

NEW *ACHILLEA*-FEEDING SPECIES OF THE APHID GENUS *UROLEUCON* (HEMIPTERA: APHIDIDAE) FROM BULGARIA

MARIUSZ KANTURSKI

Zoology Research Team, Institute of Biology, Biotechnology and Environmental Protection,
Faculty of Natural Sciences, University of Silesia in Katowice
ul. Bankowa 9, 40-007 Katowice, Poland

E-mail: mariusz.kanturski@us.edu.pl; <https://orcid.org/0000-0002-1674-1028>

An apterous viviparous female of a new aphid species *Uroleucon* (*Uroleucon*) *bulgaricum* sp. n. is described and compared with the similar species *U. (Uroleucon) achilleae* (Koch, 1865). The new species was collected by the late J. Holman in the Blagoevgrad region (SE Bulgaria), where it is associated with *Achillea coarctata* Poirlet in Lam. (Asteraceae). The similarities and differences between other *Achillea*-feeding *Uroleucon* species are discussed. A morphological key to the species of the subgenus *Uroleucon* Mordvilko, 1914 in Bulgaria is presented. A modified key to the *Achillea*-feeding *Uroleucon* aphids of Blackman and Eastop is also provided.

Key words: *Uroleucon*, Hemiptera, Aphididae, *Achillea*, aphids, Blagoevgrad, Macrosiphini, taxonomy.

INTRODUCTION

The genus *Uroleucon* Mordvilko, 1914 (Hemiptera, Aphididae: Aphidinae) is one of the most speciose within the tribe Macrosiphini Wilson, 1910 (FAVRET 2020, BLACKMAN 2010). The genus, with 247 valid species is divided into six subgenera of which *Lambersius* Olive, 1965 (58 species); *Uroleucon* Mordvilko, 1914 (122 species) and *Uromelan* Mordvilko, 1914 (62 species) are the most species-rich. The subgenera *Belochilum* Börner, 1932; *Divium* Pash-tshenko, 2000 and *Satula* Olive, 1963 are considered monotypic. Representatives of this genus are particularly characterised by a long terminal process of the last antennal segment, the presence of secondary rhinaria on ANT III in apterous viviparous females, a more or less tubular or tapering, long siphunculi with a subapical zone with polygonal reticulation and often differently developed scleroites at the setal bases (HEIE 1995). They are relatively medium-sized to large, shiny (from red to bronze coloured), they often feed on the upper parts of plants and are not visited by ants (BLACKMAN 2010).

Out of the 305 valid *Uroleucon* species (FAVRET 2020), only six are associated with the plant genus *Achillea* (Asteraceae): *U. (Uroleucon) achilleae* (Koch, 1855) *U. (U.) alaskense* Robinson, 1985, *U. (U.) ambrosiae* (Thomas, 1878), *U. (U.) astronomus* (Hille Ris Lambers, 1962), *U. (U.) ptarmicae* (Bozhko, 1959) and *U. (Lambersius) stoetzelae* Robinson, 1988. Of those, only *U. achilleae* and *U.*

ptarmicae are known from Europe (BLACKMAN & EASTOP 2006, 2020). From Bulgaria, 21 *Uroleucon* species have been described and recorded to date of which 13 are in the nominotypical subgenus (NIETO NAFRÍA 2013, KANTURSKI & BARJADZE 2020). During an examination of the aphid collection in the Aphidoidea collection of the Biology Centre of the Czech Academy of Sciences, Institute of Entomology, České Budějovice (IECA), slides of *Uroleucon* individuals that had been labelled with the manuscript name “*Uroleucon bulgaricum*” by the late Jaroslav Holman were studied. The specimens were collected from *Achillea coarctata* Poiret in Lam. (Asteraceae) in Southeastern Bulgaria. After these were compared with the most similar *Uroleucon* representatives, it appears to be a new European species, and its description is the primary goal of this paper.

