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Revision of the family Dolichocybidae (Acari: Heterostigmata) from the collection of V.D. Sevastianov

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\textbf{ABSTRACT}


\textbf{Keywords} systematics; redescription; \textit{Pavania}; \textit{Dolichocybe}; dung beetles; soil

\textbf{Zoobank} \url{http://zoobank.org/3C207D47-8CE2-41A8-89E4-AFEAF392C621}

\section*{Introduction}

The family Dolichocybidae is a small group of early-derivative heterostigmatic mites that currently includes 2 subfamilies, 6 genera and 45 species (Hajiqanbar and Khaustov 2010; Rahiminejad \textit{et al.} 2011; Zhang \textit{et al.} 2011; Loghmani \textit{et al.} 2013; Katlav \textit{et al.} 2014; Bahramian \textit{et al.} 2015; Mortazavi \textit{et al.} 2015; Sobhi \textit{et al.} 2017; Khaustov and Frolov 2017, 2018a, b; Khaustov and Trach 2017; Khaustov et al. 2018a, b). Little is known about the way of life of dolichocybid mites, but all of them are probably fungivorous (Rack 1967; Magowski 1988; Kaliszewski \textit{et al.} 1995). Some species are important pests of edible mushrooms (Lan \textit{et al.} 2017).

Identification of many dolichocybid mites is difficult or even impossible due to their incomplete and inadequate descriptions. All species described by V.D. Sevastianov and his co-authors belong to this “problematic” group. The list of dolichocybids described by V.D. Sevastianov and his co-authors includes 6 species, namely \textit{Formicomotes octipes} Sevastianov, 1980, \textit{Pavania riparia} Sevastianov, 1980, \textit{P. tadjikistanica} Sevastianov, 1980, \textit{P. protracta} Sevastianov and Abo-Korah, 1985, and \textit{Dolichocybe firjusae} Sevastianov and Chydyrov, 1994 (Sevastianov 1980; Sevastianov & Abo-Korah 1985; Sevastianov et al. 1994). Only \textit{Formicomotes octipes} was recently redescribed (Khaustov and Frolov 2018a), while other species remain unstudied since the times of their original descriptions.

The main aim of this article is to provide redescriptions of dolichocybid mites described by V.D. Sevastianov and co-authors based on type and additional material.

\section*{Materials and methods}

The type materials of dolichocybid mites were loaned from the collection of the Odessa I. I. Mechnikov National University Museum of Zoology, Odessa, Ukraine. Additional material of...
*Pavania riparia* was collected by junior author on the dung beetle *Copris lunaris* and mounted in Hoyer’s medium. One non type material slide of *P. riparia* from the collection of the junior author was remounted and several specimens were removed, dusted with gold and scanned with aid of a JEOL–JSM-6510LV SEM microscope.

Mite morphology was studied using a Carl Zeiss AxioImager A2 compound microscope.
with phase contrast and DIC objectives. Photomicrographs were taken with an AxioCam ICc5 digital camera.

The terminology of the idiosoma and legs follows Lindquist (1986); the nomenclature of subcapitular setae follows Grandjean (1944). All measurements are given in micrometers (μm). For leg chaetotaxy the number of solenidia is given in parentheses.

**Taxonomy**

**Family Dolichocybidae Mahunka, 1970a**

**Genus Pavania Lombardini, 1949**

Type species: *Pavania fusiformis* Lombardini, 1949, by original designation.

*Pavania riparia* Sevastianov, 1980


(Figs 1–4)

**Redescription**

**Female (Figs 1–4)**

Body oval, weakly sclerotized. Length of idiosoma 125–130, width 74–86.

