

## New a Species as Parasitoid of the Apple Ermine Month *Yponomeuta malinellus* Zeller, 1838 (Lepidoptera: Yponomeutidae) in the Çoruh Valley, Erzurum Province, Türkiye

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### ABSTRACT

The current study aimed to determine parasitoids of *Yponomeuta malinellus* Zeller, 1838 (Lepidoptera: Yponomeutidae) in apple trees in the Çoruh Valley, Erzurum Province, Türkiye during 2019-2020 summer. The parasitoids associated with *Y. malinellus* were reared in a laboratory, with a total of 137 individual parasitoids emerging from family Ichneumonidae (Hymenoptera). Among the identified species *Tricetes facialis* (Thomson, 1887), *Itoplectis tunetana* (Schmiedeknecht, 1914) and *Pimpla turionellae* (Linnaeus, 1758) were determined as pupal parasitoid. Of these, *Tricetes facialis* has been obtained from *Y. malinellus* our country first time and also is new for the Turkish Ichneumonidae fauna. In this study of the Çoruh Valley, the mean parasitism rate was %27.4.

**Keywords:** *Yponomeuta malinellus*, apple, parasitoid, Çoruh Valley, Türkiye.

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## INTRODUCTION

*Yponomeuta malinellus* Zeller, 1838 (Lepidoptera: Yponomeutidae), the apple ermine moth is native throughout the temperate zone of the Palaearctic region (Balachowsky, 1966).

*Yponomeuta malinellus* is belonging to order Lepidoptera and family Yponomeutidae (Gershenzon, 1986). "The larvae of pest vary as they grow from dark grey to yellowish grey, and the size of black spots changes. Full grown larvae vary from 18 to 25 mm. The white cocoons are arranged neatly side by side in a web beneath a leaf or branch of tree (CFIA, 2006).

The adult has pure white fore wings (sometimes with a slight grey suffusion at the centre), with black dots. The terminal cilia are normally slightly grey but can be pure white. It has a white head with white palps (CFIA, 2006).

The larvae of the apple ermine moth, gnawing leaves. It can defoliate apple trees and negatively impact fruit production for several years following an outbreak (Anonymous, 2020).

This pest has spread all over the world (Azerbaijan, Armenia, Canada, China, Czech Finland, France, Georgia, Germany, Kazakhstan, Iran, Italy, Korea, Japan, Lithuania, the Netherlands, Pakistan, Sweden, Turkey, Ukraine, Uzbekistan and the United Kingdom (Gershenzon, 1970; Pustovarov, 1980; Mamedov & Makhmudova-Kurbanova, 1982; Arduino, Cianchi, & Bullini, 1983; Kuhlmann, Carl, & Mills, 1988; Unruh, Congdon, & La Gasa, 1993; Jonaitis, 2001; Gençer, 2003; Hrudová, 2003; Lee & Pemberton, 2005; CFIA, 2006; Kimber, 2011; Alaserhat, 2019).

The pest's parasitoids have attracted the attention of many researchers. Many studies have been conducted in the former Soviet Union and other countries, especially Europe (Beirne, 1943; Junnikkala, 1960; Friese, 1963; Affolter & Carl 1986; Dijkerman, Groot, & Herrebut, 1986; Kuhlmann, 1996). There are studies on the pest in our country, but it is not sufficient (İren, 1960; Koçak, 1989; Bulut & Kılınçer 1989; Erol & Yaşar, 1996; Tozlu, Özbek, & Gültekin, 2000; Gençer, 2003; Çoruh, 2005; Çoruh & Özbek, 2008; Çoruh, 2010; Çoruh, 2016). The damage level of the apple ermine moth is at significant levels Amasya, Ankara, Erzurum, Manisa and Van (Narmanlioğlu & Çoruh, 2017).

Çoruh Valley is a very important transition zone that meets %97 of the fruit needs region. Naturally, there are many pests and diseases in the (Güçlü, Hayat, Özbek, Çalmaşur, & Pekel, 1998). *Yponomeuta malinellus* is also considerable pest of the region. In this case, the pest's parasitoids are very important. However, the number of studies on this subject is limited in our country (İren, 1960; Gençer & Doğanlar, 1996; Gençer, 2003; Narmanlioğlu & Çoruh, 2017).

