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Additional notes with detailed biometric data on *Brachycaudus cerasicola* (Mordvilko, 1929) (Hemiptera: Aphididae), a new record for Iran

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ABSTRACT. During the study of aphid fauna of North-Khorasan province, Iran, an aphid species, *Brachycaudus cerasicola* (Mordvilko, 1929) (Hem.: Aphididae), was collected on *Salvia aethiopsis*, *Stachys turcomanica*, *Hymenocrater elegans*, *Perovskia abrotanoides* and *Phlomis cancellata* (Lamiaceae) in 2016 and 2017 which is reported here for the first time from Iran. The first to third host plants reported as the new hosts for this aphid. Since the original descriptions of this species by Mordvilko (1929) and Shaposhnikov (1964) are rather brief, so we report here additional notes and more detailed biometric data on this species. The biometric data of the Iranian populations of *B. cerasicola* is given and compared to the original descriptions.

Key words: morphological description, aphid, fauna, taxonomy, Lamiaceae, Iran

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Introduction

So far, more than 5250 valid aphid species, belonging to 533 genera (Aphidoidea) have been described (Favret, 2018), including some of the world's most important insect pests of agriculture, horticulture and forestry (Blackman & Eastop, 2018). The numbers of aphid species described in the world are increasing day by day. This is also true for Iranian aphid fauna so that the numbers of aphid species recorded in Iran are more than 470 species (Hodjat, 2005; Mehrparvar & Rezwani, 2007; Özdemir & Barjadze,

2015; Goodarzifar et al., 2016; Mehrparvar, 2016, 2017; Barjadze et al., 2017; Kanturski & Barjadze, 2018) which could be increased up to 550 species by further investigations.

During the study of aphid fauna of North-Khorasan province (Iran) in 2016 and 2017 several species were collected and identified on different host plants. Among them, one sample belonging to the genus *Brachycaudus* van der Goot, 1913 (Aphididae: Aphidinae: Macrosiphini) i.e. *B. cerasicola* (Mordvilko, 1929) was collected on some plant species belonging

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to the family of Lamiaceae which is a new record for aphid fauna of Iran. The genus *Brachycaudus* has about 50 described species (Blackman & Eastop, 2018; Favret, 2018) which are mainly palaeartic and characterized by the large round spiracular apertures, short often semicircular cauda, and siphunculi with a subapical annular incision (Blackman & Eastop, 2006, 2018). The species of this genus are primitively heteroecious with *Prunus* as primary hosts and a number of plants belonging to Lamiaceae, Ranunculaceae, Caryophyllaceae, Boraginaceae, Asteraceae and Orobanchaceae which are infested as secondary host plants (Blackman & Eastop, 2006; Holman, 2009). Some species cause curling of leaves and shoots and are considered as pests for cultivated plants (Barbagallo et al., 1997). For some *Brachycaudus* species there is apparently a facultative host alternation to some plant species of Lamiaceae e.g. *Dracocephalum*, *Eremostachys*, *Nepeta*, *Perovskia*, *Phlomis*, *Stachys* and *Salvia* (Shaposhnikov, 1964; Narzikulov & Daniyarova, 1990).

The plant family Lamiaceae is a very large plant family occurring all over the world in a wide variety of habitats (Suthar & Patel, 2014). Lamiaceae is represented by 46 genera, 410 species and subspecies in Iran (Naghbi et al., 2005). Distribution of Lamiaceae in Iran covers the whole country but the species number decreases from the centre towards the east, south-east and south (Rechinger et al., 1982; Jamzad, 2012). Lamiaceae is an important family with most of its species recognized as useful plants with medicinal, aromatic and ornamental properties (Jamzad, 2012). So far, 25 aphid species belonging to nine genera including *Aphis*, *Aulacorthum*, *Brachycaudus*, *Cryptomyzus*, *Dysaphis*, *Eucarazzia*, *Myzus*, *Ovatus* and *Kaltenbachiella* have been recorded on Lamiaceae in Iran (Hodjat, 2005; Holman, 2009).

