Parasitization Rates of Adult Individuals of *Eurydema ornatum* (L.) (Heteroptera: Pentatomidae) by Tachinids in Manisa Province*

Buse Korkmaz, Şener Tarla

Abstract— Cabbage bug, *Eurydema ornatum* (L.) (Heteroptera: Pentatomidae) is one of the important pests that suck the sap of plants belonging to the Brassicaceae family, especially cabbage, cress and radish. There are not enough studies on the effect ratio of adult parasitoids belonging to the Tachinidae family on the population of this pest under natural conditions. For this reason, it was aimed to determine the parasitization rates of E. ornatum adults in Manisa province in 2019 and 2021. Adult individuals were collected on the host plants from March to October during both years. After separating them according to their sexes, they were cultured in different containers under laboratory conditions as male and female individuals separately. A total of 565 *E. ornatum* individuals were included in the experiment in the first year and 605 individuals in the second year. The tachinid pupae obtained from these were taken into separate tubes and kept in an incubator at 26 ± 1 oC, 60 ± 10% humidity and 16 hours of illumination until adults emerge. As a result, it was understood that 8.30% of the individuals collected in the first year and 6.70% in the second year were parasitized. In addition, it was determined that female individuals were parasitized at a higher rate. Thus, it has been understood that tachinids have a significant effect on the population of *E. ornatum* under natural conditions.

Index Terms— Cabbage bug, Eurydema, Tachinidae, Manisa

1 Introduction

Cruciferae/Brassicaceae (Cucumber) family members are distributed almost all over the world except Antarctica, generally in the temperate zone of the Northern hemisphere (Koch and Kiefer, 2006). Many plant varieties belonging to this family are among the important food sources in the world and in Turkey. Cabbage group vegetables are marketed almost throughout the year in Turkey and consumed as vegetables in different ways. They are consumed raw as well as cooked or pickled. As food, it has a great importance in the world in terms of both the breadth of production area and the total amount of production. There are many pests that cause damage in the areas where cabbage is grown. Among them, Cabbage bug, *Eurydema ornatum* (L.) (Heteroptera: Pentatomidae) is one of the important pests in our country. This pest is fed in different phenological periods of the host plants and can cause significant crop losses when left untreated. Especially when they cause damage during the seedling period, they can prevent the development of the seedling and dry it out. The damage in the seedling period is more important. It is found in cabbage, cauliflower, radish, rapeseed, and turnip as its hosts and causes damage. It is also abundantly found in *Sinapis arvensis* L. and other wild Cruciferae plants and Caper bush (*Capparis spinosa* L.). There are many biological factors that limit the reproduction of this pest under natural conditions. Among the natural enemies, *Trissolcus* spp. (Hymenoptera: Scelionidae), Thachinidae (Diptera) known as adult parasitoids, and many other polyphagous predators. Among these, adult parasitoids belonging to the Tachinidiae family have an important place. Due to their parasitoid effects on insect populations, they have been reported to be the most important members of the order Diptera (Swam 1964). Species belonging to the Tachinidae family play an important role in suppressing pest populations both in natural ecosystems and in agricultural areas (Tschorsnig, 1985, Greathead, 1986, Grenier 1988; English-Loeb et al., 1990, Mellini, 1990; Karban and English-Loeb). 1997; Coombs 2004; Stireman and Singer 2003, Stireman et al. 2006). It has been reported that Phasiinae subfamily species belonging to Tachinidae family within the Diptera order choose only Heteroptera species as hosts, sterilize their hosts and play an important role in suppressing their populations (Dubina 1974; Belyaeva and Steppanyan 1975; Tschorsnig and Herting 1994; Kıvan 1996; Blaschke 2015). In our country, there are no detailed studies on adult parasitoids, which are natural enemies of Cabbage beetle. Kara and Tschorsnig (2003) gave two species as *Ectophasia oblonga* (Robineau-Desvoidy) and *Elomyia lateralis* (Meigen) (Diptera: Tachinidae) as adult parasitoids of *E. ornatum* in the Turkey Tachinidae catalogue. Afterwards, *Ectophasia crassipennis* (Fabr.) and Cly*tiomyia continua* (Panz.) (Diptera: Tachinidae) species were also recorded as hosts for *E. ornatum* as a result of the study conducted on Tachinidae (Diptera) species in our country (Atay and Kara 2014). Thus, as a result of faunal studies, it was reported that four different adult parasitoid species chose *E. ornatum* as their host (Atay and Kara 2014, Uysal and Atay, 2021). To date, no detailed studies have been carried out on the adult parasitoid species of the pest in question and the parasitism rates of these species in the area where the study was carried out.