The aim of this study is to identify the new natural enemies of *Yponomeuta malinellus* and to investigate the activities of these beneficial species.

## MATERIAL AND METHODS

### Study area

Our investigations were carried out between 2019 and 2020. During this period 137 parasitoid specimens were made in the summers in the Çoruh Valley (Erzurum Province)

The Çoruh Valley has a special importance with its extraordinary fauna and flora, thanks to its climate. Due to its rich biodiversity, the region has been selected as one of the top 25 endangered ecological zones by Global Environment Fund (Aslantaş, Sönmez, & Demir, 2011).

The climate of the Çoruh Valley is particularly suitable for fruit production. Consequently, there are many types and numbers of fruit trees in valley (Karlıdağ & Eşitken, 2006) (Table 1).

Table 1. Fruit types and production quantities grown in İspir (Anonymous, 2022 )

Fruit	Produce amount (da/kg)	Fruit	Produce amount (da/kg)
Pear	32	Cherry	27
Quince	25	Peach	18
Walnut	34	Sour cherry	25
Apple	174	Mulberry	63
Plum	24	Cranberry	13
Apricot	30	Grape	850

2022 Statistical Information System (Iva-lbs) 3rd Term Finalized Data

İspir which is region settled in the Çoruh Valley, and its surroundings are located in the transition zone between Eastern Anatolia and the Eastern Black Sea Region. The Kaçkar Mountains in the north of the Middle Çoruh Valley and the Mescit Mountains in the south serve as a set that prevents the continental climate of Eastern Anatolia from directly affecting the region (Köse, 1991).

### Sampling and collection method

A total of 560 *Yponomeuta malinellus* larvae were collected by hand from trees in study area (Fig. 1).



Figure 1. Map of study area.

Samples were collected from different apple orchards (Fig. 2) and different altitude (1220 m, 1229 m, 1239 m.) Samples were taken to represent 50% of the culturally cultivated apple orchards. The common apple trees were *Malus pumila* Mill. (Fig. 3). *Malus pumila* is a highly important commercial crop in the valley.



Figure 2. Pictures of study areas.



Figure 3. Infestation of *Yponomeuta malinellus* larvae on *Malus pumila*.

Each sample was placed in a box with clean leaves without any other harmful species apple leaves and covered with cheesecloth (Fig. 4). Cultured larvae were reared in a laboratory at ambient temperature to obtain parasitoids and were placed in groups of 10 in boxes (10 by 20 cm) for moth or parasitoid emergence. Periodically, withered leaves were replaced with fresh ones and checked every 1 or 2 days for 4 to 5 weeks. Emerging adults of parasitoids in the boxes were transferred to a killing jar.

Parasitoids identifications was verified by comparison with the preserved specimens in the Entomology Museum, Erzurum, Türkiye (EMET). The unidentified specimens were determined by specialists (Dr. Matthias Riedel and Dr. Saliha Çoruh).

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Figure 4. Rearing boxes.

## RESULTS

All the samples obtained from cultured larvae in the laboratory. These parasitoids are belonging to orders Hymenoptera. Among 137 samples, three parasitoid species *Itopectis tunetana* (Schmiedeknecht, 1914), *Pimpla turionellae* (Linnaeus, 1758) and *Tricetes facialis* (Thomson, 1887) belong to the family Ichneumonidae (Hymenoptera) (Table 2 and 3). *Tricetes facialis* is reported for the first time for the Turkish fauna. In this study of the Çoruh Valley, the mean parasitism rate was %27.4. The present study increases the known Turkish Ichneumonidae to 1440 species.

Table 2. List of the parasitoids obtained from the *Yponomeuta malinellus* (2019-2020).

Parasitoid species	Number of individual parasitoids
<i>Itopectis tunetana</i> (Schmiedeknecht, 1914)	48
<i>Pimpla turionellae</i> (Linnaeus, 1758)	67
<i>Tricetes facialis</i> (Thomson, 1887),	22
Total	137

Table 3. Different data of parasitoids.

