Key to species of *Molothrognathus* (adult female)

1  Setae $sc_2$ much longer than other dorsal setae ......................... 2
   - Setae $sc_2$ subequal to or slightly longer than other dorsal setae .......... 9
2  Setae $sc_2$ and $c_2$ of about equal length ........................................ 3
   - Setae $sc_2$ longer than setae $c_2$ ............................................ 5
3  Setae $f$ (69-71) about as long as $h_1$ (67-74) .......................... colei Swift
   - Setae $f$ shorter than $h_1$ ................................................................ 4
4  Setae $sc_2$, $c_2$, $f$ and $h_1$ relatively long, their lengths being 100, 100, 45-50,
   and 70, respectively .................................................. dilucidus Kunztenov
   - Setae $sc_2$, $c_2$, $f$ and $h_1$ shorter, their length being 72-85, 63-72, 32-38, and
   50-60, respectively ........................................... terrulantis Meyer & Ueckermann
5  Setae $c_1$ shorter than $sc_1$ and $v_2$; striae simple, not discernible mid-dorsally
   between setae $v_1$ and $d$ ........................................... crusis Summers & Schlinger
   - Setae $c_2$ longer than $sc_1$ ...................................................... 6
6  Subequal $c_2$ and $v_2$ longer than $sc_1$ ........................................... minutus Soliman
   - Setae $c_2$ longer than setae $v_2$; $v_2$ and $sc_1$ of about equal length .......... 7
7  Medial prodorsum with normal striae, not shield-like .......................... 8
   - Medial prodorsum with weaker striae than surrounding area, shield-like .... 8
8  Dorsal setae $sc_1$ (28), $sc_2$ (84-92), $f$ (30-34), $h_1$ (50-60) relatively long, other
   dorsal setae $>= 20$; $sc_2 = 2.8$ times as long as $f$ ...... mehrnejadi sp. nov.
   - Dorsal setae $sc_1$ (13-19), $sc_2$ (57-76), $f$ (13-19), $h_1$ (25-32) relatively long,
   other dorsal setae no longer than 20; $sc_2 = 4$ times as long as $f$ .............. phytoculus Meyer & Ueckermann
9  Palptibia swollen; palptarsus about 1/3 length of palptibial claw .............. 10
   - Palptibia normal ................................................................. 10
10  Setae $sc_2$ longer than $c_2$; setae $f$ longer than $h_1$; palptibial claw about 3/4
    length of palptarsus ........................................... flatichehus Meyer & Ueckermann
   - Setae $sc_2$ and $c_2$ of about equal length; setae $f$ longer or shorter than $h_1$ .... 11
11  Medial prodorsum with weaker striae than surrounding area, looking like a
    shield ............................................................................. 12
   - Medial prodorsum with normal striae, not looking like a shield .............. 13
12  Tibia I with a single baculiform solenidion ................................ conantae Swift
   - Tibia I with 2 solenidia sharing an alveolus ............................... parmatus Meyer & Ueckermann

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**Taxonomic notes on larvae of *Willmannella* (Acari: Microtrombidiidae) and description of a new species from Iran**

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**Abstract**

The genus *Willmannella* Feider (Acari: Trombidioidae: Microtrombidiidae), previously known only from New Guinea, Java and Europe, is recorded from Middle Asia (Iran) for the first time. *Willmannella kazerunica* sp. nov. is described from a larva parasitic on an undetermined dipteran in Kazerun, Iran. A revised definition of larval *Willmannella* is proposed and the systematic position of this genus within the Microtrombidiidae is discussed.

**Key words:** *Willmannella*, systematics, parasite, *W. kazerunica* sp. nov.

**Introduction**

The genus *Willmannella* was erected by Feider (1952) with *Ottonia phyllophora* Canestrini, 1897 as the type species, which was described from New Guinea and is also known from Java (Thor & Willmann 1947). Feider (1952) included two other European species in this genus: *Willmannella racovitzai* (Feider, 1948), originally placed in *Microtrombidium* (*Enemothrombium*) Berlese, and *Willmannella franzi* (Willmann, 1950), originally placed in *Campylothrombium*
Krause. All three species of this genus were known only from adults then. Larval *Willmannella* were described by Feider (1956) who successfully reared *W. racovitzai* larvae in culture from adults. This is the only species of this genus known at both larval and post-larval stages. The host associations of this genus are unknown. In this paper, we describe a new species of *Willmannella* from a larval mite ectoparasitic on an undetermined dipteran in Kazerun, Iran. This is the first record of this genus in Middle Asia and the first record of the host association of larval *Willmannella*. We also discuss the systematic position of *Willmannella* within the Microtrombidiidae.