**Gnathosoma (Figs 4A–C)** — Gnathosomal capsule, excluding palps, almost round, its length 22, width 22–24. Dorsally with two pairs of weakly barbed and blunt-ended cheliceral setae (*cha*, *chb*). Setae *cha* 13–14 distinctly longer than *chb* 9–10. Dorsal median apodeme well developed. Postpalpal setae (*pp*) short, divided distally (Fig. 4C). Venter of gnathosoma with one pair of smooth, pointed subcapitular setae *m* 12. Palps with smooth setae *dFe* and *dGe* dorsolaterally, setae *dGe* 10–11 pointed, more than two times longer than blunt-ended.

![Figure 2](image-url) *Pavania riparia* Sevastianov, 1980, female: A – right leg I in dorsal view, B – right leg II in dorsal view, C – right leg III in dorsal view, D – right leg IV in dorsal view.
dFe 4. Palps ventrally with two solenidia (sol). Inner solenidion slightly shorter than outer one. Palp tibiotarsus with short, blunt-ended ventrolateral seta (probably tibial I’,) and distal eupathidium-like tiny seta (eup) (Fig. 4B). Palps terminate with well-developed tibial claw (cl) (Fig. 4A, B). Cheliceral stylets strong, curved. Pharynx thin-walled, elongate, with weak lateral projections.

**Idiosomal dorsum (Figs 1A, 3A)** — All dorsal shields with small sparsely distributed dimples (Fig. 3A). Prodorsal shield with three pairs of setae (v1, v2, sc2) and a pair of clavate, barbed trichobothria sc1 with rounded apex. All dorsal setae blunt-ended. Most of dorsal setae smooth or with very small barbs and only setae h1 with distinct barbs. Tips of setae h2 thickened into tiny clubs. Cupules ia on tergite D and ip on tergite EF small, round; other cupules not evident. Posterior margins of tergites C, D, and EF with several weak projections. Lengths of dorsal setae: v1 16, v2 6, sc2 30–32, c1 23–27, c2 18, d 17, e 10–12, f 17–18, h1 13–14, h2 54–63. Distances between setae: v1–v2 16–17, v2–v2 24–26, sc2–sc2 28, c1–c1 24–28, d–d 48–49, e–e 40–41, f–f 28–29, h1–h1 10, h1–h2 7–8.

**Idiosomal venter (Figs 1B, 3B, 4D)** — All ventral plates smooth. All ventral setae smooth; setae 2c pointed, other setae blunt-ended. Apodemes 1 (ap1) and apodemes 2 (ap2) well developed; prosternal apodeme not evident; apodemes 3 (ap3) and 4 (ap4) well developed. Coxal fields I-IV each with three pairs of setae. Lengths of ventral setae: 1a 6, 1b 7, 1c 6, 2a 10, 2b 6, 2c 19, 3a 9, 3b 8–9, 3c 10–11, 4a 8, 4b 8–9, 4c 9, ag 9–10, g1 4–5, g2 4, ps 9.

**Figure 3** DIC photomicrographs of *Pavania riparia* Sevastianov, 1980, female: A – dorsal view, B – ventral view.
Legs (Fig. 2) — Leg I (Fig. 2A). Setal formula: 0–4–2–6(2)–11(2). Tarsus with two small claws and semi-oval empodium. All leg setae smooth. Setae \( l' \) of femur, \( l' \), \( v' \) of genu, \( k \) and \( v' \) of tibia blunt-ended; other leg setae (except eupathidia) pointed. Trochanter dorsally with four spine-like projections. Tarsus I with ventrodistal membranous flange. Lengths of solenidia \( \omega_1 \), \( \omega_2 \), \( \varphi_1 \), \( \varphi_2 \); Solenidia \( \varphi_2 \) and \( \omega_2 \) weakly clavate, solenidion \( \varphi_1 \) distinctly clavate, solenidion \( \omega_1 \) finger-shaped. Leg II (Fig. 2B). Setal formula: 0–2–1–4(1)–6(1). Tarsal claws simple, hooked; empodium large. Solenidion \( \omega_4 \) finger-shaped, solenidion \( \varphi \) 2–3 clavate. Trochanter dorsally with two spine-like projections. Setae \( tc'' \) and \( u' \) of tarsus with flattened and weakly sclerotized blunt-ended tips. Other leg setae pointed. Setae \( v' \) of femur, \( l' \), \( v'' \) of tibia and \( tc' \), \( pl'' \) of tarsus weakly barbed, other setae smooth. Leg III (Fig. 2C). Setal formula: 0–1–1–4–5. Claws and empodium of same shape as on tarsus II. Setae (\( tc \)) of tarsus with flattened and weakly sclerotized blunt-ended tips, other leg setae pointed. Seta \( pl'' \) of tarsus weakly barbed; other leg setae smooth. Leg IV (Fig. 2D). Setal formula: 0–1–1–4–5. Claws and empodium of same shape as on tarsus III. Seta \( d \) of femur blunt-ended, seta \( tc' \) of tarsus weakly blunt-ended, other leg setae pointed. Seta \( tc' \) of tarsus smooth; other leg setae weakly barbed. Male unknown.