North-Khorasan province is located in north-eastern, Iran, and it covers an area of 28,434 Km². Climatologically, North-Khorasan province has different conditions in different areas. For example, the northern part is mountainous with a semiarid condition, while the southern part is mostly flat with a warm and dry climate. North-Khorasan province has national parks (e.g. Golestan), protected areas (e.g. Sarigol), mountain chains (e.g. Aladagh) and many unexplored arid, semi-arid and steppe lands (e.g. the north-eastern cross-border area) which are rich in biodiversity. Despite the high levels of biodiversity, only few aphid species have been recorded from these areas. From 2016, a study to determine the aphids' species of North-Khorasan province and to make a contribution to the knowledge of aphids' fauna of this province was started. During the collection surveys some specimens of a *Brachycaudus* species were collected on Lamiaceae and further investigations permitted to identify it as *Brachycaudus cerasicola* (Mordvilko, 1929). Since the original descriptions of apterous and alate viviparous females of *B. cerasicola* by Mordvilko (Nevsky, 1929) and Shaposhnikov (1964) are brief and no fully exhaustive, and also the biometric data of Iranian population have some differences with original descriptions which expanding the range of the biometric data, we have presented here more detailed data about this aphid species.

Material and methods

During May until June in 2016 and 2017, aphid specimens and their attending ant species (if any) were collected by a paintbrush from their host plants and transferred into tubes containing 70% ethanol. Sampling data such as host plant name, feeding location on the host plant, colour of the live aphid individuals, locality, date, biological information,

geographical coordinates and elevation were recorded at the time of collection. It was also noted whether there are ants in attendance.

The sampling regions were Asadli, Pelmis, Bojnourd, Mane and Samalghan, Raz and Jargalan, Esfarayen located in North-Khorasan province. Then aphid specimens were mounted on microscopic slides using suggested slide mounting technique by Ilharco, F.A. (personal communication) with some modifications. Specimens were identified using [Nevsky \(1929\)](#), [Shaposhnikov \(1964\)](#), [Blackman & Eastop \(2006, 2018\)](#). Aphid specimens are deposited in the Aphid Collection of Aphidology Research Group, Institute of Science and High Technology and Environmental Sciences, Graduate University of Advanced Technology,

Kerman, Iran. Host plants (Lamiaceae) were identified using the keys presented by [Jamzad \(2012\)](#). Samples were also sent to Mehdi Imani (Agricultural and Natural Resources Research Centre of North-Khorasan province) for confirmation. Ant samples were identified using identification keys provided by [Collingwood \(1978\)](#) and [Bolton & Ficken \(1994\)](#).

Abbreviations used in the text are as follows: ANT, antennae length; ANTI, ANTII, ANTIII, ANTIV, ANTV, ANTVIb, antennal segments I, II, III, IV, V, and the base of antennal segment VI, respectively; ANTIII Base, basal diameter of antennal segment III; PT, processus terminalis; Rhin, Rhinaria; URS, ultimate rostral segment; 2HT, second segment of hind tarsus; and SIPH, siphunculus.



Figure 1. *Brachycaudus cerasicola* (Mordvilko, 1929) colonies on different parts of their host plants. A. & B. on *Stachys*; C. on *Salvia*; D. & E. on *Phlomis*; F. on *Perovskia*.

Results

During the investigation, *Brachycaudus cerasicola* (Hem.: Aphididae) was collected and identified which is a new record for aphid fauna of Iran.

Brachycaudus cerasicola (Mordvilko, 1929)
(Hem: Aphididae) (Figs 1–3)

