



## New parasitoid records of *Arge rosae* (Linnaeus, 1758) (Hymenoptera: Argidae) from Diyarbakır province: *Tetrastichus hylotomarum* (Bouché, 1834) (Hymenoptera: Eulophidae) and *Boethus thoracicus* (Giraud, 1872) (Hymenoptera: Ichneumonidae)

Diyarbakır il'inden *Arge rosae* L. (Hymenoptera: Argidae)'nin yeni kayıt parazitoidleri; *Tetrastichus hylotomarum* (Bouché, 1834) (Hymenoptera: Eulophidae) ve *Boethus thoracicus* (Giraud, 1872) (Hymenoptera: Ichneumonidae)

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### Ö Z E T / A B S T R A C T

**Aims:** *Arge rosae* called rose sawfly (Linnaeus, 1758) (Hymenoptera: Argidae) is one of the most important harmful insect of roses around the world. This pest is also causes significant damage on rose plants growing in Diyarbakır province of Türkiye. The aim of this study was to determine the parasitoid(s) of the *A. rosae* on roses in Diyarbakır province.

**Methods and Results:** The study was conducted between 2017-2018 in established rose garden based on local varieties (pink, red, white, and yellow color) and Isparta variety in Diyarbakır province of Turkey. The cocoons (pupae) of rose sawfly, *A. rosae*, were collected from rose garden from March to October and was brought to the laboratory for rearing. Rose sawfly cocoons brought to the laboratory were cultured in plastic containers covered with narrow mesh gauze. As a result of this study, two parasitoid species, *Tetrastichus hylotomarum* (Bouché, 1834) (Hymenoptera: Eulophidae) and *Boethus thoracicus* (Giraud, 1872) (Hymenoptera: Ichneumonidae) were obtained from reared cocoons of rose sawfly and identified according to morphological and biological characteristics.

**Conclusions:** Two parasitoid species of *A. rosae* were determined. *Tetrastichus hylotomarum* (Hymenoptera: Eulophidae), as the parasitoid of *A. rosae*, was recorded for the first time in Türkiye with this study. Detailed studies are required on the distribution areas, parasitization rates and activities of these two new natural enemies in future studies. In particular, studies are focused on biological and biotechnical methods which do not leave residues on nature.

**Significance and Impact of the Study:** *A. rosae* is an important pest that causes economic damage to rose plants. It is thought that *A. rosae* determined in this study may have the potential to be used as a biological control agent for two parasitoid species.

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## INTRODUCTION

Rose cultivation in Diyarbakır has been practiced for about 5.000 years. Diyarbakır has important local rose varieties (Maral, 2010). Rose cultivation is gaining importance again in Diyarbakır. In literatures, there are many disease and insect species that cause yield loss in rose plants. (Strom et al., 1997; Horst and Cloyd, 2007; Hazar and Baktir, 2014; Bolu et al., 2021). Many insect species have been reported to cause damage to different parts of the rose plant. Amongst the rose pests, *Arge rosae* (Hymenoptera: Argidae) causes significant damage to the rose plant in worldwide including Diyarbakır province of Türkiye (Sharifi et al., 2012; Khosravi et al., 2015; Bolu et al., 2021).

The Ichneumonidae is a widespread parasitoid family attacking a large host spectrum, including species of Lepidoptera, Diptera, Coleoptera and Hymenoptera. This parasitoid group is one of the largest insect families and represented by 39 subfamilies, nearly 1.500 genera and about 25.000 described species, of which about 1.200 species were recorded in Türkiye (Yu et al., 2016). The majority of Eulophidae are primary parasitoids of concealed larvae, especially those inhabiting leaf mines. The best known species attack Lepidoptera, but many species parasitize larvae of other insects living in similar concealed situations. Other eulophids attack various gall-forming species of insects, eriophyid mites and also gall-forming nematodes (Berg et al., 1990). The Eulophidae family includes important common parasitic Hymenoptera species. Hosts for Tetrastichinae are found in 100 families of insects in 10 different order (LaSalle, 1994). The aim of this study was to determine the parasitoids of the harmful rose sawfly insect *Arge rosae* (Hymenoptera: Argidae) on roses in Diyarbakır, Türkiye.

## MATERIALS and METHODS

### *Nature and laboratory studies*

The study has been carried out between 2017-2018 in Diyarbakır and established rose garden based on local varieties (pink, red, white, and yellow color) and Isparta variety.