**Figure 4** SEM images of *Pavania riparia* Sevastianov, 1980, female: A – gnathosoma in ventral view, B – left palp in ventral view, C – postpalpal seta, D – opisthosoma in ventral view.
Figure 5 *Pavania tadjikistanica* Sevastianov, 1980, female (holotype): A – dorsum of the body, B – venter of the body. Legs omitted.

**Material examined**

Female holotype, and 10 female paratypes, slide No. D-T-2, Ukraine, vicinity of Odessa, coast of Kuyalnik Liman, on *Copris lunaris* (Coleoptera, Scarabaeidae), 22 May 1960, Sevastianov V.D. leg.; 10 females, Ukraine, Odessa Prov., Razdelnaya District, vicinity of settlement Kolontaevka (46°43’ N, 30°18’ E), on *C. lunaris*, 20 Sept. 2009, Trach V.A. leg.; 8 females,
Ukraine, Kherson Prov., Kalanchak District, vicinity of settlement Preobrazhenka (46°11’ N, 33°36’ E), on *C. lunaris*, 2-4 May 2011, Trach V.A. leg.

**Remarks**

The holotype and paratypes available for study are in poor condition and redescription is based on additional material collected by the junior author.

*Pavania tadjikistanica* Sevastianov, 1980


**(Figs 5–7)**

**Redescription**

**Female (Figs 5–7)**

The holotype and two paratypes available for this study are in rather bad condition (Fig. 7) and some tiny structures like cupules, dimples of dorsal plates and weak barbs on setae are not discernible. Length of idiosoma 120, width 80.


**Idiosomal dorsum (Figs 5A, 7A)** — Prodorsal shield with three pairs of setae (*v* 1, *v* 2, *sc* 2) and a pair of broken trichobothria *sc* 1. Setae *sc* 2 pointed, other dorsal setae blunt-ended. Tips of setae *h* 2 thickened into tiny clubs. Posterior margins of tergites without projections. Lengths of

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**Figure 6** *Pavania tadjikistanica* Sevastianov, 1980, female (holotype): A – right leg I in dorsal view, B – right leg II in dorsal view, C – left leg III in dorsal view, D – left leg IV in dorsal view.
dorsal setae: $v_1$ 14, $v_2$ 6, $sc_2$ 36, $c_1$ 20, $c_2$ 20, $d$ 22, $e$ 16, $f$ 17, $h_1$ 13, $h_2$ 53. Distances between setae: $v_1$–$v_1$ 22, $v_2$–$v_2$ 29, $sc_2$–$sc_2$ 34, $c_1$–$c_1$ 24, $d$–$d$ 34, $e$–$e$ 43, $f$–$f$ 29, $h_1$–$h_1$ 12, $h_1$–$h_2$ 6.