The terminology and abbreviations used in this paper are found in Robaux (1967) and Kethley (1990). Measurements in the description are given in micrometres (µm).

*Willmannella kazerunica* sp. nov. (Figs. 1-10)

**Description**
Larva: Holotype partially fed and swollen. Colour in life unknown. Length of idiosoma (from anterior end of scutum) 400, maximum width near level of setae *c*₃ and *d*₃ 270. A medium-sized larva as measured by total length of legs (IP 972).

Prodorsum covered predominantly by a pentagonal scutum (Fig. 1). Antero-lateral parts of scutum deflexed, with 2 antero-lateral angles directed ventrally in normal position. Scutum striate longitudinally with punctuations between striations; striations fade near 2 corners postero-lateral of setae PL and area anterior to setae AM; striations much denser in central area than deflexed antero-lateral corners, striations on latter becoming slightly reticulate in posterior part. Scutum slightly convex posteriorly, covering anterior margin of scutellum, but strongly concave laterally at level of trichobothria (S) to accommodate eyes and associated plates. Setae AM and AL nude, their combined length shorter than distance between their insertions (AM + AL < MA). Setae PL with very fine barbs, located very near postero-lateral angles of scutum; PL obviously longer than AM and AL, its length subequal to distance between insertions of AL and PL (PL = AP). Trichobothria S thin and nude, situated antero-medial of PL; S longer than PL and reaching beyond tip of PL.


Zhang & Saboori: A new species of *Willmannella* from Iran

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(1991) revised his classification of this group into two families and four subfamilies: Eutrombidiidae (Eutrombidiinae) and Microtrombidiidae s.s. (Microtrombidiinae s.s., Feideriinae and Manriquiinae).

In a recent review of larvae of Microtrombidiinae s.l., Southcott (1994) grouped Microtrombidiinae s.l. and Eutrombidiinae in Microtrombidiidae s.l. and included Willmannella in his key to larval genera of Microtrombidiinae s.l., which is the Microtrombidiidae s.s. of Welbourn (1991).

The concept of Microtrombidiidae sensu Welbourn (1991) is used in this paper. Accordingly, Willmannella is considered here a member of the restricted Microtrombidiinae, based on larval morphology. This genus seems to be most closely related to Campylotrombium Krausse and Fissitrombium Southcott.

Acknowledgements

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References


W. racovitzai are congeneric. Southcott (1994) provided a generic definition of larval Willmannella based on the description of W. racovitzai by Feider (1956). With the description of W. kazerunica, the generic limit of Willmannella can now be more clearly defined. A revised description of Willmannella larvae is proposed below:

Prodorsal scutum punctate and with longitudinal striations; antero-lateral corners deflexed and with sparser striations than median part of scutum. Scutellum punctate but with a pair of longitudinal striate strips (of not more than three lines) near insertions of setal pair c1. Other dorsal setae on hysterosoma each arise from a small plate but two plates nearest to scutellum significantly larger than others. Terminal setae h2 more than twice as long as setae h1. Coxae I each with 1 nude and 1 barbed seta, coxae II and III each with 1 barbed seta. Leg I and II each with a pair of normal claws and a claw-like empodium, leg III with 2 asymmetric, modified claws but normal claw-like empodium; claws each with a pair of barbs subterminally. Subcapitular setae short and thick, branched with several blunt digitations.

The systematic position of Willmannella within the family Microtrombidiidae is uncertain, in part due to changes in the status and extent of family-group taxa within this group.

Feider (1952) placed Willmannella in Microtrombidiinae s.l. when he erected it. Feider (1956) compared larval W. racovitzai with larvae of other genera in Microtrombidiinae s.l. and divided the then known species of this subfamily into four categories; he did not create any group names such as tribes for these categories. Feider (1956) considered W. racovitzai to be the most derived species in terms of its adaptation to parasitism.

Vercammen-Grandjean (1973) split Microtrombidiinae s.l. into three subfamilies within Trombidiidae s.l.: Microtrombidiinae s.s., Feideriniae and Georgiinae. He placed Willmannella in Georgiinae. Vercammen-Grandjean (1973) noted that only the larval stage of this genus was known then; this is not correct. Feider (1952) erected Willmannella based on adults and reared larvae from adults that he identified as W. racovitzai (Feider 1956).

