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Responses of *Meteorus Versicolor Wesm. (Hymenoptera, Braconidae)* to the Population Density of *Tephrina Arenacearia Den. et Schiff. (Lepidoptera. Geomatridae)*

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Abstract: The purpose of this research was the determination of the effectiveness of *Meteorus versicolor Wesm.* in the control of *Tephrina arenacearia Den. et Schiff.* We studied the behavioral responses of this braconid to changes the number of hosts in laboratory conditions.

It was revealed that this parasitoid is distributed proportionally to host population density. *M. versicolor* can parasitize both the single and accumulated larvae of the host.

Key Words: parasitoid, functional and numerical responses.

Meteorus Versicolor Wesm. (Hymenoptera, Braconidae)'un *Tephrina Arenacearia Den. et Schiff. (Lepidoptera, Geometridae)*'nın Populasyon Yoğunluğuna Reaksiyonları

Özet: Bu çalışmanın amacı *T. arenacearia*'ya biyolojik mücadelede *M. versicolor*'un önemini belirlemek için onun davranış tepkilerinin öğrenilmesi olmuştur. Sahibin sayısına karşı parasitoitin davranış tepkilerinin laboratuvarda incelenmesi parasitoitin kendi sahibinin sayısına uygun olarak arttığını tesbit etmiştir. Belirlenmiştir ki, *M. versicolor* sahibin hem aşağı, hem de yukarı yaygınlaştırma sıklığında faaliyet gösterir.

Anahtar Sözcükler: Parasitoit, fonksiyonel, say tepkisi.

Introduction

The food connections of braconids are very wide. Being parasitoids of pests of forest plants and agricultural crops they take part in the natural regulation of phytophagan numbers. Braconids are successfully used in the biological control of pests in several countries.

Apanteles hyphantria Riley, *Campoplex validus Gress*, *Hyposoter fugitivus Say*, *Mericia ampelus (Walker)*, *Podisus maculiventrus Say* have been introduced from the USA to the former USSR to control *Hyphantria cunea Drury* (2).

Bracon hebetor Say (Hymenoptera, Braconidae) was reared in laboratory conditions and released to farms to control the cotton bollworm in Azerbaijan (1).

The entomophages chosen for the regulation of pest number must have the ability of positive response to host population. Such an ability of *M. versicolor* was studied experimentally and quantitatively assessed.

Materials and Methods

Functional and numerical responses of *M. versicolor* to the change in *T. arenacearia* number were studied in laboratory conditions. Experiments for studying of these responses were conducted according to generally accepted methods (3–5).

One parasitoid female was used to study the functional response and 2 groups (consisting of 3 and 5 females respectively) to study the numerical responses. Host numbers were increased by geometrical progression (1, 2, 4, 8, 16, 32) in both cases. The experimental period was 24 hours. Host caterpillars were opened and eggs laid by parasitoids were calculated under a magnifying glass at the end of the experimental period.

Experiments were conducted at 25°C in petri dishes. The following densities of insects were used in the experiments: parasitoid –1, 3, 5, host –1, 2, 4, 8, 16, 32. Parasitoids in which preimaginal and postcocoon development occurred under the same conditions were utilized when 3–7 days old. Dynamics of the daily activity of the parasitoids were taken into consideration.

Results

Functional response of *M. versicolor*

It was revealed that there was directly proportional dependence between the number of host larvae and eggs laid by one parasitoid's female.

This dependence is expressed by a regression formula having a positive free term (Figure 1).

Reparasitization in *M. versicolor*

Reparasitization in *M. versicolor* depends on host supply. There is an inversely proportional dependence between reparasitization and host number (Figure 2).

Numerical responses of *M. versicolor*

Results of experiments on numerical responses of *M. versicolor* showed, that parasitoid expresses an intergenerational numerical response, and it can regulate the host population in low and high densities (Figure 3).

Discussion and Conclusion

The ability of parasitoids to regulate the host population number depends on their response to host population density. At present investigators give particular attention to the quantitative estimation of relationships existing between populations of phytophagans and parasitoids. Because such treatment gives a chance to judge the effectiveness of parasitoids on pest number regulation.

Taking the above into consideration we studied functional and numerical responses of *M. versicolor* to changes in the number of *T. arenacearia.*

There are 2 type of response: functional and numerical (7). The functional response expresses the number increase of hosts parasitized by one parasitoid female. Increase is observed to a certain threshold, which depends on the biological characteristics of the parasitoid and host. Functional response is a preliminary requirement numerical responses. The latter expresses the concentration of parasitoid females in the sites of host accumulation, and increasing parasitoids number in their following generations (6).

