

First record of *Cylindromyia bicolor* (Diptera: Tachinidae) as an adult parasitoid of *Halyomorpha halys* (Heteroptera: Pentatomidae) in the world

Halyomorpha halys'ın (Hemiptera: Pentatomidae) ergin parazitoiti olarak *Cylindromyia bicolor*'un (Diptera: Tachinidae) dünyadaki ilk kaydı

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Abstract

Among the invasive insect species, *Halyomorpha halys* (Stål) (Heteroptera: Pentatomidae), has been causing significant damages in many parts of the world, particularly in vegetables, field crops and tree fruits. In the scientific studies conducted in Türkiye and the world so far, egg parasitoids of *H. halys* have been found, but adult parasitoids have not been detected. Two specimens of *Cylindromyia bicolor* were reared from an adult of *H. halys* collected in northern Türkiye (Borçka, Artvin). Adults of *H. halys* is reported for the first time as a host of *Cylindromyia bicolor* (Olivier) (Diptera: Tachinidae) in Türkiye as well as the rest of the world.

Özet

İstilacı böcek türlerinden *Halyomorpha halys* (Stål) (Heteroptera: Pentatomidae), başta sebzeler, tarla bitkileri ve ağaç meyveleri olmak üzere dünyanın birçok yerinde önemli zararlara neden olmaktadır. Şimdiye kadar ülkemizde ve dünyada yapılan bilimsel çalışmalarda, *H. halys*'ın yumurta parositoidleri bulunmuş fakat ergin parazitoidleri tespit edilmemiştir. *Cylindromyia bicolor*'un iki örneği, Türkiye'nin kuzeyinden (Artvin, Borçka) toplanan *Halyomorpha halys* ergininden elde edilmiştir. *Halyomorpha halys* erginlerinin ilk kez *Cylindromyia bicolor*'un (Olivier) (Diptera: Tachinidae) konukçusu oldukları belirlenmiştir.

INTRODUCTION

The brown marmorated stink bug (BMSB) (*Halyomorpha halys* (Stål) (Heteroptera: Pentatomidae) is native to East Asia, but has become invasive in many regions of the world (Haye et al. 2015). *H. halys* was first detected in Europe and North America in the 1990-2000s, and later spread to all European countries (Haye et al. 2015). *H. halys* was first identified in Artvin, Türkiye in 2017 (Gokturk and Tozlu 2019).

H. halys is a highly polyphagous pest that feeds on over 170 plant species, including many cultivated fruit trees, ornamental plants, row crops, vegetables, and wild host plants (Leskey and Nielsen 2018). Nymphs and adults of

H. halys cause quality and yield loss in plants (Nielsen and Hamilton 2009).

To date, 18 species of hymenopteran endoparasitoids have been reported to parasitize eggs of *H. halys* (Abram et al. 2014). The best known of these are *Anastatus bifasciatus* (Geoffroy) (Hymenoptera: Eupelmidae), *Ooencyrtus telenomicida* (Vassiliev) (Hymenoptera: Encyrtidae), *Trissolcus japonicus* (Ashmead), *T. cultratus* (Mayr), *T. semistriatus* (Nees), and *T. mitsukurii* (Ashmead) (Hymenoptera: Scelionidae) (Haye et al. 2015, Zhang et al. 2017, Stahl et al. 2019). While most parasitoids target the egg stage of *H. halys*, *Trichopoda pennipes* targets the adults (Joshi et al. 2019).

Some Pentatomidae species (Heteroptera) are hosts in species of the family Tachinidae. The tachinids as a family have associations with a wide range of hosts, with nearly 10.000 species so far described (Irwin et al. 2003). Fauna Europaea (Tschorsnig et al. 2004) lists 875 species for Europe and 382 for Scandinavia, 358 for Sweden, 279 for Finland, and 200 for Norway. Türkiye has 94 species of Tachinidae (Kara and Tschorsnig 2003). This family of flies, 2-20 mm in size, are typically black, grayish dusted, and very bristly. All tachinids have an enlarged subscutellum (Tschorsnig et al. 2004).

All known species of tachinids develop as obligate endoparasitoids in many insect orders (Pape et al. 2011) and therefore have great ecological importance for biological control studies (Stireman et al. 2006). Tachinid flies are among the most important natural enemies of many arthropods and play a significant role in regulating pest populations. Tachinid flies mostly attack the larvae of Lepidoptera feeding on foliage. In addition, some species of the orders Heteroptera, Coleoptera, and Hymenoptera can also parasitize (Stireman et al. 2006).

The family Tachinidae has 4 subfamilies: Dexiinae, Exoristinae, Phasiinae, and Tachininae. Although the subfamily Phasiinae is the smallest, it has more than 600 described species belonging to about 100 genera (El-Hawagry 2018). The hosts of the species of the subfamily Phasiinae are mostly Hemipteran adults (Tschorsnig and Richter 1998).