The cocoons (pupae) of *A. rosae* named rose sawfly were collected from rose garden from March to October and was brought to the laboratory for rearing. Rose sawfly cocoons brought to the laboratory were cultured in plastic containers covered with narrow mesh gauze. The cocoons were reared in laboratory at a temperature of  $26\pm 1^{\circ}\text{C}$ , average humidity of  $65\pm 5\%$ , and lighting of 3.500 lux for per day 16:8 (L :D). The

emerged the parasitoids adults were counted and recorded.

Host (*A. rosae*) identification was made by the Prof. Dr. Önder Çalmaşur (Atatürk University, Faculty of Agriculture, Department of Plant Protection). Parasitoids: *Tetrastichus hylotomarum* (Hymenoptera: Eulophidae) identification was made by Prof. Dr. Lütfiye Gençer (Sivas Cumhuriyet University, Faculty of Sciences, Department of Biology, 58140, Sivas, Türkiye) and *Boethus thoracicus* (Hymenoptera: Eulophidae) identification was made by Dr. Oleksandr Varga (I. I. Schmalhausen Institute of Zoology, NAS of Ukraine, Bogdan Chmielnitski St. 15, 01630 Kyiv, Ukraine) using keys of Graham (1991) and Kasparyan (1973) respectively.

## RESULTS and DISCUSSION

As a result of this study, 2 parasitoid species were obtained from the cocoons of *A. rosae*: *Boethus thoracicus* (Hymenoptera: Ichneumonidae) and *Tetrastichus hylotomarum* (Hymenoptera: Eulophidae). Both species are firstly recorded as parasitoids of *A. rosae* in Diyarbakır and Türkiye. Furthermore, *Boethus thoracicus* is the world's first parasitoid record of *A. rosae*.

### *Arge rosae* (Linnaeus, 1758) (Hymenoptera: Argidae) (Figure 2)

**Distribution in world:** Bulgaria (Margina et al., 1999), Persia (Sahragard and Heydari, 2001; Sharifi et al., 2012; Khosravi et al., 2015)

**Distribution in Türkiye:** Antalya, Diyarbakır, Isparta, İstanbul, İzmir, Manisa (Zümreoğlu, 1972; Oğurlu et al., 1996; Özbek and Çalmaşur, 2005; Demirözer and Karaca, 2011; Bolu et al., 2021; Baki et al., 2021).

**Host plants:** *Rosa canina* Linnaeus, 1753, *R. damascena* Miller (Margina et al., 1999; Özbek and Çalmaşur, 2005; Bolu et al., 2021).

**Material examined:** 10♂♂, 10♀♀ (multiple samples), Locality: Diyarbakır (Sur district),  $37^{\circ}53'31.8''\text{N}$ ,  $40^{\circ}16'22.2''\text{E}$ , 666 m. As a result; it was determined that the NC of turfgrass can be estimated with similar prediction performance using both hand-held NDVI meter and hand-held chromameter in a more objective and economic way.



Figure 1. Male (left) and female (right) of *Arge rosae* (Scale bar = 1 mm)

*Arge rosae* is one of the pests (Figure 1) which causes economic damage to roses (Sharifi et al., 2012; Bolu et al., 2021; Baki et al., 2021). This damage occurs in two ways. The first is that females injure new shoots with their ovipositors to lay eggs. As a result of this injury, the shoots dry up (Figure 2a). The second damage is caused by the larval stages. The larval stages of the pest feed on the leaves of the rose plant, and as a result of this feeding, sometimes only the main vein of the

leaves remains (Figure 2b). In literature, there are many studies on control of the this pest species in the world as well as in our country. In particular, studies are focused on biological and biotechnical methods to leave residues on nature (Baki et al., 2021). In this purpose, the aim of this study was to determine the natural enemies of the pest. As a result, 2 parasitoid species of *A. rosae* were recorded.