Welbourn (1984) included four tribes (Eutrombidiini, Manriquiini, Microtrombidiini and Feiderinini) in the revised Microtrombidiinae s.l., but Willmannella was not listed as a member of any of these tribes. Welbourn
Remarks

Palptibia typically bears three setae in larval Trombidioidea and related mites. In this new species, we observed only one nude seta and a large membranous area on the palptibia, although two sclerotized seta-like structures were present at the proximal end underneath the membrane. Robaux (1974) likewise observed two setae and one seta-like structure on the palptibia of Campylostomium barbarum (Lucas) and one seta and two seta-like structures on the palptibia of Robauxia thaumapilosum (Robaux). He considered these seta-like structures on the palptibia to be true setae. We agree.

We also observed a dorsal pit on the palpgenu of *W. kazerunica*; this pit could be a reduced seta. Most larval microtrombidiids do not have setae on the palpgenu. Southcott (1994) recently described *Buandikia anneae* and *Patagonella echeverryae* and observed a minute seta on the palpgenu and another on the palpfemur of both species. The only other genus in the Trombidioidea that has a seta on the palpgenu is *Podothrombium* of the Trombidiidae.

Discussion

Feider (1956) gave a rather detailed description of *W. racovitzai*. His description contains many useful data but also some “problems”.

He noted in his description (Feider 1956: 11) that lateral to a row of four setae (each arising from a rectangular sclerite) is a group of two short setae, which are shown in his Fig. 1, but on page 31, he wrote in his French description of the mite: “à l’extrémité grands, se trouve un groupe de trois petits poils”. One of the statements must be wrong. It is rather unusual that these setae are found only on one side.

In his Table 2 on page 8, Feider showed five setae on femur I and six setae on femur II; but in his Figs. 10 and 11, he showed five setae on both. However, most microtrombidiids have 6 setae on femur I and 5 setae on femur II, as observed in *W. kazerunica*.

His illustrations seem out of proportion, probably drawn free-hand instead of from a camera lucida. For example, setae $h_1$ is shown $<4$ times as long as $h_2$ in his Fig. 1, but it is over 5 times as long as $h_2$ according to his measurements (page 11).

Only a re-examination of Feider’s specimen will resolve these problems. Despite all these inconsistencies, there seems little doubt that *W. kazerunica* and
FIGURE 6-8. Willmannella kazemunica Zhang & Saboori sp. nov. (larva). 3, tarsus, claws and empodium I; 4, tarsus, claws and empodium II; 5, tarsus, claws and empodium III. All in postero-lateral view.
distal microseta \( \kappa \) minute, 4 long. Tibia I 53 long, with solenidia \( \phi_1 \) (45) at \( \approx 3/4 \) and \( \phi_2 \) (26) \( \approx 9/10 \) of segment length; microseta \( \kappa \) (5) distal to \( \phi_1 \); 6 barbed setae: 1 ventral at \( \approx 1/4 \) and another ventral at \( \approx 3/4 \), 1 antero-lateral at \( \approx 2/3 \) of segment length, 1 antero-lateral and 2 postero-lateral distal to level of \( \phi_i \). Tarsus I 88 long, with dorsal solenidia \( \omega \) (28) at \( \approx 1/4 \) and eupathidium \( \zeta_1 \) (44 \( \mu \)m) at \( \approx 2/3 \) of segment length (Fig. 6); postero-lateral \( \zeta_2 \) (18) near distal end; famulus \( \epsilon \) (6) proximal to \( \omega \); 17 barbed setae: 2 proximal and 2 at level of \( \omega \), 8 between levels of \( \omega_1 \) and \( \zeta_1 \), and 5 distal to level of \( \zeta_1 \). 2 claws (18) shorter but thicker than claw-like empodium (28); claws each with a pair of small barbs near distal ends.

Leg II (305, excluding claws) shorter than leg I. Trochanter II 33 long, with 1 dorsal barbed seta (Fig. 1). Femur II 58 long, with 1 nude seta near basal end, 2 barbed setae (1 antero-lateral and 1 ventral) near middle, and 2 barbed setae (1 dorsal and 1 postero-lateral) between 2/3–3/4 of segment length (Fig. 4); 2 setae near middle longer than 1/2 length of femur. Genu II 22 long, slightly longer than wide, with 1 dorsal solenidion \( \sigma \) (47) at \( \approx 1/3 \) of segment length, 2 barbed setae (1 antero-lateral and 1 postero-lateral) near 3/5 of segment length; all setae about 1.5 as long as length of genu; microseta \( \kappa \) almost imperceptible. Tibia II 48 long, with solenidia \( \phi_1 \) (39) at \( \approx 1/8 \) and \( \phi_2 \) (18) \( \approx 7/8 \) of segment length; 5 barbed setae: 1 ventral at \( \approx 1/3 \) and 1 postero-lateral at \( \approx 2/3 \) of segment length, 2 antero-lateral and 1 postero-lateral slightly proximal to level of \( \phi_2 \). Tarsus II 74 long, tapering distally, with dorsal solenidia \( \omega \) (21) slightly proximal to middle of segment length (Fig. 7); famulus \( \epsilon \) (4) lateral to \( \omega \); 14 barbed setae: 5 proximal and 9 distal to level of \( \omega_1 \). 2 claws (18) shorter but thicker than claw-like empodium (31); claws each with a pair of small barbs near distal ends.

