



***Aphrodes diminuta* Ribaut, 1952 (Hemiptera: Auchenorrhyncha: Cicadellidae): a new record for Turkish leafhoppers**

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Abstract

In this study, specimens which belong to genus *Aphrodes* Curtis (Hemiptera: Cicadellidae: Aphrodinae), collected from Kastamonu provinces between 2016-2018 have been examined. Materials were collected by a sweeping net and a hand aspirator on the plants during daytime. Two species were found distributed in this area; *Aphrodes bicinctus* (Schrank, 1776), *Aphrodes diminuta* Ribaut, 1952. *Aphrodes diminuta* is a new record for the Cicadellidae fauna of Türkiye. The distribution of the species both in Türkiye and the world, the photographs of aedeagus and the coordinates of the specimens were given. In order to show the differences in aedeagus, photographs and measurements of the *A. makarovi* Zachvatkin, 1948 have also been added.

Key words: Cicadellidae, Türkiye, biodiversity, *Aphrodes diminuta*

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***Aphrodes diminuta* Ribaut, 1952 (Hemiptera: Auchenorrhyncha: Cicadellidae): Türkiye Cicadellidae faunası için yeni bir kayıt**

Özet

Bu çalışmada 2016-2018 yılları arasında Kastamonu'dan toplanan *Aphrodes* (Hemiptera: Cicadellidae: Aphrodinae) cinsine ait örnekler incelenmiştir. Materyal gün içinde bitkilerin üzerinden atrap ve aspiratör yardımıyla toplanmıştır. Çalışma alanında bu cinse ait 2 tür tespit edilmiştir: *Aphrodes bicinctus* (Schrank, 1776), *Aphrodes diminuta* Ribaut, 1952. *A. diminuta*, Türkiye Cicadellidae faunası için yeni bir kayıttır. Türlerin Türkiye ve Dünya'daki dağılımları, aedeagus fotoğrafları ve örneklerin toplandıkları lokalitelerin koordinatları verilmiştir. Aedeagusdaki farklılıkları gösterebilmek için *A. makarovi* Zachvatkin, 1948'nin fotoğrafları ve ölçümleri de eklenmiştir.

Anahtar kelimeler: Cicadellidae, Türkiye, biyolojik çeşitlilik. *Aphrodes diminuta*

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1. Introduction

Cicadellidae (Hemiptera), being one of the largest insect family, comprises more than 22000 described species is grouped into about thirty-six subfamilies [1]. It has 2300 species described in 338 genera in the Palearctic region [2]. According to Demir [3], Türkiye Cicadellidae fauna is considered to have 473 species. This number reached to 482 with the new records and new species in the following years [4, 5, 6, 7, 8, 9, 10, 11, 12].

Leafhoppers of the genus *Aphrodes* Curtis (Hemiptera: Cicadellidae: Aphrodinae) are common and widely distributed in the Palearctic [13]. They are not only vectors of some plant diseases [14] but are also evaluated as an appropriate indicator group in grassland communities [15]. Due to the similarity and variation in the morphological characters of coloration, size and aedeagus, some species were grouped under the name of *A. bicincta* species group. Nickel [16] suggested that this species group consists of 4 species; *A. bicincta* (Schrank, 1776); *A. makarovi* Zachvatkin, 1948; *A. diminuta* Ribaut, 1952 and *A. aestuarina* (Edwards, 1908). The genus *Aphrodes* comprise at least four species which are very similar morphologically and often live syntopically [17]. The genus *Aphrodes* is a taxonomically challenging taxon, different species are considered as the ecotype or subspecies of those species. For example, *A. aestuarina* has been accepted as a different ecotype of *A. makarovi* [18]. To solve problems in the species status Tishechkin [19]. used the the male vibrational signal in The Central European Russia *bicincta* species group by combining it with morphological characters and founded that *A. makarovi*, *A. bicincta* ve *A. centrorossica* (= *A. diminuta*) were separated from each other. Bluemel *et al.* [20]. used a combination of different criteria (vibration signals, mitochondrial DNA, aedeagus morphology) samples collected from Slovenia and U.K, and stated that *A. aestuarina*, *A. bicincta*, *A. diminuta* and *A. makarovi* are genetically and morphologically distinct. In the same study, morphological key to male *Aphrodes* was constituted according to the morphometric measurements of some body parts and morphological characters of the aedeagus (body length/ aedeagus length ratio and distance between aedeagal spines). In this study, the measurements mentioned above were carried out and it has been demonstrated that morphometric measurements of aedeagus are very useful parameters in the differentiation of the species.