- *Buse Korkmaz, Uşak University, Faculty of Agriculture, Plant Protection Department, Uşak, Turkey, bskrkmz@windowslive.com*
- *Şener Tarla, Uşak University, Faculty of Agriculture, Plant Protection Department, Uşak, Turkey. PH-902762212121. E-mail: sener.tarla@usak.du.tr*

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The aim of this study was to determine the parasitization rates of individuals belonging to the Tachinidae family as potential biological control agents on adults of *E. ornatum* in Manisa province.

2. MATERIAL AND METHODS

The material of the study was overewintered and new generation egin *E. ormatum* and host plants collected from agricultural and non-agricultural areas in the Center, Salihli and Şehzadeler districts of Manisa, pupae and adults of tachinids with adult parasitoids, plastic bags, ice box, incubator where they were cultured, culture vessels, mesh cages, glass tubes and petri dishes.

Method

Studies were carried out in agricultural and non-agricultural areas in Salihli and Center Şehzadeler districts of Manisa province in 2019 and 2021, and the coordinates and information about these areas are given in Table 1.

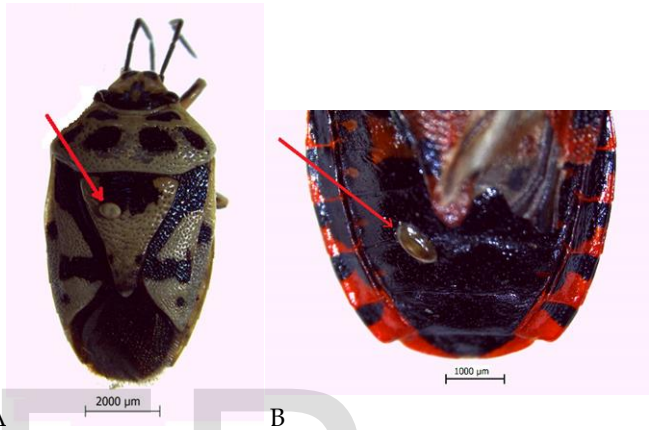
Table 1. The areas where the study was carried out and the coordinate information

Province	District	Region	Coordinates
Manisa	Salihli	Sarıpınar	38° 29´ 19.0752"N 28° 10´ 12.4248" E
Manisa	Salihli	Dombaylı	38° 34' 3.3888" N 28° 18' 20.4264" E
Manisa	Şehzadeler	Aşağıçobanisa	38° 33' 59.4756" N 27° 34' 14.2860" E

Between March and September, 565 individuals of *E. ornatum* were collected in the first year and 605 individuals in the second year by hand and atrap. The samples were collected in different places such as vacant land, field edges and roadsides where the hosts were mainly *Diplotaxis muralis* L. D.C., *Sinapis arvensis* L. (Cruciferae) and *Capparis spinosa* L. (Capparaceae). Collected individuals were taken into plastic bags with the host plant and brought to the Entomology laboratory in an ice box. Individuals brought to the laboratory were divided into male and female by looking at their genital organs. They were placed in plastic containers, male and female separately, on which moistened sterile blotting paper was laid in order to provide humidity in each of them and host plants were placed on them for feeding. As food, plants (wild mustards and rapeseed) on which adults are collected were used. Blotting paper in the containers was moistened every two days and the food was replaced with a new one if necessary. All collected individuals were fed in this manner at room temperature until death. Parasitoid pupae emerging as a result of daily controls were taken into labeled glass tubes of 10x1.6 cm. These tubes were kept in an incubator at 26±1 °C, 60±10% humidity and 16 hours of illumination until adults emerge. The parasitoid species that emerged as a result of the trials were appropriately pinned and labeled, and then taken to the collection cabinets. The diagnosis of *E. ornatum* was made by the second author. Thus, parasitoid species and ratios were determined in males and females in adult individuals of *E. ornatum*. Pictures were taken using an Olympus SZX10 stereo microscope with an attached Olympus SC30 camera. *Eurydema* and tachinid specimens used for identification purposes in the study were preserved in Uşak University, Faculty of Agriculture and Natural Sciences, Department of Plant Protection Museum.