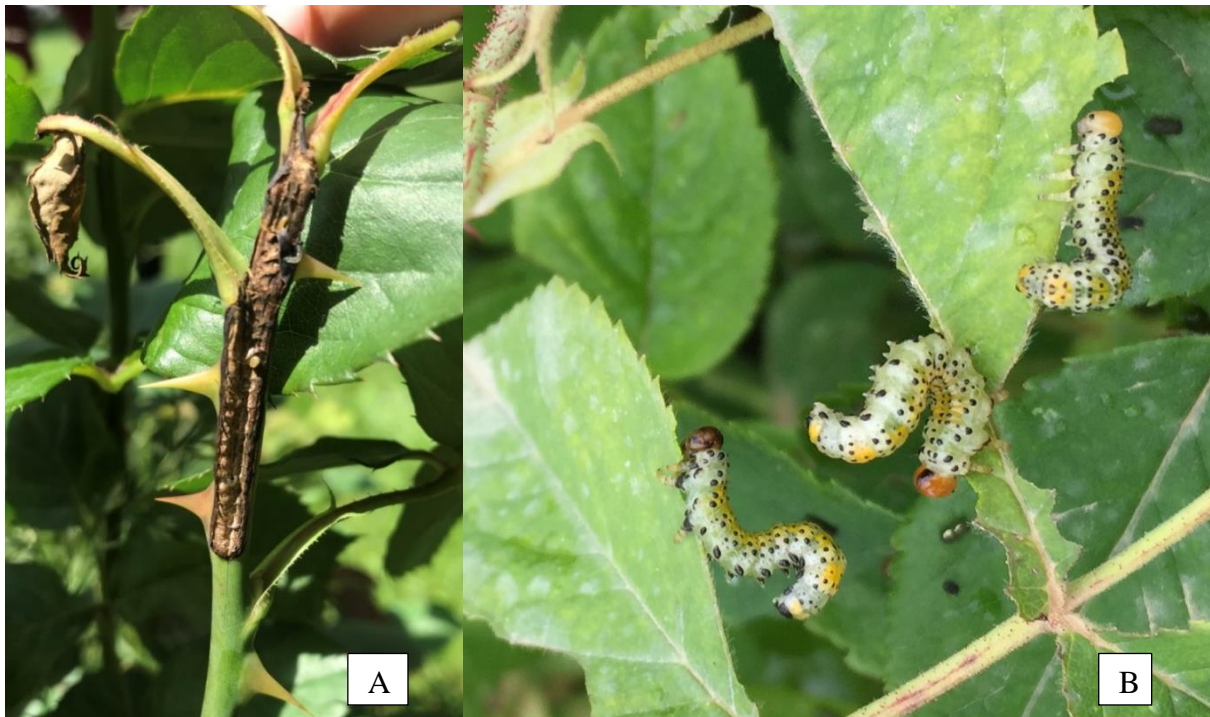


Figure 2. Damage caused by *Arge rosae* laying eggs in the shoot (A) and feeding damage of its larvae on the leaf (B)

**Recorded parasitoids in Turkey:** No record.

**Recorded parasitoids in the world:** *Ischnus migrator* (Fabricius, 1775), *Monoblastus brachyacanthus* (Gmelin, 1790) (Hymenoptera: Ichneumonidae) (Yu and Horstmann, 1997); *Eulophus incubitor* Bouché, 1834, *Eulophus nigrator* Bouché, 1834, *Tetrastichus atrocoeruleus* Nees, 1834, *Tetrastichus hylotomarum* (Bouché, 1834) (Hymenoptera: Eulophidae) (Anonymous, 2022).

***Boethus thoracicus* (Giraud, 1872) (Hymenoptera: Ichneumonidae) (Figure 3)**

**Distribution in world:** Albania, Armenia, Azerbaijan, Bulgaria, France, Hungary, Israel, Italy, Kazakhstan, Poland, Russia: Saratov Oblast, Volgograd Oblast, Spain,

Switzerland, Tajikistan, Türkiye, Ukraine (Yu et al., 2016).

**Distribution in Türkiye:** Burdur (1♂) (Gürbüz and Kolarov, 2006); Elazığ (1♀) (Yaman, 2014).

**Recorded hosts:** *Arge berberidis* Schrank, 1802, *A. nigripes* (Retzius, 1783) and *A. rustica* (Linnaeus, 1758) (Kasparyan, 1973; Scaramozzino, 1991). *Cydia caryana* (Fitch, 1856) (Tortricidae) (Dalla Torre, 1902).

**New record host from Diyarbakır:** In the present study *Arge rosae* was recorded as a host of *Boethus thoracicus* for the first time.

**Material examined:** 5♂♂, 7♀♀ 26.III.2018; 4♂♂, 8♀♀ 16.IV.2018; 1♂ 30.IV.2018, Locality: Diyarbakır (Sur district), 37°53'31.8"N, 40°16'22.2"E, 666 m.