According to the literature, *Aphrodes* fauna of Türkiye consists of 11 species. Oshanin [21] listed *A. bicinctus*, Dlabola [22, 23] listed *A. bifasciatus* (Linnaeus, 1758) and *A. histrionicus* (Fabricius, 1794) and Nast [24] *A. nigrinus* (Kirschbaum, 1868) from Türkiye. Lodos and Kalkandelen [25] and Özgen and Karsavuran [26] added 6 new records for this genus; *A. albiger* (Germar, 1821), *A. albifrons* (Linnaeus, 1758), *A. angusticeps* Emelyanov, 1964, *A. elongatus* (Lethierry, 1876), *A. trifasciatus* (Fourcroy, 1785) and *A. flavostriatus* (Donavan, 1799). Başpınar & Uygun [27] reported *A. makarovi* from Adana for the first time.

2. Material and method

The specimens were collected from Kastamonu provinces between May 2016 and October 2018. The sampling of the adults was made by a sweeping net and a hand aspirator over the plants during the daytime. All the material was collected by the first author. The samples were taken in insect killing jars, labeled and brought to the laboratory and placed in insect storage packages. The specimens were prepared by standard insect preparation and identified according to Bluemel *et al.* [20]. The photos of the general view of dry samples were taken by Canon Eos 70D model camera connected to Zeiss Stem 2000-C stereomicroscope. The body length of the males, the length of the aedeagus, the distance between the upper and lower spines were measured for identification. Specimens of *A. makarovi* that has been in the personal collection of the first author have also been added for comparison. Specimens (9♂♂, 5♀♀) of *A. makarovi* were collected from Sinop before [28]. General views of the species from the dorsal are given in Figure 1, the pictures of the aedeagus taken from the ventral are given in Figure 2.

Specimens are stored at Sinop University, Faculty of Arts and Sciences, Department of Biology, Invertebrata Laboratory.

3. Results

A total of 30 specimens belonging to *Aphrodes* genus collected from Kastamonu provinces. The following information is given for the material listed: Administrative district (town, village or specific locality), date, altitude, (coordinate), number of specimens. Additionally, distribution in Turkey and the world and locality remarks are added.

Aphrodes diminuta recorded in Türkiye for the first time. Morphometric measurements used for identification of species are shown in Table 1.

Aphrodes bicinctus (Schrank, 1776)

Material examined: Kastamonu: Araç, 20.vii.2017, 41° 18' 01.2" N, 33° 31' 54.4" E, 1101 m, (2♂♂); İhsangazi, 20.vii.2017, 41° 13' 21.9" N, 33° 25' 38.0" E, 780 m, (3♂♂).

Distribution of Türkiye: Adana, Afyon, Ankara, Antalya, Bilecik, Bursa, Çanakkale, Diyarbakır, Edirne, Elazığ, Erzincan, Erzurum, Gaziantep, Giresun, Gümüşhane, Hakkari, İstanbul, İzmir, Kars, Kırklareli, Konya, Kütahya, Manisa, Muğla, Ordu, Rize, Samsun, Sinop, Tekirdağ, Tokat, Trabzon, Uşak, Van, Zonguldak [29].