Syn.: *Anuraphis phlomicola* Nevsky, 1929

Materials examined: ARG00108, Iran, North-Khorasan province, Asadli, 37° 18' 28.916"N, 57° 20' 52.216"E, 1848 m. a.s.l., *Phlomis cancellata* (Lamiaceae), 26 May 2016; ARG00106, Iran, North-Khorasan province, Asadli, 37° 17' 24.795"N, 57° 19' 43.972"E, 1622 m. a.s.l., *Phlomis cancellata* (Lamiaceae), 2 June 2016; ARG00107, Iran, North-Khorasan province, Raz and Jargalan, 37° 54' 25.625"N, 56° 55' 46.917"E, 1250 m. a.s.l., *Phlomis cancellata* (Lamiaceae), 15 May 2016; ARG00133, Iran, North-Khorasan province, Bojnord, Esfidan, 37° 20' 11.079"N, 57° 36' 48.37"E, 1504 m. a.s.l., *Phlomis cancellata* (Lamiaceae), 6 September 2017; ARG00104, Iran, North-Khorasan province, Asadli, 37° 17' 24.795"N, 57° 19' 43.972"E, 1622 m. a.s.l., *Perovskia abrotanoides* (Lamiaceae), 2 June 2016; ARG00105, Iran, North-Khorasan province, Raz and Jargalan, 37° 54' 23.452"N, 56° 55' 47.165"E, 1216 m. a.s.l., *Perovskia abrotanoides* (Lamiaceae), 15 May 2016; ARG00132, Iran, North-Khorasan province, Pelmis, 37° 14' 41.078"N, 57° 22' 9.021"E, 1910 m. a.s.l., *Perovskia abrotanoides* (Lamiaceae), 5 October 2017; ARG00109, Iran, North-Khorasan province, Asadli, 37° 17' 24.795"N, 57° 19' 43.972"E, 1622 m. a.s.l., *Stachys turcomanica* (Lamiaceae), 2 June 2016; ARG00110, Iran, North-Khorasan province, Asadli, 37° 18' 28.916"N, 57° 20' 52.216"E, 1848 m. a.s.l., *Stachys turcomanica* (Lamiaceae), 25 May 2016; ARG00134, Iran, North-Khorasan province, Raz and

Jargalan, 37° 54' 23.971"N, 56° 55' 48.106"E, 1246 m. a.s.l., *Stachys turcomanica* (Lamiaceae), 27 May 2017; ARG00111, Iran, North-Khorasan province, Raz and Jargalan, 37° 54' 25.625"N, 56° 55' 46.917"E, 1250 m. a.s.l., *Stachys turcomanica* (Lamiaceae), 15 May 2016; ARG00112, Iran, North-Khorasan province, Raz and Jargalan, 37° 54' 22.155"N, 56° 55' 49.705"E, 1273 m. a.s.l., *Hymenocrater elegans* (Lamiaceae), 15 May 2016. leg.: N. Sedighi.

Apterous viviparous female (n=33): live specimens are dark brown to black (Fig. 1). In slide mounted specimens, body widely oval with pale flattened marginal tubercles on the I-V abdominal segments, which are placed on black marginal spots (Fig. 2). Head, ANTI, ANTII, abdominal segments I-VIII, SIPH, cauda and coxae dark brown; ANTIII pale brown with darker apices; ANTIV, ANTV, ANTVI brown; front femur pale brown; middle femur brown; hind femur dark brown with paler basal part; tibiae pale brown with darker apices; tarsi, URS brown.

Morphological characters: ANT shorter than body. Antennal segments ratios are as follow: ANTIII/ANTIV: 1.46–1.92, PT/ANTVIb: 2.75–3.42, ANTIII/PT: 0.79–1.19. Rhinaria absent on ANTIII-ANTV. URS 1.08–1.40 times longer than 2HT and bearing 4–6 hairs. SIPH 1.0–1.5 times longer than cauda and 0.05–0.07 times as long as body length. SIPH 0.64–0.96 times shorter than URS. Cauda bearing 3–5 hairs.

Morphological ratios given in the original description by Mordvilko (Nevsky, 1929), are as follow: PT/ANTVIb: 4, SIPH as long as cauda and 0.07 times as long as body length. ANTIII as long as PT.

Biometric data of apterous viviparous females are given in Table 1 and compared to the original description by Mordvilko (Nevsky, 1929).

