



## Tachinid (Diptera: Tachinidae) parasitoids reared from hemipteran hosts in Bolu and Düzce (Türkiye) Provinces

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### ABSTRACT

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This study aimed to determine the tachinid parasitoids (Diptera: Tachinidae) associated with different hemipteran hosts in Bolu and Düzce provinces in the Western Black Sea region of Türkiye in the period from 2022 to 2024. For this purpose, samples of Hemiptera were collected from various weeds, shrubs and cultivated plants. These specimens were brought to the laboratory and cultivated on the corresponding host plant material at  $25 \pm 2$  °C and 60-70% RH. In this study, three different parasitoid species of tachinids were identified on three different hemipteran hosts. Of these, *Graphosoma lineatum* Linnaeus (Hemiptera: Pentatomidae) is a new host record for *Ectophasia crassipennis* (Fabricius, 1794) and *Gymnosoma clavata* (Rohdendorf, 1947) (Diptera: Tachinidae) from Türkiye. In addition, information on the hosts of the parasitoids parasitoids in Türkiye is presented.

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## Introduction

Tachinids (Diptera: Tachinidae) are one of the largest groups of the order Diptera with 8.592 species globally and 2.112 species in the Palearctic region (O'Hara et al., 2020). In Türkiye, a total of 341 species from this family have been recorded (Kara et al., 2020). Among biological control agents, parasitoid insects are widely recognized for their efficacy and specificity in pest control. Hymenoptera and Diptera are the two most important orders of insect parasitoids (Scaramozzino et al., 2020). Tachinids are internal parasitoids, that mainly target the larval stages of Lepidoptera. In addition, various insects from other orders such as Coleoptera, Heteroptera and Hymenoptera are also hosts (Stireman et al., 2006; Dindo, 2011; Cerretti et al., 2014). As natural enemies of predominantly phytophagous groups, tachinid flies play crucial ecological regulatory roles in both natural and managed ecosystems (Stireman et al., 2019). Despite the considerable knowledge gained in this field, many aspects of parasitoid behavior and interactions with their hosts remain to be fully elucidated. It is also important to determine possible host diversity based on regional differences (Stireman et al., 2019; Scaramozzino et al., 2020).

The most recent and comprehensive catalog of the Palearctic was published by Tschorsnig (2017). In Türkiye, Kara and Tschorsnig (2003) compiled an exhaustive list of all known hosts of tachinids and documented the host species of 95 tachinid flies. Furthermore, Kara et al. (2014) compiled a catalog of 27 tachinid species that are parasitoids of Turkish forest pests. In addition, Tarla et al. (2023), mentioned 10 different hemipteran hosts, which host 11 different tachinid species in Türkiye.

In the present paper, we report the occurrence of hemipteran hosts of some tachinids in the Bolu and Düzce provinces of the Western Black Sea region of Türkiye.

## Materials and Methods

The study was carried out in the Bolu and Düzce provinces between 2022 and 2024. The insects were collected from agricultural fields and areas with weeds and bushes. The collected insects, were brought to laboratory together with their host culturing. And then, they were placed in individual cultivated containers, which were kept

at a temperature of  $25 \pm 2^\circ\text{C}$  and a relative humidity of 60–70%. Culture containers were checked regularly and plants were replaced once when necessary.

Emerging tachinid adults were prepared for identification and identified according to Tschorsnig & Herting (1994), Tschorsnig & Richter (1998) and Gilasian et al. (2013). Herting & Dely-Draskovits (1993) followed for Tachinidae species nomenclature. Pentatomid and scutellerid hosts were identified by Prof. Dr. Emine Demir Özden (Düzce University, Faculty of Agriculture, Department of Plant Protection, Düzce/Türkiye) and the weeds from which host insects are collected were identified by Dr. Bahadır ŞİN (Sakarya University of Applied Sciences, Faculty of Agriculture, Department of Plant Protection, Sakarya/Türkiye). The tachinids and hemipterans specimens are housed at the Plant Protection Museum, Faculty of Agriculture, Tokat Gaziosmanpaşa University, Tokat, Türkiye.

Parasitoids emergence dates, the number of males and females, host species, host locations, and associated plants, were documented separately. Additionally, host records of the reared parasitoids in Türkiye were presented.

## Results and Discussion

In the study, three distinct species from the Tachinidae family were reared from three different host species. These are given below:

### Subfamily: Phasiinae

#### Tribe: Phasiini

##### *Gymnosoma clavata* (Rohdendorf, 1947)

Reared specimens: 20.VII.2024, ♂, reared from *Graphosoma lineatum* (Linnaeus, 1758) (Hemiptera, Pentatomidae) collected in Bolu-Mudurnu, (13 adult specimens),  $40^\circ30'44''\text{N}$ ,  $31^\circ15'32''\text{E}$ , 849 m from the *Rubus* sp. (Rosales: Rosaceae), 14.VII.2024.