The genus *Cylindromyia* (Meigen 1803), which is included in the subfamily Phasiinae and the tribe Cylindromyiini (Diptera: Tachinidae), is represented by 149 species (Herting 1983, Herting and Dely-Draskovits 1993, Tschorsnig, 2017). The genus *Cylindromyia* is distinguished from other Cylindromyiini genera by a sclerotized postmetacoxal area, absent or strongly reduced palpus, presence of a preapical posteroventral seta on the hind tibia, and concealed abdominal sternites (Tschorsnig and Richter 1998). The tribe Cylindromyiini tribe is distinguished by autapomorphic characters, such as tergite and sternite 7 into a hook-like complex in females; division of the hypandrium into a basal horse-shoe-shaped or arc-shaped part and a movable complex

connected to the pregonite and postgonite, and a simple aedeagus (Tschorsnig 1985).

The aim of this study is to detect adults parasitoids of *Halyomorpha halys*.

MATERIAL AND METHODS

The specimens of *H. halys* and *C. bicolor* were obtained during routine local fauna screenings in Artvin. In total, 500 specimens of *H. halys* and 2 specimens of *C. bicolor* were collected and examined. Adults of *H. halys* were collected from pheromone traps and the surface of plants. *C. bicolor* was collected on *H. halys* adults using a net. After collection, the flies were killed with ethyl acetate and brought to the laboratory and prepared using standard museum methods. The specimens were examined for external morphological features and illustrations were prepared using an Olympus microscope. *C. bicolor* was identified using the keys by Tschorsnig and Richter (1998) and Cerretti (2010).

The specimens deposited in the Arthropod Collection of the Department of Entomology of Artvin Coruh University.

RESULTS AND DISCUSSION

During these surveys, a parasitoid tachinid was found to parasitize an adult of *H. halys* in Artvin on June 5, 2021. During our exploration for natural enemies of *H. halys*, we discovered one adult parasitoid in Türkiye, which was a new species, *Cylindromyia bicolor* (Olivier 1812) (Diptera: Tachinidae). The association between *C. bicolor* and *H. halys* is reported here for the first time. Moreover, this is the first record of this tachinid in northern Türkiye (Artvin).

Subfamily: Phasiinae

Tribe: Cylindromyiini

Cylindromyia (Ocyptera) bicolor (Olivier 1812)

Synonyms. *Ocyptera coccinea* (Meigen 1824),
Ocyptera pentatoma (Robineau-Desvoidy 1830).

Material Examined: 05.VI.2021, 1♀, 09.VI.2021, 1 ♂: N 41°27'13", E 41°38'30", 290 m. Distribution in Türkiye: Samsun (Herting 1983), Black Sea Region (Işık et al.1987), Tokat (Kara and Alaoglu 1999, Lekin et al. 2016b), Zonguldak (Korkmaz 2007), Bartın-Karabük (Atay 2017), Çorum (Uysal 2018), Aydın-Muğla (Lutovinovas et al. 2018).

Distribution in The World: Caucasus- Central-West Asia (Herting and Del-Draskovits 1993, Gilasian et al. 2013), Romania (Soltesz et al. 2016), Bulgaria-Serbia (Hubenov 2015), East-North-South-West Europe (Tschorsnig et al. 2004), Türkiye (Kara and Alaoglu 1999, Korkmaz 2007, Lekin et al. 2016, Kara and Tschorsnig 2003, Tschorsnig 2017).

Diagnosis: Antenna shorter than face; frontal vitta black; vibrissa 0.7–0.8 times as long as face; lateral (outer) vertical setae absent; back of head with a few scattered black setulae dorsally; proepisternum bare; scutellum black, with 3 pairs of marginal setae; posterior supra-alar seta absent; katepisternum with 2 setae; basicosta black; legs black; mid tibia with 2 anterodorsal setae; hind tibia without posteroventral setae; abdominal tergites 4–5 yellowish-orange; tergites 2–4 with a pair of dorsal discal setae (sometimes with 1 seta, rarely absent in female); male sternite 5. Abdomen red to the tip (with the exception of a black spot at the base). Body length 11–14 mm. Compound eyes are large and dark brown. Wings are partially smoked. Calyptra of adults is large and white (Figure 1).



Figure 1. *Cylindromyia bicolor* male

Key to the Species of Cylindromyia Bicolor Meigen

The following identification key basically follows Herting (1983) with the inclusion of the newly described specimen.

- Vibrissa stronger, more than half times as long as face..... 2
- Abdomen red to the tip (with the exception of a black spot at the base). Tergites 2–4 almost always with

discal bristles. Body length 11–14 mm*C. bicolor* Oliv.

According to observations by Herting (1983), the females lay their eggs on their hosts, usually one egg per adult. Later, the hatched larvae enter the interior of the adult's abdomen and develop there. They pupate on the ground after winter. However, according to our observations, the female of tachinidae directly lay an egg in the adult of *H. halys* (Figure 2).



Figure 2. *C. bicolor* laying an egg in *H. halys* (photographed in the field)

CONCLUSION

In order to benefit from parasitoids in biological control programs, their existence in nature should be revealed and the relationship between host and parasitoids should be explained. In the world Türkiye (Borçka; Artvin), *C. bicolor* is newly detected to parasitize adults of *H. halys*. New studies should be conducted to evaluate the role of this parasitoid species in the biological control of *H. halys* in Türkiye. A predictive phylogeny of *C. bicolor* is needed for future predictive studies in biological control. Populations of *C. bicolor* are becoming established in new areas and this should be continued, including release strategies, augmentation, conservation, and monitoring.

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