Names of Taxa	NH	Host food	ZR	Associated (plants)
<i>Itopectis tunetana</i>	15	<i>Vaccinium uliginosum</i> , <i>Vitis vinifera</i>	EP, E, WP	-
<i>Pimpla turionellae</i>	144	<i>Abies alba</i> , <i>A. sachalinensis</i> , <i>Beta vulgaris</i> , <i>Brassica oleracea capitata</i> , <i>Euonymus europaeus</i> , <i>Fagus sylvatica</i> , <i>Hedya pruniana</i> , <i>Larix decidua</i> , <i>Malus domestica</i> , <i>Medicago sativa</i> , <i>Oryza sativa</i> , <i>Pinus contorta</i> , <i>P. resinosa</i> , <i>P. sylvestris</i> , <i>Prunus avium</i> , <i>P. padus</i> , <i>Quercus pedunculata</i> , <i>Ribes nigrum</i> , <i>Ribes rubrum</i> , <i>Spina-cia oleracea</i> , <i>Vitis vinifera</i>	EP, E, NEAR, OCC, ORR, WP	<i>Adonis vernalis</i> , <i>Alnus glutinosa</i> , <i>Anethum graveolens</i> , <i>Anthriscus sylvestris</i> , <i>Carpinus betulus</i> , <i>Chae-rophyllum aromaticum</i> , <i>C. bulbosum</i> , <i>Corylus avellana</i> , <i>Daucus carota</i> , <i>D. carota sativus</i> , <i>Epilobium angustifolium</i> , <i>Euphorbia nicaeensis</i> , <i>E. virgate</i> , <i>Fraxinus excelsior</i> , <i>Heracleum sphondylium</i> , <i>Juniperus communis</i> , <i>Malus domestica</i> , <i>Peucedanum oreoselinum</i> , <i>Picea excels</i> , <i>Prunus cerasifera</i> , <i>Quercus robur</i> , <i>Sambucus nigra</i> , <i>Urtica dioica</i>
<i>Tricetes facialis</i>	2	-	E, WP	-

Number Host (NH): Zoogeographical regions (ZR): E: Europe, EP: Eastern Palearctic, NEAR: Nearctic Region, OCC: Oceanic, WP: Western Palaearctic, ORR: Oriental.



## DISCUSSION

This study was conducted in the same region in different localities between the years 2019-2020 to determine the parasitoids of harmful species in apple orchards.

A similar study to this study was carried out by the same authors in the same region before, and six parasitoid species were reared from *Yponomeuta malinellus*. Among these parasitoids, four species, *Diadegma armillatum* (Gravenhorst) *Triclistus tricarinatus* (Holmgren) *Itopectis tunetana* (Schmiedeknecht) and *Itopectis maculator* (Fabricius) (Ichneumonidae: Hymenoptera); one species, *Bessa parallela* (Meigen) (Tachinidae: Diptera) and one species, *Habrobracon concolorans* (Marshall) (Braconidae: Hymenoptera) Narmanlioğlu & Çoruh, 2017).

*Y. malinellus* have been reported in previous studies in Turkey (İren, 1960; Junnikkala, 1960; Dijkerman, De Groot, & Herrebout, 1986; Kuhlmann et al., 1988; Gençer & Doğanlar, 1996; Gençer, 2003; Narmanlioğlu & Çoruh, 2017).

This study was conducted in the same region in different lodges between the years 2015-2016. In 2019, the harmful damage increased again and the study was carried out again.

Similar results were observed in our previous study on parasitoid, assemblages of ectophagous Lepidoptera in apple orchard situated in Coruh Valley (Narmanlioğlu & Çoruh, 2017).

Parasitoids of *Yponomeuta malinellus* have been reported in previous studies in Turkey (İren, 1960; Junnikkala, 1960; Dijkerman et al., 1986; Kuhlmann et al., 1988; Gençer & Doğanlar, 1996; Gençer, 2003; Narmanlioğlu & Çoruh, 2017).