MATERIAL AND METHODS

The specimens were examined using a Leica DM 3000 LED light microscope and photographed using a Leica MC 190 HD camera using a differential interference contrast. The measurements were taken according to ILHARCO and VAN HARTEN (1987). All of the measurements are given in millimetres. The current host plant names are given according to THE PLANT LIST (2013). The following abbreviations are used: ABD TERG: abdominal tergite; ANT: antennae or their lengths; ANT I–VI: antennal segments I, II, III, IV, V, VI or their lengths (ratios between antennal segments are simply given as e.g. ‘VI: III’); BASE: basal part of last antennal segment or its length; BD III: basal articular diameter of ANT III; BL: body length (from the anterior border of the head to the end of cauda); III FEMORA: hind femora length; HW: greatest head width across the compound eyes; HT I: first segment of the hind tarsus; HT II: second segment of the hind tarsus or its length; LS ANT III: length of the longest setae of ANT III; PT: processus terminalis of the last antennal segment or its length; SIPH: siphunculus or its length; III TIBIAE: hind tibiae length; URS: ultimate segments of the rostrum (IV + V) or their lengths. In the case of a series of single slides with a single specimen with the same collection data for the examined material sections, all of them present the same data as the full previous slide to avoid repetition.

The type material is deposited in the IECA – the Biology Centre of the Czech Academy of Sciences, Institute of Entomology, České Budějovice (Czech Republic) and the DZUS – Zoology Research Team, University of Silesia in Katowice Hemiptera Collection, Katowice (Poland).

The material of *Uroleucon achilleae* that was examined: three apterous viviparous females, **Bulgaria**, reg. Vidim, Belogradčik, 04.06.1990, *Achillea crithmifolia* Waldst. & Kit., J. Holman leg., 21972, IECA; two apterous viviparous females, Salaš, 03.06.1990, J. Holman leg., 21949 (apt 1-2), IECA; one apterous viviparous female, **Czech Republic**, Kraj Vysočina, Sněžné, 17.08.1973, *Achillea millefolium* L., J. Holman leg., 14474, IECA; two apterous viviparous females, **Hungary**, Gyöngyös, Mátrafüred, 23.06.1964, *A. millefolium*, H. Szelegiewicz leg., 2284, R4117, ZMPA; one apterous viviparous female, **Poland**, Pomeranian Voivodeship, Władysławowo, 17.06.1966, *A. millefolium*, H. Szelegiewicz leg., 3139, R4115, ZMPA (Museum of Zoology, Polish Academy of Sciences, Warsaw, Poland); two apterous viviparous females, Masovian Voivodeship, Warszawa-Bielany, 08.07.1956, *A.*

millefolium, H. Szelegiewicz leg., 285, R4120, ZMPA; four apterous viviparous females, Stamirowice near Grójec, 18.08.1961, *A. millefolium*, H. Szelegiewicz leg., 1673, R4116 (ZMPA); one apterous viviparous female, Podkarpackie Voivodeship, Rzeszów, 23.06.1965, *A. millefolium*, S. Huculak leg., R4121, ZMPA; one apterous viviparous female, R4345, ZMPA; two apterous viviparous females, **Slovakia**, Region Trnava, Buková, 29.07.1982, *A. millefolium*, J. Holman leg., 18100, IECA;

TAXONOMY

Aphididae Latreille, 1802

Aphidinae Latreille, 1802

Macrosiphini Wilson, 1910

Uroleucon Mordvilko, 1914

***Uroleucon (Uroleucon) bulgaricum* sp. n.**

(Figs 1–4)

Material examined: Holotype. Apterous viviparous female, Bulgaria, reg. Blagoevgrad, Elešnica near Rila, 09.09.1988, *Achillea coarctata*, J. Holman leg., 20519A (apt 8), IECA.

Paratypes. Apterous viviparous female, other data same as in holotype, 20519A (apt 9), IECA; two apterous viviparous females, 09.09.1090, other data same as in holotype, 20519A (apt 27–28), IECA; two apterous viviparous females, 09.09.1090, other data same as in holotype, 20519A (apt 35–36), IECA; two apterous viviparous females, 09.09.1090, other data same as in holotype, 20519A (apt 53–54), IECA; two apterous viviparous females, 09.09.1090, other data same as in holotype, 20519A (apt 37–38), DZUS; two apterous viviparous females, Rilski Manastir, 10.10.1988, *A. coarctata*, J. Holman leg., 20530 (apt 5–6), IECA; two apterous viviparous females, other data same as in 20530 (apt 21–22), IECA.