Distribution of the world: Afghanistan, Albania, Algeria, Austria, Bulgaria, Cyprus, Czechoslovakia, Denmark, England, Finland, France, Germany, Greece, Hungary, Iran, Ireland, Italy, Lebanon, Madeira Islands, Mongolia, Morocco, Netherlands, North America, Norway, Spain, Sweden, Switzerland, Poland, Portugal, Romania, Syria, Tunisia, Türkiye, Yugoslavia [29].

***Aphrodes diminuta* Ribaut, 1952**

Material examined: **Kastamonu:** Centre, 06.viii.2017, 41° 32' 24.5" N, 33° 46' 33.3" E, 1041_m, (4♂♂, 3♀♀); 06.viii.2017, 41° 43' 39.2"N, 34° 01' 55.9"E, 1331 m, (9♂♂, 5♀♀); Yaralıçilvegöz, 06.viii.2017, 41° 47' 35.8"N, 34° 04' 53.2"E, 1400 m, (4♂♂).

Distribution of the world: Austria, Central Asia, Kazakhstan, Russian Far East, Siberia, Slovenia, Switzerland [13, 30,31,32].

Table 1. The range of obtained values for male body and aedeagus characters

Character (mm)	<i>A. bicinctus</i>			<i>A. makarovi</i>			<i>A. diminuta</i>		
	Min.	Max.	Ave.	Min.	Max.	Ave.	Min.	Max.	Ave.
Body length	5,7	6,6	6,1	6,9	7,6	7,2	4,6	5,2	4,9
Aedeagus length	0,66	0,72	0,7	0,88	1	0,95	0,78	0,92	0,87
Distance between spines	0,08	0,15	0,09	0,04	0,09	0,06	0,18	0,25	0,23

It is evident that the length of the aedeagus and the distance between the spines of aedeagus are more than the other two species according to the body length of *A. diminuta*. *A. makarovi* is distinctly larger than the other two species. The spines of the aedeagus are very close to each other. In *A. bicincta*, the spines are similar to each other but the aedeagus is smaller (Table 1).