**Idiosomal venter** (Figs 5B, 7B) — All ventral setae blunt-ended. Ap1 and ap2 well developed; prosternal apodeme not evident; sejugal apodeme (apsej) weakly developed laterally; ap3 and ap4 well developed. Coxal fields I-IV each with three pairs of setae. Genital setae ($g_1$, $g_2$) very small, vestigial. Lengths of ventral setae: 1$a$ 6, 1$b$ 6, 1$c$ 5, 2$a$ 8, 2$b$ 5, 2$c$ 8, 3$a$ 7, 3$b$ 7, 3$c$ 9, 4$a$ 6, 4$b$ 9, 4$c$ 8, ag 7, $g_1$ 1, $g_2$ 1, ps 9.

**Legs** (Fig. 6) — Leg setation as in previous species. Leg I (Fig. 6A). Tarsus with two small claws and semioval empodium. Setae $l'$ of femur, $l'$, $v'$ of genu, $k$, $l'$ and $v'$ of tibia blunt-ended; other leg setae (except eupathidia) pointed. Trochanter dorsally probably without spine-like projections. Lengths of solenidia $\omega_1$ 6, $\omega_2$ 3, $\phi_1$ 6, $\phi_2$ 5; solenidia $\omega_1$, $\phi_2$ and $\omega_2$ weakly clavate, solenidion $\phi_1$ distinctly clavate. Leg II (Fig. 6B). Tarsal claws simple, hooked; empodium large. Solenidia $\omega$ 5 and $\phi$ 3 weakly clavate. Trochanter probably without spine-like projections. All leg setae pointed. Leg III (Fig. 6C). Claws and empodium of same shape as on tarsus II. Seta $d$ of femur blunt-ended, other leg setae pointed. Leg IV (Fig. 6D). Claws and empodium of same shape.
Figure 8 *Pavania protracta* Sevastianov, 1980, female (paratype): A – dorsum of the body, B – venter of the body. Legs omitted.

shape as on tarsus III. Seta $d$ of femur blunt-ended, other leg setae pointed.

**Male unknown.**

**Material examined**

Female holotype, and 2 female paratypes, slide No. T-D-3, Tadjikistan, vicinity of Dushanbe, under elytra of *Onthophagus* sp. (Coleoptera, Scarabaeidae), 25 Aug. 1969, Ilyasov I.N. leg.
**Pavania protracta Sevastianov, 1980**

(Pavania protracta Sevastianov, 1980, p.1459, Figs 8–10. (Figs 8–10)

**Redescription**

**Female (Figs 8–10)**

Length of idiosoma 150, width 75.


**Idiosomal dorsum (Figs 8A, 10A)** — All dorsal shields smooth. Prodorsal shield with three pairs of setae (v1, v2, sc2) and a pair of clavate and distinctly barbed trichobothria sc1. All dorsal setae weakly barbed. Setae v2 blunt-ended, other dorsal setae pointed. Posterior margins of tergites without projections. Cupules not evident. Lengths of dorsal setae: v1 18, v2 7, sc2 28, c1 20, c2 26, d 21, e 20, f 21, h1 16, h2 36. Distances between setae: v1–v1 9, v2–v2 18, sc2–sc2 20, c1–c1 21, d–d 37, e–e 38, f–f 25, h1–h1 12, h1–h2 8.