Apterous viviparous female – description ($n = 14$) (Figs 1–4, Table 1). Colour in life: unknown. Pigmentation on slide: head sclerotised, light brown; ANT I–II brown; ANT yellow with darker apical end of ANT III–IV, brown distal half of ANT V; pronotum and mesonotum usually with yellow sclerotisation; Femora of legs yellow with only the apices slightly dusky; tibiae yellow with dark distal parts, tarsi dark brown; abdomen yellow with brown sclerites and scleroites; SIPH uniformly dark brown, cauda yellow (Fig. 1a). HW $0.14\text{--}0.15 \times$ ANT. Head with long, rigid and pointed setae, $0.070\text{--}0.100$ mm long. ANT tubercles each with 2–3 setae on internal angles. ANT $1.33\text{--}1.60 \times$ BL. ANT III with 9–12 slightly protuberant, rounded, different-sized secondary rhinaria with well-developed sclerotised rims (Fig. 2a, b), ANT IV longer than ANT V. PT $5.41\text{--}6.31 \times$ BASE. Other antennal ratios: VI:III $1.44\text{--}1.67$, V:III $0.80\text{--}0.84$, IV:III $0.86\text{--}0.92$, PT:III $1.24\text{--}1.54$, PT:IV $1.42\text{--}1.53$, PT:V $1.50\text{--}1.67$. ANT chaetotaxy: ANT have thick, rigid setae with slightly blunt or narrow capitate apices. ANT III setae $0.02\text{--}0.06$ mm long, LS ANT III $1.33\text{--}1.71 \times$ BD III. ANT I with 7–8, ANT II with 4–5, ANT III with 15–18, ANT IV with 13–14, ANT V with 9–11 setae. ANT VI with 3 basal, 4 apical and 4–6 setae along the PT. Rostrum reaching hind coxae. URS $0.23\text{--}0.30 \times$ ANT III, $0.16\text{--}0.18 \times$ ANT VI, $0.18\text{--}0.21 \times$ PT, $1.11\text{--}1.21 \times$ BASE and $1.40\text{--}1.66 \times$ HT II with 4–5 fine, pointed accessory setae (Fig. 2c). Mesosternal furca fused, wide, without stem (Fig. 3a). III FEMORA have medium-long to long, stiff, rigid and pointed setae,

0.020–0.065 mm long. Setae on III TIBIAE with rigid, medium-long to long and pointed setae, 0.025–0.075 mm long. HT I with 5:5:5 setae, HT II 0.15–0.18 × ANT III, 0.10–0.12 × ANT VI, 0.12–0.14 × PT and 0.70–0.81 × BASE. Abdomen membranous without marginal tuber-



Fig. 1. Comparison of the general view of the holotype of a = *Uroleucon bulgaricum* sp. n. and b = *U. achilleae* (Koch). Scale bar: 1.00 mm

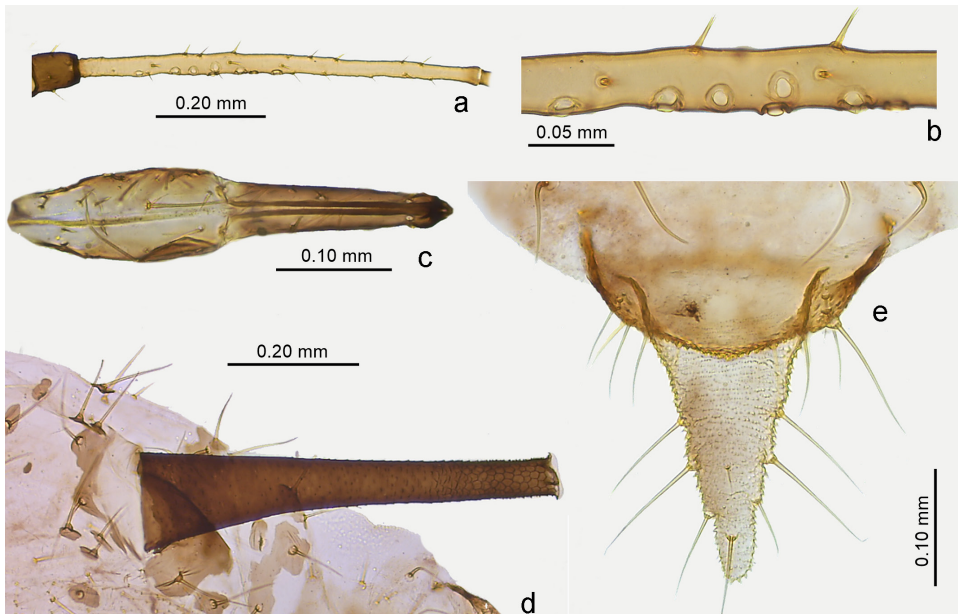


Fig. 2. *Uroleucon bulgaricum* sp. n. morphological characters: a = antennal segment III, b = antennal segment III secondary rhinaria structure, c = ultimate rostral segments, d = SIPH, e = cauda