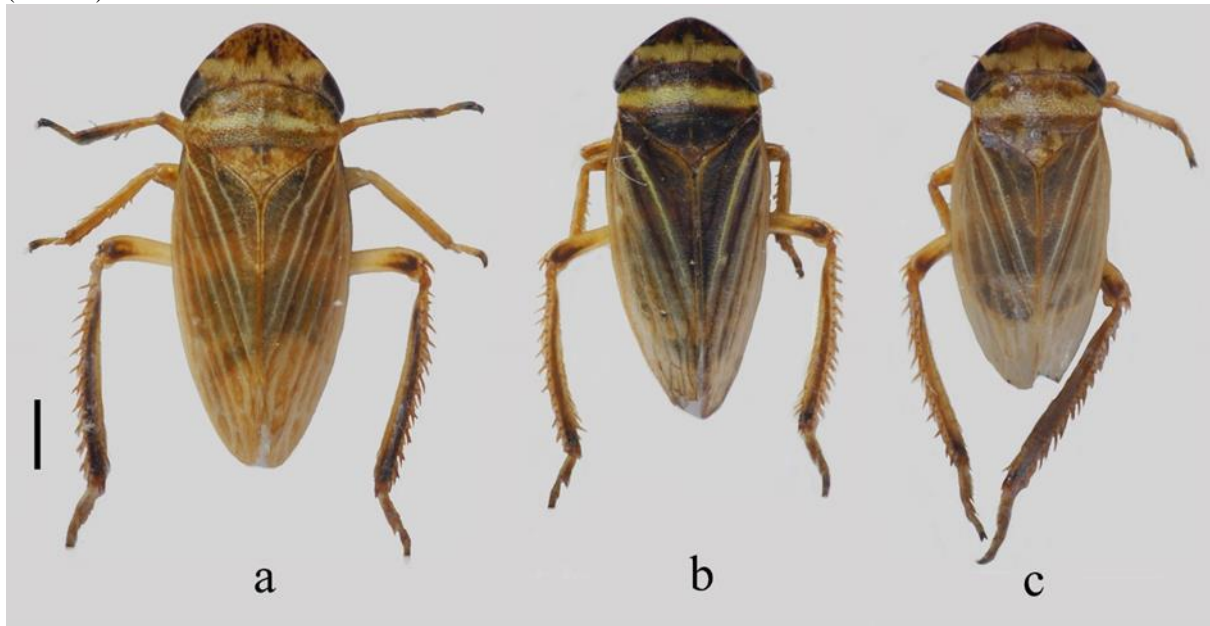


Figure 1. Habitus of three *Aphrodes* spp. (♂) a) *Aphrodes makarovi*, b) *Aphrodes bicinctus*, c) *Aphrodes diminuta* (Scale bar:1 mm)



Figure 2. Frontal view of aedeagus of three *Aphrodes* spp. a) *Aphrodes makarovi*, b) *Aphrodes bicinctus*, c) *Aphrodes diminuta* (Scale bar: 0,1 mm)

4. Conclusions and discussion

A. bicincta species group is characterized by consisting of wide transverse bands on the head and pronotum. This pattern shows variations according to light and darkness. The aedeagus is elongated with two pairs of spines in its central section [18, 33]. The position of the spines in the aedeagus and their distance from each other are used in the differentiation of the species [34]. To eliminate taxonomic gap due to variation within and between species, different parameters were used. Within these parameters, one of the important characters for distinction in *Aphrodes* species is known as the body length /aedeagus length ratio and the location of the spines in the aedeagus. *Aphrodes diminuta* is distinguished by having the largest aedeagus according to body size. *A. macarovi*, *A. bicincta* specimen are similar in distance from the spines in the aedeagus, but *A. makarovi* is significantly different from *A. bicincta* in both body size and aedeagus size [20]. The diagnosis of the species evaluated in this study was made according to this study. Morphometric measurements were parallel with the study [20] mentioned above.

The samples belonging to *A. makarovi* species has the largest size of 3 species with its 7.2 mm size. In the U.K and Slovenia samples, this ratio is 5.93 mm. The males of *A. diminuta* differ from other *Aphrodes* species by being small in size [19]. Similar results were obtained from the samples in this study. *A. diminuta* has the largest aedeagus in terms of body size when body lengths are compared to aedeagus length. In *A. diminuta*, the distance between the upper spines and the lower spines in the aedeagus is greater than the average species. (mean: 2.33 mm).

Bluemel *et al.* [20] stated that this rate is also an important character in the identification of the species. The results obtained in this study are similar. In *A. makarovi* and *A. diminuta* samples, the transverse bands in the head and pronotum are light colored and the variation is small. In *A. bicincta*, it is bright yellow in general but the variation is quite high. Although the samples were collected from a limited area, the results may vary according to coloration. Since *A. bicincta* species group belongs to taxonomically problematic groups it is very possible that they have already been recorded under different names in other parts of the country. The fact that this species has not been registered in our country so far may be related to this situation. When all the results are evaluated, the ratio of body length to aedeagus length is a very useful character in distinguishing 3 species.

No data were found on the ecology of *A. diminuta*. There is an evidence which shows that it was collected only from the higher areas. It is known that *A. diminuta* is generally located at 1200 m and at least 1500 m in Bovyera Alps [16]. According to Seljak [32] in Slovenia *A. diminuta* seems to have a more mountainous distribution, being

collected mainly at altitudes between 600 - 1400 m. Similarly, the samples collected in this study are at an altitude of 1000-1400 m.

Türkiye *Aphrodes* fauna has reached to 12 species after the record of *A. diminuta* from Kastamonu. Leafhoppers of the genus *Aphrodes*, are abundant, widely distributed over the Palearctic and also in North America. *Aphrodes diminuta* is placed into the European chorotype [35]. and distributed at Austria, Kazakhstan, Central Asia, Siberia, Russian Far East, Slovenia and Switzerland. When its distribution in the world is examined, although this record seems to be new for the Türkiye Cicadellidae fauna, it is thought that it may have been evaluated as another species due to variation within the genus before.

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