3. RESULTS

The *E. ornatum* individuals used in the experiment were examined and it was understood that tachinids rarely lay their eggs on individuals (Figure 1A) and generally on the abdomen (Figure 1B), which is the lower part of the wings.



A B

Figure 1. Tachinids rarely lay their eggs on individuals (A), but usually under the wings on the abdomen (B)

The number of E. ornatum adults and parasitization rates collected in 2019 in the areas where the study was carried out are given in Table 2. In the first year, it was determined that 6.92% of males and 9.70% of females were parasitized by adult parasitoids. As can be seen, the rate of parasitism was higher in female individuals. The total parasitization rate in all individuals was determined to be 8.30%.

Table 2. *Eurydema ornatum* adult numbers and parasitization rates collected in 2019 in the areas where the study was conducted

District/ Region	*Eurydema ornatum*						General rate (%)
	♂			♀			
	n	Parasitized (number)	%	n	Parasitized (number)	%	
Salihli/ Sarıpınar	142	9	6.33	163	16	9.81	8.07
Salihli/ Dombaylı	54	4	7.40	61	6	9.83	8.61
Center/ Aşağıçobanisa	71	5	7.04	74	7	9.45	8.24
Total	267	18	20.77	298	29	29.09	24.92
Mean	89	6	6.92	99.33	9.67	9.70	8.30

In the second year of the study, 2021, the collected *E. or-*

natum adult numbers and parasitization rates are given in Table 3.

Table 3. *Eurydema ornatum* adult numbers and parasitization rates collected in 2021 in the areas where the study was conducted

District/ Region	*Eurydema ornatum*						General rate (%)
	♂			♀			
	n	Parasitized (number)	%	n	Parasitized (number)	%	
Salihli/ Sarıpınar	138	8	5.79	200	17	8.50	7.14
Salihli/ Dombaylı	42	2	4.76	80	5	6.25	5.50
Center/ Aşağıçobanisa	67	4	5.97	78	7	8.97	7.47
Total	247	14	16.52	358	29	23.72	20.11
Mean	82.33	4.67	5.50	119.33	9.67	7.90	6.70

As can be seen, 5.50% of males and 7.90% of females were found to be parasitized by adult parasitoids. As can be seen, the rate of parasitism in females was higher in the second year, as in the previous year. In all individuals, the total parasitization rate was found to be 6.70%.

4. DISCUSSION

As a result of this study, parasitization rates of male and female individuals of *E. ornatum* by tachinids were determined for the first time in Manisa. In our country, there was no evidence of parasitization rates of *E. ornatum* individuals by tachinids. However, both in our country and in many other countries, Sunn pest, *Eurygaster* spp. (Heteroptera: Scutelleridae) has been determined to occur at a high rate of parasitism. For example, in our country, it was reported that 40.7% of overwintered Sunn pests collected during the nymph survey period in Gaziantep province İslahiye district cause parasitization by adult parasitoids at a rate of up to 66.9% in a study conducted in Iran (Tarla 2002; Amir-Maafi 1991). On the same subject, it has been reported that the overewintered *E. maura* adults collected in the Sivaslı district of Uşak province in 2016 and 2017 were parasitized by adult parasitoids at a rate of 16.3% and 11.4%, respectively (Tarla and Tarla, 2018). In other studies on Sunn pest, Şimşek et al. (1994) found that the parasitization rates were approximately 0.7-11.3% in the Mediterranean Region, Kıvan (1996) reported that the average rate of parasitism was 7.7% and 4.6% in the grain fields of Tekirdağ Province in 1994 and 1995, respectively, and Islamoğlu and Kornoşor (2003) showed that the average parasitism rate in Gaziantep province in 2001 was 9.3% reported that it was 11.0% in 2002, 16.5% in 2001 and 19.0% in 2002 in Kilis province. Apart from these, similar studies have been carried out in different provinces and it has been reported that parasitization rates occur at close values (Gözüçık et al., 2010; Duman and Sertkaya, 2015).

As a result of this study, it was determined that tachinids parasitized the adults of *E. ornatum* at a significant level. In addition, it has been determined that female individuals parasitize at a higher rate. In the future, it would be appropriate to conduct more detailed studies on this pest and its natural enemies It is thought that these results will shed light on the future use of adult parasitoids of *E. ornatum* both in scientific studies and in mass production.

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