Leg III (319, excluding claws) shorter than leg I but longer than leg II. Trochanter III 47 long, with 1 barbed dorsal seta (Fig. 2). Femur III 66 long, with 1 nude seta near basal end, 1 ventral barbed seta at \( \approx 1/3 \), 1 antero-lateral barbed seta at \( \approx 2/3 \) and 1 dorsal barbed seta at \( \approx 3/4 \) of segment length (Fig. 5). Genu III 24 long, slightly longer than wide, with 1 dorsal solenidion \( \sigma \) (50) at \( \approx 1/4 \) of segment length, 2 barbed setae (1 antero-lateral and 1 postero-lateral) near mid-segment. Tibia III 60 long, with 5 barbed setae: 1 subventral at \( \approx 1/3 \) and 1 postero-lateral at \( \approx 2/3 \) of segment length, 2 antero-laterals and 1 postero-lateral within distal 1/3 of segment. Tarsus III trapezoidal in lateral view (Fig. 8), 62 long dorsally and 54 long ventrally, with 13 barbed setae: 4 (1 ventral, 2 antero-laterals and 1 postero-lateral) in proximal half and 9 (2 dorsals, 2 ventrals, 4 antero-laterals and 1 postero-lateral) in distal half of segment; postero-lateral seta at 1/3 of segment length much longer than other setae; ventral seta at distal end thicker and shorter than other setae; distal antero-lateral seta subdorsal in location and branched along distal 2/3. Anterior claws (20) longer than posterior claw (10); both thicker but shorter than claw-like empodium (48); claws each with a pair of very small barbs near distal ends.

Gnathosoma 94 wide, with posterior margin concave (Fig. 9). Palpi tapering, 60 long. Palptrochanter reduced. Palpfemur without setae, 24 long. Palpgenu 18 long, without obvious setae but with a dorsal pit (Fig. 10). Palptibia 18 long, with a nude seta (34) postero-laterally and a large (16 long and 7 wide) membranous area enclosing base of tibial claw; 2 sclerotized seta-like structures at proximal end underneath membrane; tibial claw 9 long, recurved in lateral view and deeply divided. Palptarsus small (8 long and 8 in diameter), with a postero-lateral solenidion \( \omega \) (7 m), a distal eupathidium \( \zeta \) (6 um) and 6 nude setae; 1 postero-lateral seta 27 long and 1 ventral seta 39 long. Chelicerae robust; cheliceral base 90 long and 30 wide; cheliceral blade 18 long, sickle-shaped with 2 small teeth subterminally. Sclerotized oral “ring” not closed dorsally, with membranes outside it; outer ring margin with \( \approx 30 \) “teeth”, while inner ring margin finely dentate; maximum distance between outer margin 36. Oral setae (or1) nude, 13 long. Subcapitular setae (s.c) short (15) and thick (4 in diameter at base), branched along distal 2/3 with 9 blunt digitations (Fig. 9). Ventral surface of subcapitulum tongue-shaped and punctate posterior to setae s.c.

**Etymology**

This species is named after the type locality Kazerun in Iran.

**Type specimen**

This species is described from a single larva [slide identification ARS-19950406-2] collected by H. Ostovan from an undermined dipteran in Kazerun, Iran. The holotype larva is deposited in The Zoological Museum, College of Agriculture, University of Tehran, Tehran, Iran.

**Diagnosis of larva**

This species differs from *W. racovitzai* in many characters and can readily be distinguished from the latter by the following: (1) scutum length subequal to, not significantly greater than, scutellum width; (2) eye plate smooth, not striate;
distal microseta κ minute, 4 long. Tibia I 53 long, with solenidia ϕ₁ (45) at \( \approx \) 3/4 and ϕ₂ (26) \( \approx \) 9/10 of segment length; microseta κ (5) distal to ϕ₁; 6 barbed setae: 1 ventral at \( \approx \) 1/4 and another ventral at \( \approx \) 3/4, 1 antero-lateral at \( \approx \) 2/3 of segment length, 1 antero-lateral and 2 postero-lateral distal to level of ϕ₁.

