

The Searching and Ovipositional Behaviour of *R. Rossicus*

Attracting to the alfalfa the female finds the host with the help of excrements.

R. rossicus paralyzes its host temporaly. Host remains in paralysis condition for 4 minutes. Parasitoid attacks the 1st and 2nd instar caterpillars of host and it can deposite 13-14 eggs in 1 host caterpillar. *R. rossicus* reproductes in parthenogenetic way, too. Both *M. versicolor* and *R. rossicus* are arrhenotockic insects. The male hatches from unfertilized eggs.

The mating behaviour of *R. rossicus.*

The mating behaviour of *R. rossicus* is not complicated and consists of several simple motions. The active role belongs to the male. It attacks the female, rises to its back and copulates it. It takes them 2 or 2,5 minutes for the copulation. After copulation both the male and female "clean" themselves.

Discussion and Conclusion

M. versicolor and *R. rossicus* parasitize some lepidopterian. These parasitoids have been raised from some pests by Azerbaijan authors in Azerbaijan condition. *M.*

versicolor has been raised from *Orgia antiqua* L., but adults of *R. rossicus* have been catched from forests, fields, fruit gardens, mountain meadows by Abdibekova (7), Aliyev (8) raised *M. versicolor* from *Syngrapha circumflexa* L. and *R. rossicus* from *Heliothis armigera* Hb., *Agrotis obesa* Bd., *Euxoa temera* Hb. But we raised both parasitoids from the *T. arenacearia.* The pest has been given as a host for *M. versicolor* for the first time.

Taking into consideration that, it is necessary to have information about the host too, in order to study the biological abilities of the parasitoids we give the short information about *T. arenacearia.* Geometridae contains some forest and agricultural plants pests. *T. arenacearia* damages to alfalfa, too. The connection of Geometridae with the alfalfa has been noticed by Piriyev (9). According to Piriyev's information the pest hibernates as the pupa. At the begining of May the spring generation butterflies fly out. Batterflies deposit eggs on the leaves or branches of th alfalfa with the small heaps. At the second part of May hatching caterpillars destroy the leaves and generative organs of the alfalfa. This species gives 2 full generations in Azrebaijan condition. The pupae of the 3rd generation hibernate in the ground.

In spite of parasitisation of both parasitoids *M. versicolor* and *R. rossicus* in the same host there is not an interspecific competition between them. Because each of these parasitoids attacks different instar caterpillars. While *R. rossicus* parasitizes the 1st and 2nd instar caterpillars of *T. arenacearia, M. versicolor* prefers the 4th and 5th instar ones. The behaviour abilities of both parasitoids have been studied under laboratory condition.

As Flanders (10), Huffaker et al. (11) and others confirm, the analysis of biological control practise shows that, well developed searching abilities are the most important characteristic of the efficient entomophagouses. According to Viktorov (4) the searching behaviour includes the following stages: the host habitat searching, host seacrhing and host selection.

The stimulus connected with the host fodder crops play a great role for parasitoids of phytophagous insects in searching of the host habitat. It has been revealed in consequences of laboratory experiments that, both parasitoids, *M. versicolor* and *R. rossicus* find host habitat parasitoids look for host. The parasitoids use stimulus connected either with hos directly, or hosts life-activity products in thes stage. In consequence of laboratory experiments with *Contesia rubecula,* Nealis (12) revealed that, this parasitoid finds its host by kairomones from the host excrements. The analogous results have been obtained by us on *R. rossicus.* This parasitoid was interested in alfalfa leaf damaged by the host. The reaction of parasitoids was more intensive when the host excrements (excrements of the 1st and 2nd instar caterpillars) were added to damaged leaf. Parasitoid turnerd to the object immediately and began to move directly to leaves. Approaching to the object it curverd the end of the antennae to substrate. Catching the leaves it moved slowly inspecting the each side of them. Finding the host the female cought it with help of its front of pair of legs and antennae. Then it curved its abdomen, inserted ovipositor into the host body in a moment and took it out. *R. rossicus* paralyzes its host temporarily. It does not let out the caterpillar till it compltely immobile. It takes approximately 2 minutes to paralyse the host. After host paralysis the female inserts its ovipositor into the host body again and deposits egg. It approximately takes 2 minutes to oviposit. Then parasitoid lets out the caterpillar and "cleans itself up" and "has a rest". Then all the processes are repeated again.

The visual stimulus play an important role in the host searching behaviour for a number of parasitoids parasiting the free-living hosts. Judging by experimental data of Monteith (13) the female of tachina fly- *Drino bohemica* is arttracted by host movement. It has been revealed in consequence of the experiments conducted on female of *M. versicolor* by us that, the female is attracted by host's smell directly at the first stage. But the host's movement stimulates the active oviposition. Some females even tried to deposit the egg on the alfalfa leaf when it moved.

Thus, *M. versicolor* finds its host attracting to smell and movement of host, but *R. rossicus* finds it according to the alfalfa damaged by host, and as well as, in accordance with the kairomones parted with the host's excrements.

The other stage of host searching behaviour is the host selection. We can notice according to the experiments conducted on *M. versicolor* and *R. rossicus* that, while *R. rossicus* parasitizes the 1st and 2nd instar host caterpillars, *M. versicolor* prefers the 4th and 5th instar ones.