**Idiosomal venter (Figs 8B, 10B)** — All ventral plates smooth. Setae 1a, 1b, 1c, 2b, 2c, and g1 blunt-ended; other ventral setae pointed. Setae 1a, 1b, 1c, 2b, and 2c weakly barbed; other ventral setae smooth. Only ap2 and ap3 present, weakly developed; other apodemes not evident. Coxal fields I-IV each with three pairs of setae. Lengths of ventral setae: 1a 5, 1b 3,
Legs (Fig. 9) — Leg setation as in previous species. Leg I (Fig. 9A). Tarsus with two small claws and very short empodium. Setae \( v' \) of genu, \( k \) and \( v' \) of tibia blunt-ended; other leg setae (except eupathidia) pointed. Setae \( v' \), \( l \) of femur, \( k \) of tibia, \( pl' \), \( u \) and all eupathidia of tarsus smooth; other leg setae weakly barbed. Trochanter dorsally with three spine-like projections; central projection distinctly smaller than lateral ones. Lengths of solenidia \( \omega_1 \) 9, \( \omega_2 \) 4, \( \varphi_1 \) 8, \( \varphi_2 \) 5; Solenidia \( \omega_1 \) and \( \varphi_2 \) finger-shaped; solenidion \( \omega_2 \) weakly clavate, solenidion \( \varphi_1 \) distinctly clavate. Leg II (Fig. 9B). Tarsal claws simple, hooked; empodium small, semioval. Solenidia \( \omega_5 \) finger-shaped and \( \varphi_3 \) weakly clavate. Trochanter with one spine-like projection. All leg setae pointed and weakly barbed. Leg III (Fig. 9C). Claws and empodium of same shape as on tarsus II. Seta \( pv' \) of tarsus thickened, spiniform, blunt-ended; other leg setae pointed. Setae \( pv' \) and \( tc' \) of tarsus smooth; other leg setae weakly barbed. Leg IV (Fig. 9D). Claws and empodium of same shape as on tarsus III. Seta \( pv' \) of tarsus thickened, spiniform, blunt-ended; other leg setae pointed. Setae \( pv' \) and \( tc' \) of tarsus smooth; other leg setae weakly barbed.

Figure 10 DIC photomicrographs of *Pavania protracta* Sevastianov, 1980, female (holotype): A – dorsal view, B – ventral view.
Male unknown.

Material examined

Female holotype, and 1 female paratype, slide No. T-D-4, Russia, Tatarstan, vicinity of Kazan, soil under maize, 27 Aug. 1968, Artemjeva T.I. leg.

Remarks

The holotype is in rather bad condition (Fig. 13). One female paratype was remounted and description is based on this paratype specimen.
**Pavania tahanae Sevastianov and Abo-Korah, 1985**

*Pavania tahanae Sevastianov and Abo-Korah, 1985, p.35, Figs 1–4. (Figs 11–13)*

**Redescription**

**Female (Figs 11–13)**

Length of idiosoma 135, width 80.


**Idiosomal dorsum (Figs 11A, 13A)** — All dorsal shields smooth. Prodorsal shield with three pairs of setae (v1, v2, sc2) and a pair of clavate and weakly barbed trichobothria sc1. Setae e weakly barbed, other dorsal setae apparently smooth. Setae v1 and v2 blunt-ended, other dorsal setae pointed. Posterior margins of tergites without projections. Cupules not evident. Lengths of dorsal setae: v1 18, v2 9, sc2 32, c1 22, c2 29, d 23, e 25, f 28, h1 18, h2 35. Distances between setae: v1–v1 11, v2–v2 20, sc2–sc2 28, c1–c1 37, d–d 53, e–e 46, f–f 42, h1–h1 11, h1–h2 9.

**Idiosomal venter (Figs 11B, 13B)** — All ventral plates smooth. All ventral setae smooth. Setae g1 and g2 blunt-ended, other ventral setae pointed. Only ap2 and ap3 clearly discernible; other apodemes not evident. Coxal fields I-V each with three pairs of setae. Lengths of ventral setae: 1a 7, 1b 8, 1c 6, 2a 13, 2b 6, 2c 15, 3a 9, 3b 7, 3c 13, 4a 7, 4b 8, 4c 8, ag 11, g1 4, g2 4, ps 10.