3 different parasitoid species were identified in this study:

*Itopectis tunetana* is a species of Hymenoptera in the family ichneumon wasps. This is emerged from pupa of the Lepidoptera and has a solitary lifestyle. The host density are quite high (Yu, van Achterberg, & Horstmann, 2016). This has been also obtained from *Y. evonymella* in Çoruh Valley on our previous study (Çoruh, 2005; Çoruh & Özbek, 2018; Narmanlioğlu & Çoruh, 2017). Again, it is reported that this was obtained from different *Yponomeuta evonymella*, *Y. malinellus*, *Y. padellus*, *Y. rorellus* by many researchers (Özdemir & Kılıncı, 1990; Erol & Yaşar, 1996; Gençer, 2003; Özdemir & Özdemir, 2002; Çoruh & Özbek, 2008; Çoruh, 2016). *Itopectis tunetana* has many different known hosts (*Acrolepiopsis assectella*, *Aleiodes gastritor*, *Anarsia lineatella*, *Ancyliis sativa*, *Cacoecimorpha pronubana*, *Choreutis nemorana*, *Eupoecilia ambiguella*, *Lobesia botrana*, *Pandemis heparana*, *Parapandemis chondrillana*, *Plutella xylostella*, *Tebenna bjerckandrella*, *Tortrix viridana*, *Yponomeuta malinella*) worldwide (Constantineanu & Pisica, 1977; Talebi et al., 2005). It was obtained from %35.04 of the parasitized larvae (48 of 137).

*Pimpla turionellae* (Linnaeus, 1758) has been an important parasitic Hymenoptera species used in biological control for continuous management of pest (Gül, Özlük, & Özkorkmaz, 2013). This species emerged from larva/nymph, pupa, endoparasitoid, oviposit in larva/nymph, prepupa has a solitary lifestyle. The host density and the

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number of associated plants are quite high (Yu et al., 2016). This species has obtained from 144 different hosts worldwide. It has also obtained from *Archips rosana*, *Archips* spp., *Cydia* sp., *Cydia pomonella*, *M. franconica*, *M. neustria*, *Yponomeuta cagnagella*, *Y. evonymella*, *Y. malinellus*, *Y. padellus*, *Y. rorellus* (İren, 1960; 1977; Soydanbay, 1978; Kansu & Uğur, 1984; Kansu, Kılınçer, Uğur, & Gürkan, 1986; Özdemir & Kılınçer, 1990; Öncüler, 1991; Kolarov, 1995; Erol & Yaşar, 1996; Özdemir & Özdemir, 2002; Çoruh & Özbek, 2008, Çoruh, 2016). *Pimpla turionellae* is used in biocontrol of *Choristoneura fumiferana*, *Euproctis chrysorrhoea*, *Lymantria dispar*, *Malacosoma disstria*, *Operophtera brumata*, *Orgyia pseudotsugata* and *Rhyacionia buoliana* (Yu et al., 2016). It was obtained from %48.91 of the parasitized larvae (67 of 137).

Piekarska-Boniecka, Rzańska-Wieczorek, Siatkowski, & Barczak (2022) found that *I. maculator* and *P. turionellae* in the apple ermine moth parasitoid complex.

*Tricetes facialis* (Thomson, 1887) is a rare species. The is emerged from pupa, endoparasitoid, oviposit in larva/nymph and has a solitary lifestyle. The associated plant is *Oryza sativa* L. (Yu et al., 2016). It shows only in Finland, Sweden, Ukraine and Czechoslovakia distribution in the world. So far it has been only *Yponomeuta malinellus* and *Yponomeuta padella* in the world (Yu et al., 2016). It has been obtained from *Y. malinellus* our country first time with this study. Therewithal, *Tricetes facialis* is a new record for the Turkish fauna. It caused %16.06 mortality of the specimens collected in this study (22 of 137).

The number of known Ichneumonidae species is currently 1439 (Doğru, 2022; İneçiklioğlu, 2022). The present study increases the known Turkish Ichneumonidae to 1440 species.

When all these results are evaluated, it can be said that, the highest percentage of parasitism was recorded *Pimpla turionellae* in apple trees.

In this study, a new parasitoid of *Y. malinellus* was found the Çoruh Valley and the density of parasitoids-has been recorded.

We suggested that the list of parasitoids infesting larvae and pupae of *Y. malinellus* in Turkey is not completed yet. Studies have to be extended in the main fruit growing regions and Coruh Valley clarify parasitoid role as a mortality factor in various ecological conditions.

The study will help future laboratory and field studies to be carried out on this subject.

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