The multiparasitoidism is a characteristic feature for both parasitoids. Neither *M. versicolor* nor *R. rossicus* can differ parasitized host caterpillar from unparasitized one. However, *R. rossicus* can differ the host with the parasitoid larva in it and avoid the parasitoidisation of such host. Multiparasitoidism of these parasitoids depends on host providing. If number of host is enough, the multiparasitoidism will be less. For instance, we revealed that, while 1 female of *R. rossicus* parasitizes 1 host caterpillar for an hour 14 times, it parasitizes every host cater-

pillar at most 2 times on providing it with 8 hosts. The analogous results were obtained in experiments conducted on *M. versicolor.* One female of *M. versicolor* parasitizes 1 host for an hour 7 times, and it parasitizes 1 time the most of caterpillars and 2 or 3 times some of then on providing it with 8 hosts.

It must be noted that, in spite of repeated parasitoidisation only one larva of both parasitoids completes its development within one host caterpillar. Intra specific competition takes place between larvae of both parasitoids within the host body. The larva hatched out from the first deposited egg is stronger and it eliminates the other larvae or eggs.

It is known that, insects can defend themselves from entomophagous with help of a number of protective reactions. It may be physiological ,mechanical and etc.

The 4th and 5th instar caterpillars of *T. arenacearia* defend themselves from approaching *M. versicolor* female by strong motions of front part of the body. But it is clear that, the parasitoids in their turns acquire a number of adaptations allowing them to shun protection reactions of their hosts. *R. rossicus* creates the condition for its oviposition paralyzing the host temporarily. *M. versicolor* has a number of behaviour adaptations allowing it to oviposit before the host sees it. Seeing the moving host the female bends its abdomen under thorax, such as, apex of ovipositer sticks out of head. At this condition it steals up to host. This condition allows it to observe all of hosts motions. The female brings its ovipositor close to the hosts body. It stays a shot way off host and stretches the tip of abdomen forward maximally. In Viktorov's (4) opinion this form appears at the different groups of parasitoid-hymenopterian which parasitize the active insects.

The mating behaviour of *M. versicolor* and *R. rossicus* has been studied, too. Data on mating behaviour is necessary for elaboration the scientific basis of the biological control of iunsects.

The active role belongs to male in the mating behaviour of both parasitoids. As soon as the adults hatch out they begin to copulate. The mating behaviour of *R. rossicus* is not complicated and consists of simple motions. The vibration of wings is not usual for male during the mating behaviour. It attacks the female and raises to its back. The female resists and tries to put it away. The female keeps it with its front pair of legs. The female is calm during the copulation. The male stricks to female's head with its antennae. After copulation both the female and male "clean themselves".

The mating behaviour of *M. versicolor* consists of several species-specific motions. At the first time, the male begin pursuit the female vibrating the wings. The male often stricks the female's abdomen with its head and makes it to take a copulation pose. This process lasts till female pushes away the male with the help of its back pair of legs. The male achieves its purpose on appearance the cause distracting the female from flight. For example, it may happen when the female feeds or purshes away the male and etc. The male takes advantage of this moment. It curves its abdomen and pulls out its genitals. Sometimes the male keeps the female with its front pair of legs. The male throw back raising a little its wings and tries to fortify its position in substrate. Copulation lasts approximately 2 minutes. After copulation the individuals disperse and "clean themselves". Then they take a rest. The male is polygamous, but the female is monogamous.

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References

1. Aliyev A.A., Ivanov Y.V., Gorbatovskii V.V. Some aspects of mass rearing of brakacon and its host flour moth on a technological equipments. Mat. of X cong. of OEs. Leningrad: p.6-9, 1990.
2. Kurbanov G.G., Kuliyev G.A. The results of *Habrobracon* test on the cotton pest - *Pectinophora malvella* Hb. under th condition of Nach. ASSR.Thesis of rep. Interresp. coord. conf. on problems of agricult . and med. biol. in Trancaucasian. Baku, 1960-1961.
3. Fasulaty K.K. Field studying on land invertebrates. "Visshaya shkola", Moscow, 1971, p. 423.
4. Viktorov G.A. Ecology of parasite-entomophages. M.S. Gilyarov. "Nauka", Moscow, 1976, p. 151.
5. Weseloh R.M. Mating behaviour of gypsy moth parasite *Apanteles melanoscelis* Ann. Ent. Soc. Am., No 4. 70, 459-554. 1977.
6. Ascary A., Coppel H.C. Observation on courtship and mating behaviour of *Meteorus pulchricornis* a gypsy moth parasitoid. Ann. Ent. Soc. Am., 71, N 3, 364-366, 1978.
7. Abdinbekova A.A. Braconids (Hymenoptera, Braconidae) of Azerbaijan V.1. Tobias. "Elm", Baku, 1975, p. 322.
8. Aliyev S.V. Noctuids (Lepidoptera, Noctuidae) of Azerbaijan. "Elm", Baku, 1984, p. 225.

9. Piriyev A.A. Geometridae (Lepidoptera, Geometridae) damaging to alfalfa in Absheron peninsula. Mat. of III Scient. seccion of ent. of Dagestan. Makhachkala, 1989, p. 81-84.

10. Flanders S.E. Elements of host discovery as exemplified by parasitic Hymenoptera. Ecology. 28, 229-309., 1947.

11. Huffaker C.B., Messenger P.S. De Bach P. The natural enemy component in natural control and the theory of biological control. In: Biological control. N 4, 16-67, 1971.

12. Nealis V.G. Factors affecting the rate of attack by *Cotesia rubecula* (Hymenoptera, Braconidae). Ecol. Entomology, 15, N 2, 163-168, 1990.

13. Monteith L.G. Influence of host movement on selection of hosts by *Drino bohemica* Mesn. (Diptera, Tachinidae) as determined in an alfactometer. Canad. Entomol., 88, 583-586, 1956.