Figure 3. Female (left) and male (right) individual of *Boethus thoracicus* (Scale bar = 1 mm)

***Tetrastichus hylotomarum* (Bouché, 1834) (Hymenoptera: Eulophidae) (Figure 4-5)**

**Distribution in the world:** Bulgaria, (former) Czechoslovakia, France, Germany, Hungary, The Netherlands, Russia, Sweden and United Kingdom (Graham, 1991); Italy and Romania (Hansson & Schmidt, 2020).

**Distribution in Türkiye:** No record.

**Recorded hosts:** Reared from *Arge ochropus* (Gmelin, 1790), *A. pagana* (Panzer, 1798) *Arge rosae* (Hymenoptera: Argidae), *Athalia cordata* Audinet-Serville, 1823, *Cladius pectinicornis* (Geoffroy, 1785)

(Hymenoptera:Tenthredinidae), parasitizing host larvae and pupae (Graham, 1991; Anonymous, 2022).

**New record host for Diyarbakır:** In the present study *A. rosae* was recorded as a new host of *T. hylotomarum* for Diyarbakır. In addition, *T. hylotomarum* was recorded for the first time in Türkiye.

**Material examined:** 3♂♂, 3♀♀ 25.X.2017 (total 27 samples); 5♂♂, 5♀♀ 26.III.2018 (total 80 samples), Locality: Diyarbakır (Sur district), 37°53'31.8"N, 40°16'22.2"E, 666 m.

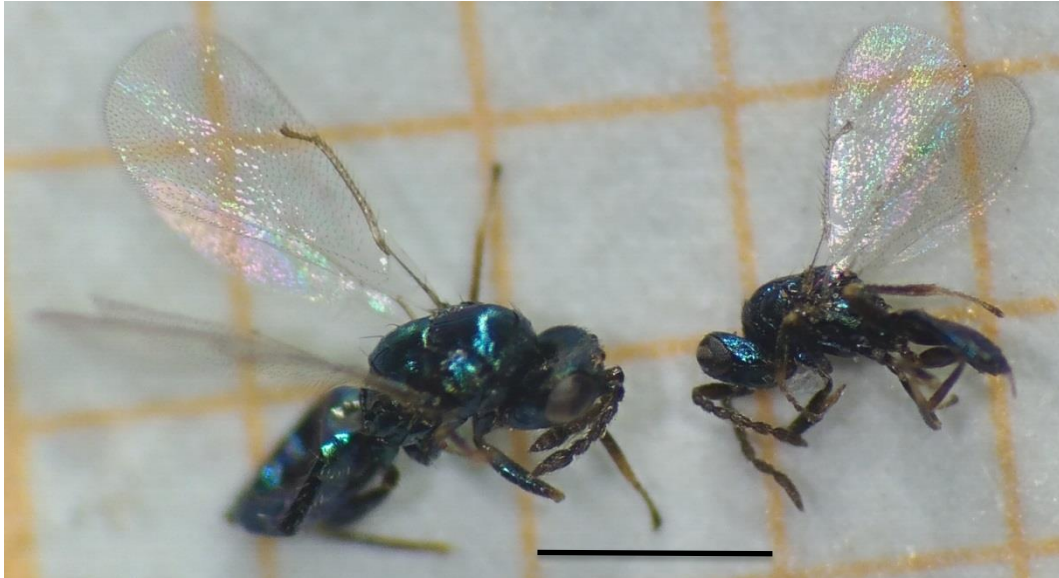


Figure 4. Adult stage of *Tetrastichus hylotomarum* (left female-right male) (Scale bar = 1 mm)



Figure 5. Adult stage of *Tetrastichus hylotomarum* emerging from the cocoons of *Arge rosae*

In conclusions, two parasitoid species of *Arge rosae* were determined and identified according to morphological and biological characteristics: eulophid species, *Tetrastichus hylotomarum*, and ichneumonid species, *Boethus thoracicus*. *T. hylotomarum* can be identified using following diagnostic features: Antennal scape as long as an eye and almost reach to vertex; first flagellomere as long as or slightly longer than pedicellus; clava slightly broader than third flagellomere and 2,0-2,9 times as long as broad, C2 slightly shorter than or at most as long as broad; gaster subcircular to short oval; ovipositor sheaths not reach apex of last tergite; mid and hind tibiae broadly