cles with long and rigid setae with pointed apices, 0.080–0.130 mm long on ABD TERG I–V and 0.085–0.130 mm long on ABD TERG VI–VIII. ABD VIII with 4–6 setae without sclerotised bar. Setae on abdomen arising from well-visible, rounded or slightly irregular scleroites, larger than setae bases (Fig. 4a, c). SIPH tubular, tapering with a distinct zone of subapical reticulation, well-developed antesiphuncular and postsiphuncular sclerites and small flange (Fig. 3d). Reticulated zone $0.22\text{--}0.30 \times$ SIPH. SIPH $2.29\text{--}2.71 \times$ cauda, $0.22\text{--}0.29 \times$ BL and $0.76\text{--}0.87 \times$ ANT III. Genital plate with 2–4 long anterior, 0–2 median and 7–13 shorter posterior setae. Cauda triangular, $1.56\text{--}1.75 \times$ its width at base and $0.09\text{--}0.10 \times$ BL with 7–9 long, thick and pointed setae (Fig. 2e).

Diagnosis. The new species is most similar to *Uroleucon achilleae* (Fig. 1b) because of the similar number of secondary rhinaria on ANT III, siphunculi and cauda ratios, the cauda length to width and the number of caudal setae. Additionally, the long, thick and rigid setae that arise from well-developed scleroites are both species-shared characters.

However, the apterous viviparous females of *U. bulgaricum* differ from those of *U. achilleae* in several apparent features such as:

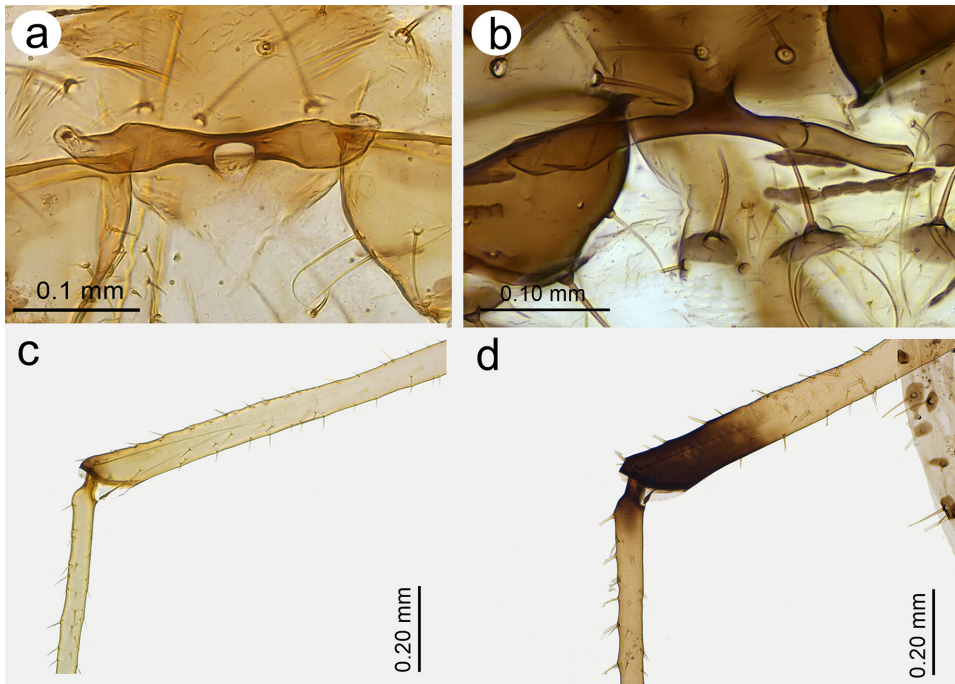


Fig. 3. Differences between *Uroleucon bulgaricum* and *U. achilleae*: a = mesosternal furca of *U. bulgaricum* without a stem, b = mesosternal furca of *U. achilleae* with a well-developed stem, c = pigmentation of the distal part of the femur and proximal part of the tibia of *U. bulgaricum*, d = pigmentation of the distal part of the femur and the proximal part of the tibia of *U. achilleae*

Table 1. Measurements (in mm) of an apterous viviparous female of *Uroleucon bulgaricum*.