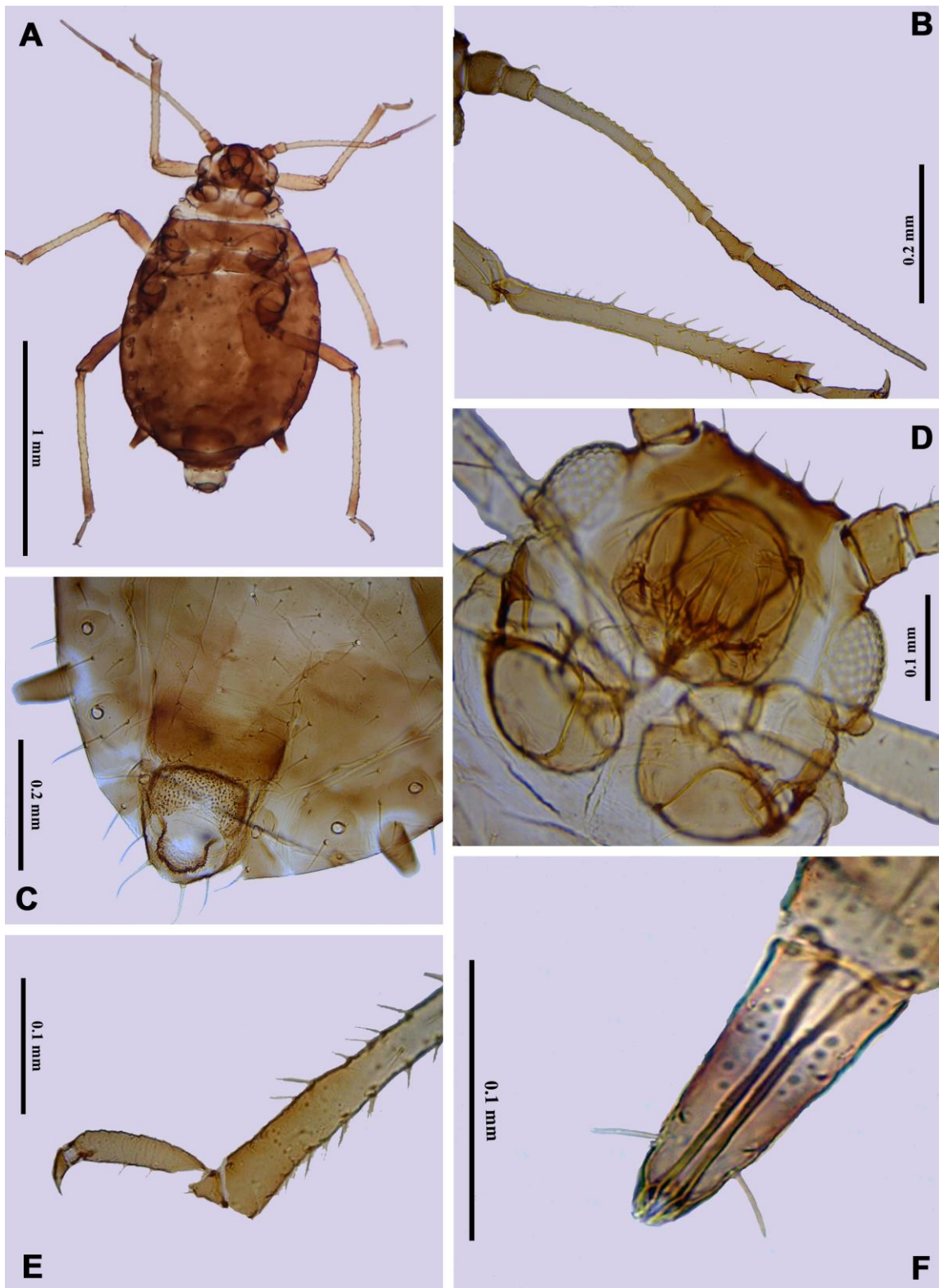


Figure 2. Photograph of different body parts of apterous viviparous female of *Brachycaudus cerasicola* (Mordvilko, 1929). **A**, habitus; **B**, antenna; **C**, posterior part of abdomen with cauda and SIPH; **D**, head; **E**, hind tarsus; **F**, ultimate rostral segment (URS).

Alate viviparous female (n=7): Body elliptic-egg shaped (Fig. 3). In slide mounted specimens, head, thorax and antennae dark brown; femora dark brown with paler basal part; tibia and tarsi dark brown; dark brown solid patch on abdominal tergites II-VI; narrow dark brown transversal bars on abdominal tergites VII and VIII; marginal spots on the abdominal tergites I-V; SIPH, cauda, coxa and URS dark brown.