infusate, sometimes mainly black; body bright bluish-green, through blue-green to blue. Although this species was previously recorded in several European countries such as Bulgaria, (former) Czechoslovakia, France, Germany, Hungary, The Netherlands, Russia, Sweden and United Kingdom (Graham, 1991); Italy and Romania (Hansson & Schmidt, 2020), best of our knowledge this study is the first time reporting *T. hylotomarum* from Türkiye, increasing the number of Eulophidae in the fauna of the country. *B. thoracicus* can be identified using following diagnostic features: clypeus with two apical teeth; epicnemial and occipital carinae absent; propodeum without carinae; wings

darkened; female largely reddish-orange, while male has head and mesosoma mostly black. This species is a common parasitoids of the sawflies of the genus *Arge* Schrank, 1802: *A. berberidis*, *A. nigripes* and *A. rustica* (Kasparyan, 1973; Scaramozzino, 1991). In here, we expand our knowledge on the biology and host ranges of *B. thoracicus*: *A. rosae* was recorded as a new host of this parasitoid species.

Since *A. rosae* is a serious pest which causes economic damage to roses, there are many studies focused on the pest control in the world. Two parasitoid species of *A. rosae*, which were determined in this study, might have potential to be used as biological control agent. Detailed studies are, however, required on the distribution areas, parasitization rates and activities of these two new natural enemies in future studies. In particular, studies are focused on biological and biotechnical methods which do not leave residues on nature.

## ÖZET

**Amaç:** Gül yaprak arısı *Arge rosae* L. (Hymenoptera: Argidae) dünya genelinde yetiştiriciliği yapılan gül bitkisinin en önemli zararlılarından birisidir. Zararlı böcek Diyarbakır ilinde yetişen gül bahçelerinde önemli zararlara neden olmaktadır. Zararının doğal düşmanları üzerinde ülkemizde yapılan çalışma sayısı oldukça azdır. Bu çalışma ile Diyarbakır ilinde gül yaprak arısı *A. rosae*'nin parazitoidlerinin belirlenmesi amaçlanmıştır.

**Yöntem ve Bulgular:** Bu çalışma 2017-2018 yılları arasında yerel Diyarbakır çeşitleri (pembe, kırmızı, beyaz ve sarı renkli) ve Isparta gül çeşitlerinin yetiştirildiği gül bahçesinde gerçekleştirilmiştir. Gül yaprak arısı *A. rosae*'nin kokonları (pupalari) Mart-Ekim ayları arasında gül bahçesinden toplanarak laboratuvara getirilmiştir. Laboratuvara getirilen gül yaprak arısı kokonları, üzeri ince tül ile kapatılmış plastik kaplarda, 26±1°C sıcaklıkta, %65±5 bağıl nemde, 3500 lux ve günde 16 saat süreyle aydınlatmaya ayarlı laboratuvar koşullarında kültüre alınmıştır. Kutular kontrol edilerek çıkan parazitoid erginleri sayılarak kaydedilmiştir. Bu çalışma sonucunda *A. rosae*'nin kokonlarından 2 parazitoid türü olan *Boethus thoracicus* (Giraud, 1872) (Hymenoptera: Ichneumonidae) ve *Tetrastichus hylotomarum* (Bouché, 1834) (Hymenoptera: Eulophidae) elde edilerek morfolojik ve biyolojik özelliklerine göre teşhisleri yapılmıştır.

**Genel Yorum:** Bu çalışma ile *A. rosae*'nin iki parazitoid türü belirlenmiştir. *T. hylotomarum*'un *A. rosae*'nin parazitoidi olduğu ilk kez bu çalışma ile kaydedilmiştir. İleride yapılacak çalışmalarda bu iki yeni doğal

düşmanın yayılış alanları, parazitlenme oranları ve aktiviteleri hakkında detaylı çalışmalara ihtiyaç duyulmaktadır. Çalışmalarda özellikle doğada kalıntı bırakmayan biyolojik ve biyoteknik yöntemlere odaklanmaktadır.

**Çalışmanın Önemi ve Etkisi:** *A. rosae*, gül bitkilerinde ekonomik zarar veren önemli bir zararlıdır. Bu çalışmada belirlenen *A. rosae*'nin iki parazitoid türünün biyolojik kontrol etmeni olarak kullanılma potansiyeli olabileceği düşünülmektedir.

**Anahtar Kelimeler:** Gül yaprak arısı, *Arge rosae*, parazitoid, yeni kayıt, Türkiye.

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## CONFLICT OF INTEREST

The authors declares that there is no conflict of interest in the study.

## AUTHOR'S CONTRIBUTIONS

The contribution of the authors is equal.

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