Character	Apterous viviparous female
BL	1.95–2.70
HW	0.46–0.52
ANT	3.12–3.62
ANT III	0.65–0.81
ANT IV	0.60–0.71
ANT V	0.55–0.67
ANT VI	1.09–1.17
BASE	0.16–0.17
PT	0.92–1.01
URS	0.19–0.20
FEMORA III	0.95–1.17
TIBIAE III	1.95–2.27
HT II	0.12–0.13
SIPH	0.57–0.67
CAUDA	0.21–0.27

- Mesosternal furca without a stem (mesosternal furca with a well-developed stem in *U. achilleae*) (Figs 3a, b).
- Femora of legs are only slightly dusky at the very apical tips (femora of legs brown to dark brown on about ¼ of their distal length in *U. achilleae*) (Figs 3c, d).
- Proximal part of the tibiae of the legs yellow (proximal part of the tibiae brown to dark brown in *U. achilleae*).
- ANT pale with distal ends of ANT IV and V brown and brown ANT VI (ANT brown to dark brown with only basal and central part of ANT III paler in *U. achilleae*).
- Antesiphuncular sclerites present (antesiphuncular sclerites absent in most representatives of *U. achilleae* as well as according to BLACKMAN (2010) (Figs 4a, b).
- Dorsal setae pointed (dorsal setae blunt or capitate *U. achilleae*) (Figs 4c, d).
- ABD VIII not sclerotised (ABD VIII with a solid sclerotic bar in *U. achilleae*).
- Lower ratio of HT II:BASE, 0.70–0.81 (0.90–1.04 in *U. achilleae*).

Etymology. The name of the species is derived from Bulgaria where it was collected. I have the pleasure to follow the naming of this species according to J. Holman's suggestions and notes on the slides.

Host plant and biology. The species feeds on *Achillea coarctata* Poir. from the family Asteraceae, but nothing is known about the place where it feeds. Alate viviparous females and sexual morphs are as yet unknown.

Taxonomical comments

In the Palaearctic, only two species of the genus *Uroleucon* are known to feed on *Achillea* – *Uroleucon achilleae*, which is a common species in most countries, and *U. ptarmicae*, which to date is only known from Ukraine from where it was described (HOLMAN 2009, BOZHKO 1976). The remaining species including *U. stoetzelae* from the subgenus *Lambersius* are known from North America. Of the last one, *U. bulgaricum* sp. n., differs first of all in subgeneric

differences such as its uniformly dark pigmented siphunculi (pale basally in *Lambersius*), next by fewer accessory setae on the URS and the lack of marginal tubercles on the abdomen (ROBINSON 1988). In reference to the remaining species with uniformly dark siphunculi, the new species ranks as entirely independent with its features but is similar in some of its features to *U. achilleae*/*U. ptarmicae*, which differ from the group of the American species *U. astronomus*/*U. alaskense*/*U. ambrosiae*. According to the *Achillea*-feeding key to aphids of BLACKMAN and EASTOP (2020), the group *U. achilleae*/*U. ptarmicae* can be distinguished by the presence of antesiphuncular (presiphuncular) sclerites on the abdomen and a high ratio of the SIPH:cauda, which is more than 1.6. *Uroleucon bulgaricum* sp. n. fits into the first group by its abdomen, which has rather well-visible antesiphuncular sclerites as well as its SIPH:cauda ratio. The two species can be distinguished from *U. ptarmicae* first of all by its much shorter cauda (less than 0.35 mm), shorter ANT III (about 0.91 in *U.*