Morphological characters: Antennal segments ratios are as follow: ANTIII/ANTIV: 1.82–2.44, PT/ANTVIb: 3.0–4.38, ANTIII/PT: 1.0–1.63. Rhinaria on ANTIII 24–62 which distributed along whole of the segment. The number of rhinaria on ANTIV and ANTV are 3–23 and 0–3, respectively. Longest hair on ANTIII 0.75–1.0 times as long as ANTIII Base. URS 1.0–1.2 times longer than 2HT. SIPH 1.17–1.43 times longer than cauda, 0.05–0.07 times as long as body length and 0.61–0.88 times shorter than URS. URS bearing 4–5 hairs. Cauda helmet-shaped, shorter than its basal width in dorsal view and with 4–7 hairs.

Morphological characters given in the original description by Mordvilko (1929) are as follow: Longest hair on ANTIII 0.9–1.2 times as long as ANTIII Base. The number of rhinaria on ANTIII, ANTIV and ANTV are 40–62, 19–25 and 0–9, respectively.

Biometric data of alate viviparous females are given in Table 2 and compared to original description by Shaposhnikov (1964).

Biology: In general, the aphid was mostly found inside the flowers of the Lamiaceae plants. However, depending on the host plant, the infested parts are a bit different (Fig. 1). Here, the aphid specimens were collected on *Salvia aethiopsis*, *Stachys turcomanica*, *Hymenocrater elegans*, *Perovskia abrotanoides* and *Phlomis cancellata* (Lamiaceae). On *P. cancellata* the aphid

mostly was collected between the flags and spike or flowers. On *P. abrotanoides* on the top of the host plant. On *S. turcomanica* into the sepals of flowers. On *S. aethiopsis* on stem and flowers. On *H. elegans* on the leaves. Kadyrbekov (2014) records this aphid also on other plant families, including *Rhodiola* (Crassulaceae) and *Gentiana/Gentianella* (Gentianaceae), where there was a probable confusion respectively with *B. sedi* and *B. gentianae* (Blackman & Eastop, 2018).

Brachycaudus cerasicola is attended by ants (Hymenoptera: Formicidae). The collected attending ant species in this study are *Crematogaster schmidti* (Mayr, 1853), *Lasius brunneus* (Latreille, 1798), *Acantholepis frauenfeldi* Karavaiev, 1932, *Monomorium areniphilum* Santschi, 1911 and *Tetramorium chefketi* Forel, 1911.

Discussion

Brachycaudus (Acaudus) cerasicola is reported here for the first time from Iran. Biometric data of Iranian population indicating that they are smaller in body and appendages sizes in comparison to those originally described by Mordvilko (Nevsky, 1929) and Shaposhnikov (1964), as probable consequence of host plant and the period of collection. In addition to size, the colour of aphids is also different so that Iranian population is darker.

In order to identify aphid specimens, it is needed to know the host plant identity, as aphids are specific in their host plants. However, it is also important to know about the intraspecific variation that may exist. Many aphid taxa have a biological complexity in their life cycle (Martin & Brown, 2008). There are variability clines within a broad distribution area of the same species in aphids. Therefore, to make a safe decision about the identity of an aphid species, all of these aspects should be considered.

Brachycaudus is comprising nine subgenus (Favret, 2018) which each one rather associated with secondary host plants families, e. g. subgenus *Brachycaudina* associated with Ranunculaceae, *Acaudus* with Lamiaceae and Caryophyllaceae, *Prunaphis* with Boraginaceae and Asteraceae and *Scrophulaphis* with Orobanchaceae (Blackman & Eastop, 2018). Iranian specimens have some morphological differences from previously described materials by Mordvilko (Nevsky, 1929) and Shaposhnikov (1964). The observed differences between the specimens of *B. cerasicola* collected from Iran and the original descriptions could be because of differences in environmental conditions, geographical distribution and different host plants which cause local adaptation (Madjdzadeh & Mehrparvar, 2009; Madjdzadeh et al., 2009; Mehrparvar et al., 2012). The specimens of the original description were collected on *Phlomis* sp. (Nevsky, 1929), while the Iranian specimens were founded on *Salvia aethiopsis*, *Stachys turcomanica*, *Hymenocrater elegans*, *Perovskia abrotanoides* and *Phlomis cancellata* in which, first to third plants reported as the new

hosts for this aphid. Aphids have achieved some adaptations in relation to their host plants and this could include the morphological adaptation (Mehrparvar et al., 2012).