Tarsus I 88 long, with dorsal solenidia \( \omega \) (28) at \( \approx \) 1/4 and eupathidium \( \zeta \) (44 \( \mu \)m) at \( \approx \) 2/3 of segment length (Fig. 6); postero-lateral \( \zeta \) (18) near distal end; famulus ε (6) proximal to \( \omega \); 17 barbed setae: 2 proximal to and 2 at level of \( \omega \), 8 between levels of \( \omega_1 \) and \( \zeta_1 \), and 5 distal to level of \( \zeta_1 \). 2 claws (18) shorter but thicker than claw-like empodium (28); claws each with a pair of small barbs near distal ends.

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(3) plates $c_2$ and $d_1$ oval, not subrectangular; (4) setae $c_1$ mediad of, not lateral to, striation on scutellum; (5) setae $h_2$ between 2-3, not 4, times as long as setae $h_1$; (6) coxal setae $Ib$ near middle of distal margin, not near antero-distal corner, of coxa I; (7) genu I with 4, not 3, barbed setae; (8) palptibia with 1, not 2, nude setae; (9) cheliceral blade with 2, not 1, subterminal teeth ventrally; (10) leg lengths I-II-III 348-305-310, not 301-251-265.

FIGURE 1. *Willmannella kazerunic* Zhang & Saboori sp. nov. (larva). 9, gnathosoma, ventral view; 10, palp, dorsal view.
Remarks

Palptibia typically bears three setae in larval Trombidiioidea and related mites. In this new species, we observed only one nude seta and a large membranous area on the palptibia, although two sclerotized seta-like structures were present at the proximal end underneath the membrane. Robaux (1974) likewise observed two setae and one seta-like structure on the palptibia of Campylotrombium barbarum (Lucas) and one seta and two seta-like structures on the palptibia of Robauxia thaumapilosum (Robaux). He considered these seta-like structures on the palptibia to be true setae. We agree.

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Prodorsal scutum punctate and with longitudinal striations; antero-lateral corners deflexed and with sparser striations than median part of scutum. Scutellum punctate but with a pair of longitudinal striate strips (of not more than three lines) near insertions of setal pair c1. Other dorsal setae on hysterosoma each arise from a small plate but two plates nearest to scutellum significantly larger than others. Terminal setae h2 more than twice as long as setae h1. Coxae I each with 1 nude and 1 barbed seta, coxae II and III each with 1 barbed seta. Leg I and II each with a pair of normal claws and a claw-like empodium, leg III with 2 asymmetric, modified claws but normal claw-like empodium; claws each with a pair of barbs subterminally. Subcapitular setae short and thick, branched with several blunt digitations.

The systematic position of Willmannella within the family Microtrombidiidae is uncertain, in part due to changes in the status and extent of family-group taxa within this group.

Feider (1952) placed Willmannella in Microtrombidiinae s.l. when he erected it. Feider (1956) compared larval W. racovitzai with larvae of other genera in Microtrombidiinae s.l. and divided the then known species of this subfamily into four categories; he did not create any group names such as tribes for these categories. Feider (1956) considered W. racovitzai to be the most derived species in terms of its adaptation to parasitism.

Vercammen-Grandjean (1973) split Microtrombidiinae s.l. into three subfamilies within Trombidiidae s.s.: Microtrombidiinae s.s., Feideriinae and Georgiinae. He placed Willmannella in Georgiinae. Vercammen-Grandjean (1973) noted that only the larval stage of this genus was known then; this is not correct. Feider (1952) erected Willmannella based on adults and reared larvae from adults that he identified as W. racovitzai (Feider 1956).

Welbourn (1984) included four tribes (Eutrombidiini, Manriquini, Microtrombidiini and Feideriini) in the revised Microtrombidiinae s.l., but Willmannella was not listed as a member of any of these tribes. Welbourn

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(1991) revised his classification of this group into two families and four subfamilies: Eutrombidiidae (Eutrombidiinae) and Microtrombidiidae s.s. (Microtrombidiinae s.s., Feideriinae and Manriquiinae).

In a recent review of larvae of Microtrombidiinae s.l., Southcott (1994) grouped Microtrombidiinae s.l. and Eutrombidiinae in Microtrombidiidae s.l. and included Willmannella in his key to larval genera of Microtrombidiinae s.l., which is the Microtrombidiidae s.s. of Welbourn (1991).

The concept of Microtrombidiidae sensu Welbourn (1991) is used in this paper. Accordingly, Willmannella is considered here a member of the restricted Microtrombidiinae, based on larval morphology. This genus seems to be most closely related to Campylotothrombium Krausse and Fissitrombium Southcott.

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