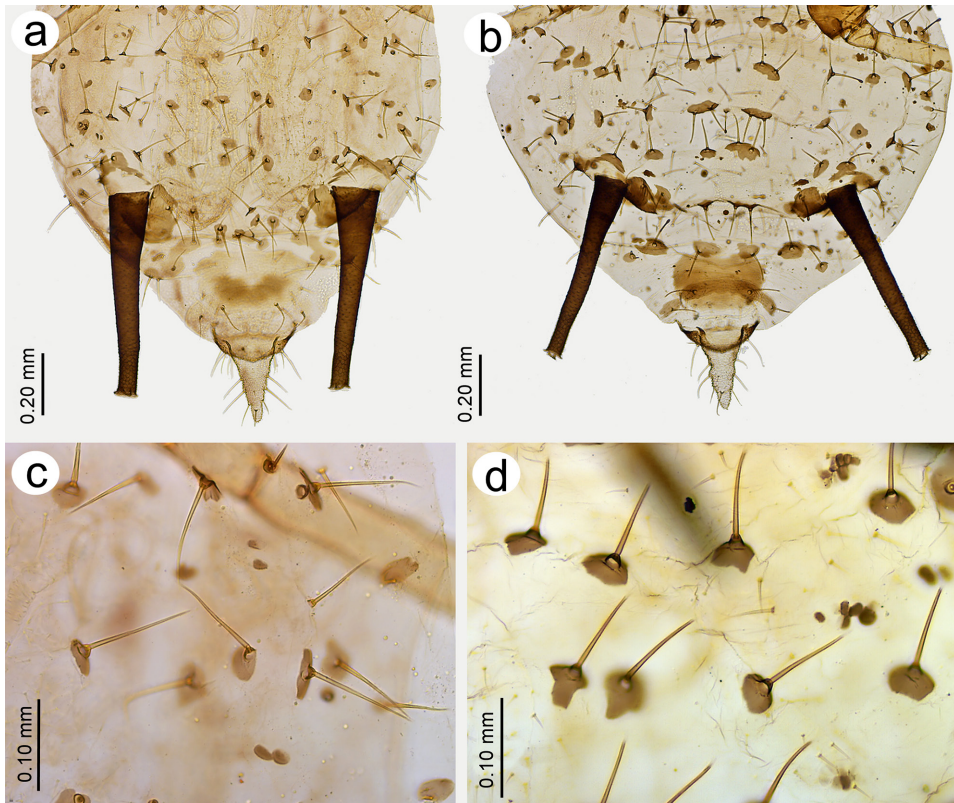


Fig. 4. Differences between *Uroleucon bulgaricum* and *U. achilleae*: a = abdomen of *U. bulgaricum*, b = abdomen of *U. achilleae*, c = abdominal setae of *U. bulgaricum*, d = abdominal setae of *U. achilleae*

ptarmicae) and by the smaller number of secondary rhinaria on ANT III (not more than 26 rather than more than 30 in *U. ptarmicae*) (Bozhko 1976). The new species clearly differs from *U. achilleae* by all the differences given in the diagnosis section, especially by the pigmentation of the antennae and legs, mesosternal furca without a stem and pointed dorsal setae.