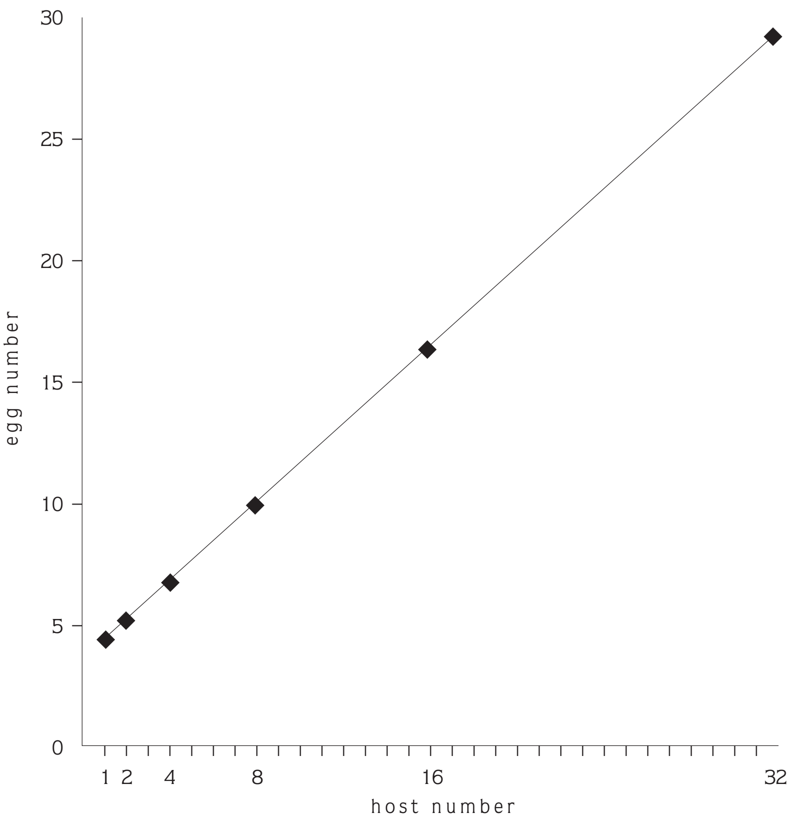

Figure 1. Functional response of *Meteorus versicolor*: $y= 3.5+0.8x$.

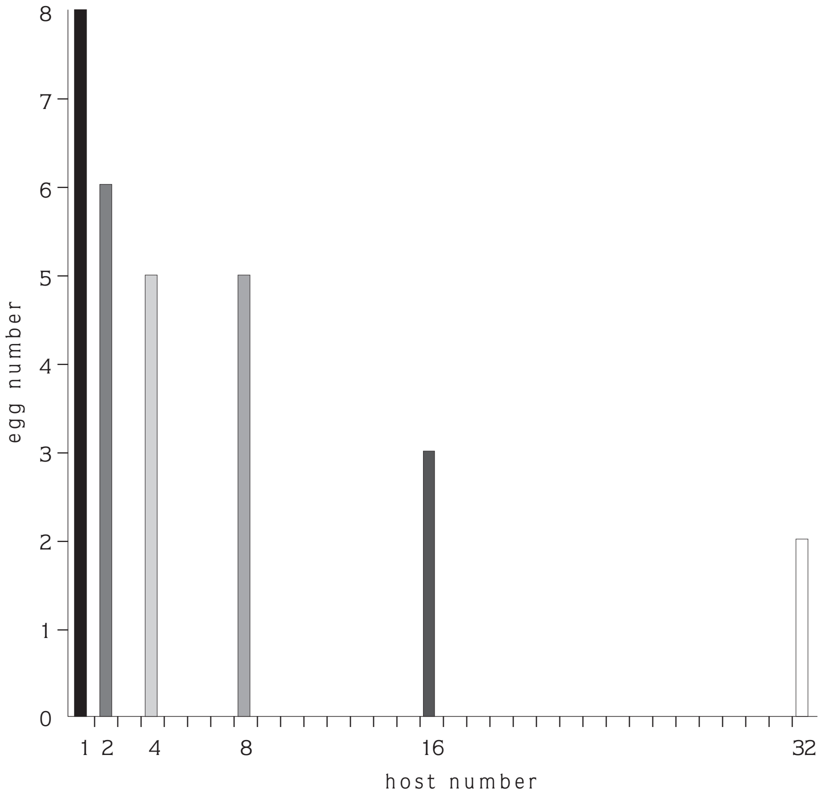

Figure 2. Reparasitization of *Meteorus versicolor*.