It is required to mention that no morphometric studies of morphological variations in *B. cerasicola* associated with various host plants have yet been carried out and it is needed to do so. It is also necessary to compare the specimens with holotype or paratypes to define the differences.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

Table 1. Biometric data of apterous viviparous females of *Brachycaudus cerasicola* (Mordvilko, 1929) (Hemiptera: Aphididae) collected in Iran and original description by Mordvilko (Nevsky, 1929). Measurements are in mm.

Characters	Iranian population (n=33)	Original description by Mordvilko, 1929
Body length	1.36-1.90	1.40-1.90
ANTIII	0.16-0.29	0.33
ANTIV	0.10-0.17	0.21
ANTV	0.06-0.11	0.13
ANTVIb	0.06-0.09	0.08
PT	0.19-0.27	0.32
URS	0.11-0.14	
2HT	0.09-0.11	
SIPH	0.07-0.12	0.1
Cauda	0.05-0.09	0.08
Hind femura	0.33-0.48	
Hind tibia	0.57-0.82	

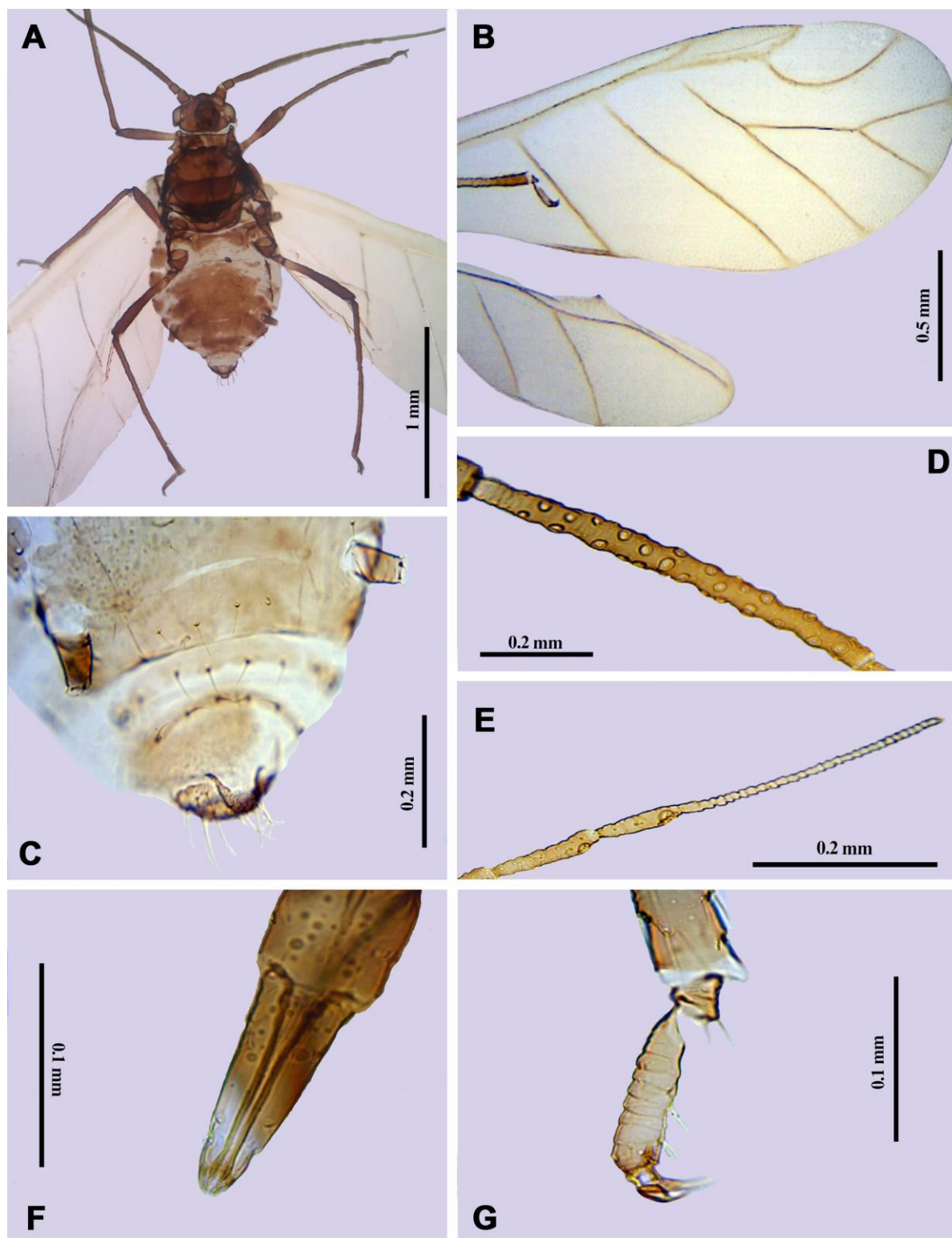


Figure 3. Photograph of different body parts of alate viviparous female of *B. cerasicola* (Mordvilko, 1929). **A**, habitus; **B**, wings; **C**, posterior part of abdomen with cauda and SIPH; **D**, antennal segment III (ANTIII); **E**, antennal segments V and VI (ANTV and ANTVI); **F**, ultimate rostral segment (URS); **G**, hind tarsus.

Table 2. Biometric data of alate viviparous females of *Brachycaudus cerasicola* (Mordvilko, 1929) (Hemiptera: Aphididae) collected in Iran and original description by Shaposhnikov, 1964. Measurements are in mm.

Characters	Iranian population (n=7)	Original description by Shaposhnikov, 1964