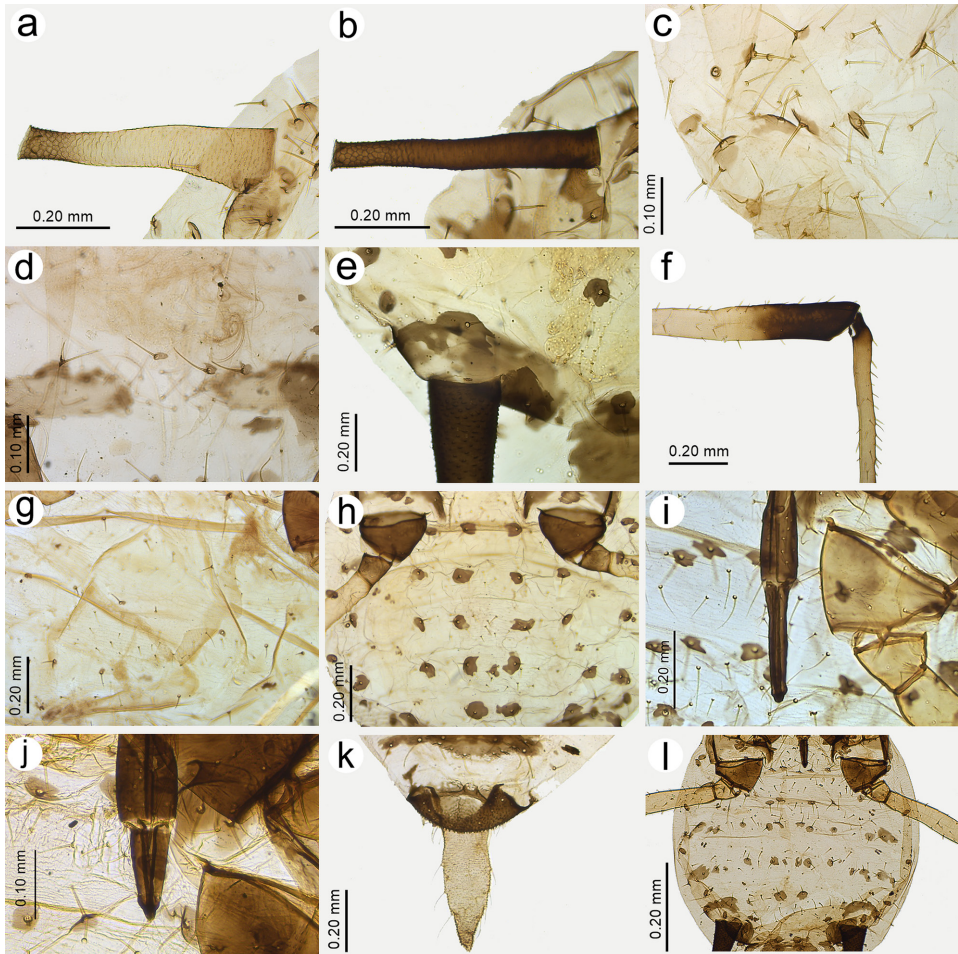


Fig. 5. Main key morphological features of species of the subgenus *Uroleucon* in Bulgaria: a = siphunculi of *U. tussilaginis* with a middle section pale, b = dusky siphunculi of *U. sonchi*, c = dorsal abdominal scleroites of *U. tanacetii*, d = dorsal abdominal scleroites of *U. tussilaginis*, e = antesiphuncular sclerite on abdomen of *U. sonchi*, f = pigmentation of hind femur and tibiae of *U. picridis*, g = dorsal abdominal scleroites of *U. sonchi*, h = dorsal abdominal scleroites of *U. cichorii*, i = ultimate rostral segments of *U. picridis*, j = ultimate rostral segments of *U. obscurum*, k = cauda of *U. jaceicola*, l = dorsal abdominal scleroites of *U. hypochoeridis*

Additionally, the new species differs from *U. achilleae* because of its longer URS and shorter cauda. It should be noted here that on the other hand, HEIE (1995) and BLACKMAN (2010) placed *U. achilleae* into the group together within *Uroleucon* species, which have no antesiphuncular sclerites. In fact, during an examination of the material for comparison, specimens of *U. achilleae* with and without antesiphuncular sclerites were observed and examined. In the author's opinion, this is not an error in the key of the *Achillea*-feeding aphids of BLACKMAN and EASTOP (2020), and two explanations are possible. Most probably, in many cases of some specimens of *U. achilleae*, the sclerites at the setal bases often fuse into larger ones (Fig. 4b). When this fusion occurs in front of the siphunculi, they might be treated or mistaken as poorly developed or vestigial antesiphuncular sclerites, especially in a flat slide-mounted specimen. The second possibility is that perhaps two or more taxa are included in the combination of common features for *U. achilleae* and a future molecular study would solve such question.

Taking into account the basic morphological features of many European species of the nominotypical subgenus *Uroleucon*, *U. bulgaricum* sp. n., which has a uniformly dark pigmented siphunculi; well-developed antesiphuncular sclerites; well-visible, dark sclerites at the setal bases and a high ratio of URS:HT II, is similar and can be compared with *U. leontodontis* (Hille Ris Lambers, 1939) and *U. picridis* (Fabricius, 1775) (HEIE 1995, BLACKMAN 2010). The new species can be easily distinguished from both species by the pigmentation of legs (in this character the new species also differs from most species, which have dark pigmented distal parts of femora and proximal parts of the tibiae), the lack of marginal tubercles and fewer accessory setae on the URS.

Key to Bulgarian species of the nominotypical subgenus *Uroleucon*

The key partially based on SZELEGIEWICZ 1962, HOLMAN 1981, HEIE 1995, BLACKMAN 2010, and the material of the European *Uroleucon* slides that are deposited in the IECA and ZMPA. According to KANTURSKI and BARJADZE (2020), *U. bielawskii* and *U. mulgedii* belong to the subgenus *Lambersius*.