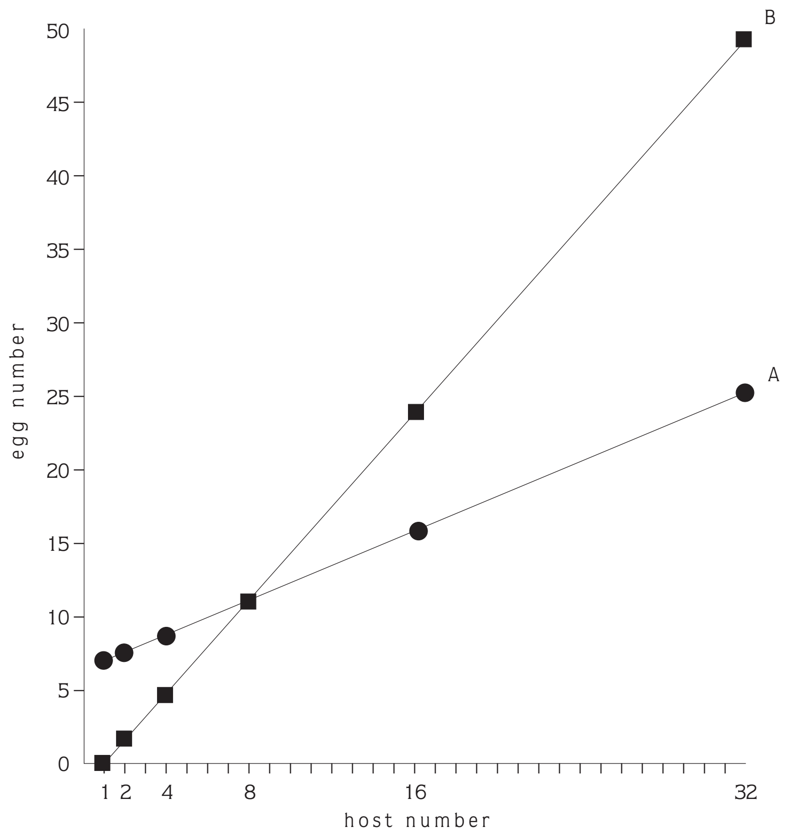

Figure 3. A. Numerical response of *Meteorus versicolor* for 3 females: y=6.3+0.6x.
B. Numerical response of *Meteorus versicolor* for 5 females: y=–1.6+1.6x.

Results of the experiments on the functional response of *M. versicolor* showed the increase in quantity of eggs laid by 1 female in proportion to host density increase. It turned out that there was directly proportional dependence described by rectilinear regression equation (y = 3.6 + 0.8x) between quantity of eggs laid by *M. versicolor* female and change in host number. Quite a large coefficient of correlation (r=0.9) indicates the directly proportional increase of quantity of laid eggs. In most cases dependence between eggs and host numbers was rectilinear and the further increase in host number did not change its character. Thus, the functional response corresponds to the 1st type according to the classification of Holling (3) was received with the participation of 1 female and without the influence of interference.

It should be noted, that the meteorus's female reparasitizes its host. As figure 2 shows the meteorus does not change host, and if its instar is suitable for the parasitoid it can parasitize it repeatedly.

Searching of host by the female has a random character at the beginning of the experiment. Reparasitization depends on host supply. If quantity of host offered to the parasitoid is not sufficient, then the female will parasitize the same host several times. Eight eggs laid by one female were found inside the body of the host (Figure 2). But the strategy of the female changes prompted by sufficient quantity of hosts. We did not find more than 2 eggs in one host caterpillar on offering to 32 hosts. Deviation of the curve from the beginning of coordinate to the ordinate axis is evidence of reparasitization (Figure 1). Functional response is described by a rectilinear regression equation with a positive constant term. But studying only the functional response does not allow a judgement about the regulation ability of parasitoid with great confidence. It serves as a major precondition for a numerical response.

As indicated above, 2 groups (groups consisting of 3 and 5 females respectively) of *M. versicolor*'s female were released to the already known densities (1, 2, 4, 8, 16, 32) of host. Intragenerational numerical response was observed during the release of the group consisting of 3 females, which is evidence of aggregation of females in the sites of host accumulation. This response coincided with the functional response of 1 female (Figure 1). Increase in laid eggs proportionally with increase in host population density was observed in this case too. The dependence was rectilinear in most cases, although adding another females to the group did not lead to changes in dependence form, but it allowed the determination of the lower threshold of the parasitoid's response to host density. Thus, the results was an intergenerational numerical response for the group consisting of 5 females which is described by the following equation with a negative free terms: y =–1.6 + 1.6x.

Such a response increased in regulative significance (Figure 3). Females are not only concentrated in the sites of host accumulation, each female lays more eggs too. The large value of angular coefficient (Figure 3) and approach of the curve to the ordinate axis is evidence of this fact.

It should be noted, that the complicated form of searching behavior is typical for meteorus' adult. As described above, the female of *M. versicolor* orientates itself by the moving host. Although increase in host density in the experimental area restricts their motion, but adding females to the group contributes to the fact that even the slightest motion of the host does not distract the females' attention from first adopting a position for egg laying. Adoption of such a positon has a typical character and the mature part of the eggs of the female probably serves as an internal stimulus for it. The female keeps a vigilant watch on host motion. Each of motion of the host, whether single or in accumulation, meets with an attack from the female.

Experiments were carried out in laboratory conditions. Host caterpillars were isolated from external factors, but in nature they are more active. This circumstance makes parasitoids' females parasitize more hosts. Thus, the efficiency of *M. versicolor* can be increased in nature.

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