Body length	1.43–1.68	1.5–1.71
Body width	0.61–0.78	0.82–0.83
Antennal length	1.01–1.41	1.13–1.29
ANTIII	0.33–0.44	0.37–0.41
ANTIV	0.15–0.23	0.23–0.26
ANTV	0.09–0.13	0.13–0.16
ANTVIb	0.06–0.12	0.09–0.10
PT	0.23–0.37	0.37–0.42
URS	0.10–0.13	
2HT	0.09–0.12	
SIPH	0.06–0.10	0.105–0.12
SIPH width at basis	0.038–0.057	0.053–0.055
SIPH width before flange	0.029–0.038	0.037
Cauda	0.05–0.09	
Hind femura	0.40–0.49	
Hind tibia	0.75–0.89	
Setae on ANTIII	0.010–0.024	0.016–0.026
Setae on abdominal tergite III	0.019–0.033	0.023–0.037

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اطلاعات تکمیلی به همراه داده‌های بیومتریکی دقیق برای *Brachycaudus cerasicola* (Hemiptera: Aphididae) (Mordvilko, 1929)، یک گزارش جدید برای ایران

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چکیده: در طی مطالعه فون شته‌های استان خراسان شمالی، ایران، یک گونه شته به نام *Brachycaudus cerasicola* (Mordvilko, 1929) (Hem.: Aphididae) از روی *Hymenocrater elegans*, *Stachys turcomanica*, *Salvia aethiopsis* و *Perovskia abrotanoides* (Lamiaceae) *Phlomis cancellata* در سال‌های ۱۳۹۶ و ۱۳۹۷ جمع‌آوری گردید که برای اولین بار از ایران گزارش می‌شود. گیاهان میزبان اول تا سوم به عنوان میزبان‌های جدید این شته گزارش می‌شوند. از آنجا که توصیف اصلی این گونه توسط Mordvilko (1929) و Shaposhnikov (1964) نسبتاً مختصر است، بنابراین اطلاعات تکمیلی و داده‌های بیومتریکی با جزئیات بیشتر برای این گونه ارائه شد. داده‌های بیومتریکی جمعیت ایرانی *B. cerasicola* ارائه و با توصیف‌های اصلی مقایسه شد.

واژگان کلیدی: توصیف مورفولوژیک، شته، فون، تاکسونومی، Lamiaceae، ایران