Hosts in Türkiye: *Dolycoris baccarum* (Linnaeus, 1758) (Karsavuran, 1986; Herting & Tschorsnig, 1993; Kara & Tschorsnig, 2003; Keçeci et al., 2007, Tarla et al., 2023), *Carpocoris* sp. (Herting & Tschorsnig, 1993; Tarla et al., 2023), *Ancyrosoma leucogrammes* (Gmelin, 1790) (Karsavuran & Kara, 2003), *C. fuscispinus* (Boheman, 1850) (Atay & Kara, 2014), *Aelia rostrata* Boheman, 1852 (Hemiptera: Pentatomidae), *Scantius aegyptius* (Linnaeus, 1758) (Hemiptera: Pyrrhocoridae) (Tarla et al., 2023).

Remarks: The parasitoid's typical host family is the Pentatomidae (Hemiptera), is frequently reared from *D. baccarum*. This parasitoid was obtained from only two species of the genus *Graphosoma*. These species are *G. lineatum* and *G. semipunctatum* and their records are very old (Tschorsnig, 2017). *G. lineatum* is a new host record for *G. clavatum* in Türkiye.

##### *Ectophasia crassipennis* (Fabricius, 1794)

Reared specimens: 24.V.2022 ♀, reared from *Eurygaster integriceps* Puton, 1881 (Hemiptera: Scutelleridae), collected in Düzce-Yığılca, (23 adult specimens),  $40^\circ56'42''\text{N}$   $31^\circ21'42''\text{E}$ , 301m, from the *Triticum* sp. (Poales: Poaceae) 13.V.2022; 12.IX.2022, ♀, reared from *G. lineatum*, collected in Düzce-Central, (27

adult specimens),  $40^\circ54'11''\text{N}$ ,  $31^\circ11'26''\text{E}$ , 265 m, from the *Daucus corata* L. (Apiaceae: Apiaceae), 31.VIII.2022.

Host in Türkiye: *E. integriceps*, (Zwölfer, 1932; Lodos, 1953, 1961, 1986; Şimşek et al., 1994; Duman & Sertkaya, 2015, Duman et al., 2015), *Eurydema ornata* (Linnaeus, 1758), *Carpocoris pudicus* (Poda, 1761) (Hemiptera: Pentatomidae) and *Coreus marginatus* (Linnaeus, 1758) (Hemiptera: Coreidae) (Atay & Kara, 2014).

Remarks: Scutelleridae and Pentatomidae (Hemiptera) are the usual host families for this tachinid. In addition, the host range includes several species of Coreidae, Lygaeidae and Reduviidae (Hemiptera). This parasitoid was frequently obtained from *E. integriceps*. There are only three records indicating that it was reared from *G. lineatum* (Tschorsnig, 2017). Also, *G. lineatum* is the new host record for *E. crassipennis* in Türkiye.

### Tribe: Cyliindromyiini

#### *Cylindromyia brassicaria* (Fabricius, 1775)

Reared specimens: 07.VIII.2023, ♂, reared from *D. baccarum*, collected in Düzce-Çilimli, (43 adult specimens),  $40^\circ53'03''\text{N}$ ,  $31^\circ01'32''\text{E}$ , 158 m, from the *D. corata*, 26.VII.2023.

Hosts in Türkiye: *D. baccarum* (Karsavuran, 1986; Kara & Tschorsnig, 2003; Keçeci et al., 2007; Atay & Kara, 2014, Tarla et al., 2023), *Holcostethus vernalis* (Wolff, 1804) (Hemiptera: Pentatomidae) (Kara & Alaoglu, 1999).

Remarks: The typical host family of *C. brassicaria* is the Pentatomidae (Hemiptera) family. Usually, it was obtained from *D. baccarum*. Furthermore, some of its hosts are members of the Scutelleridae (Hemiptera) (Tschorsnig, 2017).

In this study, tachinid parasitoids associated with different hemipteran species were identified in the Bolu and Düzce provinces of the Western Black Sea Region of Türkiye. Three tachinid species were recovered from three different hosts. Of these, *G. lineatum* is a new host record for *E. crassipennis* and *G. clavata* in Türkiye. The Tachinidae family contains important species for biological control. They are effective natural enemies of many agricultural pests. As a matter of fact, *E. integriceps*, one of the hosts determined in this study, is one of the important cereal pests in Türkiye (Lodos, 1986; Mutlu et al., 2021). In addition, *G. clavata*, one of the parasitoids obtained, is known to parasitise *A. rostrata*, another destructive cereal pest in Türkiye (Tarla et al., 2023). In order to use these species in biological control studies, their species diversity and host relationships should be explained. Türkiye has different climatic zones and altitudes and therefore has a high biodiversity. This also means that the species diversity of the Tachinidae family and the hosts of these parasitoids will be high in Türkiye. It is estimated that the number of parasitoid species is higher. For this reason, further comprehensive studies are needed to investigate the host-parasitoid pairs in different regions and ecosystems of Türkiye.

## Declarations

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**Ethical Approval Certificate** Ethical committee approval and informed consent is not required for this study.

**Author Contribution Statement**

İbrahim CİNER: Host insect collected, culture reared, species identification and writing.

Turgut ATAY: Species identification, writing, supervision, and editing

Sevcan ÖZTEMİZ: Supervision, writing and editing

**Conflict of Interest**

The author declare no conflict of interest.

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