- | | | |
|---|---|---|
| 1 | SIPH clearly pale in the middle (Fig. 5a) | 2 |
| – | SIPH uniformly dusky to dark (Fig. 5b) | 3 |
| 2 | Sclerites at setal bases dark, much larger than setae bases (Fig. 5c) | |
| | <i>U. tanacetii</i> (Linnaeus, 1758) | |
| – | Sclerites at setal bases indistinct, pale, not much larger than setae bases (Fig. 5d) | |
| | <i>U. tussilaginis</i> (Walker, 1850) | |

- | | | |
|----|--|----|
| 3 | Antesiphuncular sclerites present (Fig. 5e) | 4 |
| – | Antesiphuncular sclerites absent | 11 |
| 4 | Scleroites at setal bases indistinct, pale, not larger than setae bases (Fig. 5g)
<i>U. sonchi</i> (Linnaeus, 1767) | |
| – | Scleroites at setal bases dark, larger than the setae bases (Fig. 5h) | 5 |
| 5 | Distal halves of femora and proximal parts tibiae pale or yellow. Cauda triangular (Figs 3e, c)
<i>U. bulgaricum</i> sp. n. | |
| – | Distal halves of femora and proximal parts tibiae pale or dark. Cauda tongue-shaped (Figs 3d, 5f) | 6 |
| 6 | URS 1.45–1.57 × HT II, long and slender (Fig. 5i)
<i>U. picridis</i> (Fabricius, 1775) | |
| – | URS 0.84–1.35 × HT II, not long and slender (Fig. 5j) | 7 |
| 7 | URS 0.84–1.08 × HT II (rarely more than 1.05). Marginal sclerites larger than sclerites and scleroites in spinal and pleural area (Fig. 5l)
<i>U. hypochoeridis</i> (Fabricius, 1779) | |
| – | URS 1.04–1.33 × HT II (rarely more than 1.10). Marginal sclerites not larger than sclerites and scleroites in spinal and pleural area | 8 |
| 8 | Hind tibiae dark
<i>U. cichorii</i> | |
| – | Hind tibiae with distinct pale section | 9 |
| 9 | HT I with 3–3–3 setae
<i>U. pilosellae</i> (Börner, 1933) | |
| – | HT I with 5–5–5 setae | 10 |
| 10 | ANT III with 13–54 secondary rhinaria
<i>U. obscurum</i> (Koch, 1855) | |
| – | ANT III with 63–74 secondary rhinaria
<i>U. chondrillae</i> (Nevsky, 1929)
(Bulgarian specimens) | |
| 11 | URS very long, 2.30–2.60 × HT II with 30–36 accessory setae
<i>U. bifrontis</i> (Passerini, 1879) | |
| – | URS much shorter, 0.76–2.00 × HT II with not more than ten accessory setae | 12 |
| 12 | URS 0.76–0.87 × HT II with 8–10 accessory setae
<i>U. murale</i> (Buckton, 1876) | |
| – | URS 1.10–2.00 × HT II with 5–6 accessory setae | 13 |

- 13 Cauda triangular, not longer than $2.0 \times$ its basal width. SIPH less than $0.33 \times$ BL *U. achilleae* (Koch, 1855)
- Cauda tongue shaped (Fig. 5k), longer than $2.0 \times$ its basal width. SIPH more than $0.33 \times$ BL *U. jaceicola* (Hille Ris Lambers, 1939)

BLACKMAN and EASTOP (2020) modified key
to *Achillea*-feeding *Uroleucon* (from couplet 36)

- 36 SIPH $1.7\text{--}2.9 \times$ cauda. Presiphuncular sclerites present, vestigial or absent. 37
- If SIPH are more than $1.6 \times$ cauda, then R IV+V bears at least 17 accessory hairs. Presiphuncular sclerites absent. 39
- 37 Cauda, less than 0.35 mm long and less than twice its basal width. ANT III with 7–24 rhinaria 38
- Cauda more than 0.4 mm long and more than twice its basal width. ANT III with 30–36 rhinaria *U. ptarmicae*
- 38 Femora of legs with dark distal halves. Mesosternal furca with well-developed stem, dorsal setae blunt or slightly capitate *U. achilleae*
- Femora of legs yellow with only the apices slightly dusky. Mesosternal furca without stem, dorsal setae pointed *U. bulgaricum*
- 39 R IV + V bearing 17–24 accessory hairs *U. astronomus*
- RIV + V with ten or fewer hairs 40
- 40 Marginal tubercles (MTu) well developed and evident on at least ABD TERG 2–5. SIPH $1.0\text{--}1.2 \times$ cauda and $0.21\text{--}0.26 \times$ BL *U. alaskense*
- MTu usually absent. SIPH $1.2\text{--}1.5 \times$ cauda and $0.25\text{--}0.30 \times$ BL *U. ambrosiae*

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