![Figure 12](image.png)

**Figure 12** *Pavania tahanae* Sevastianov and Abo-Korah, 1985, female (holotype): A – right leg I in dorsal view, B – right leg II in dorsal view, C – right leg III in dorsal view, D – right leg IV in dorsal view.
Legs (Fig. 12) — Leg setation as in previous species. Leg I (Fig. 12A). Tarsus with two small claws, empodium not evident. All leg setae smooth. Seta $k$ of tibia and all eupathidia of tarsus blunt-ended; other leg setae pointed. Trochanter dorsally without spine-like projections. Lengths of solenidia $\omega_1$ 9, $\omega_2$ 5, $\varphi_1$ 8, $\varphi_2$ 3; solenidion $\omega_1$ finger-shaped; solenidion $\omega_2$ baculiform, solenidia $\varphi_1$ and $\varphi_2$ distinctly clavate. Leg II (Fig. 12B). Tarsal claws simple, hooked; empodium very small, semi-oval. Solenidia $\omega$ 8 finger-shaped and $\varphi$ 2 weakly clavate. Trochanter without spine-like projections. All leg setae pointed and smooth. Leg III (Fig. 12C). Claws and empodium of same shape as on tarsus II. Solenidion $\varphi$ 2 weakly clavate. All leg setae pointed and smooth. Leg IV (Fig. 12D). Claws and empodium of same shape as on tarsus II. Solenidion $\varphi$ 2 weakly clavate. All leg setae pointed and smooth.

Male unknown.
Material examined
Female holotype, slide No. 704, Egypt, vicinity of Shibin El Kom, soil under cotton, 1 Sept. 1980, Abo-Korah leg.

Key to world species of Pavania (based on Khaustov & Frolov 2018b)

1. Setae $sc_1$ absent. ........................................................................................................... 2
   — Setae $sc_1$ present. ........................................................................................................... 5

2. Setae $1c$ and $2c$ present. ................................................................................................ 3
   — Setae $1c$ and $2c$ absent .............................................................................................. P. neotropica Khaustov and Frolov, 2017 (Brazil)

3. Setae $v_1$ shorter than distance between their bases; setae $cha$ less than three times longer than $chb$; setae $e$ never longer than $f$; setae $h_2$ at most seven times longer than $h_1$ .................. 4
   — Setae $v_1$ longer than distance between their bases; setae $cha$ three times longer than $chb$; setae $e$ longer than $f$; setae $h_2$ 15 times longer than $h_1$ ................................. P. gymnopleuri Hajiqanbar and Khaustov, 2010 (Iran)

4. Genu I with one seta ($v'$); dorsal idiosomal setae smooth; setae $c_1$ longer than $c_2$; setae $c_1$ and $d$ pointed ............................... P. sabzevarensis Hajiqanbar and Khaustov, 2010 (Iran)
   — Genu I with two setae ($v'$, $l'$); dorsal idiosomal setae weakly barbed; setae $c_2$ longer than $c_1$; setae $c_1$ and $d$ distinctly blunt-ended........... P. onthophagi Hajiqanbar and Khaustov, 2010 (Iran)

5. Setae $sc_1$ capitate ........................................................................................................... 6
   — Setae $sc_1$ seta-like ........................................................................................................ P. setiformis Loghmani and Hajiqanbar, 2013 (Iran)

6. Setae ($u$) and ($pv$) of tarsus I not lanceolate ................................................................. 7
   — Setae ($u$) and ($pv$) of tarsus I lanceolate .................................................................... P. lanceolata Bahramian and Hajiqanbar, 2015 (Iran)

7. Coxal fields II with 3 pairs of setae ..................................................................................... 8
   — Coxal fields II with 2 pairs of setae .............................................................................. P. equisetosa Mahunka, 1975 (Ghana)

8. Empodium on tarsi II-IV small, not reaching beyond tips of claws, seta $pv'$ on tarsi III and IV simple ................................................................. 9
   — Empodium on tarsi II-IV large, reaching beyond tips of claws ..................................... 10

9. Seta $pv'$ on tarsi III and IV thickened, spiniform and blunt-ended, solenidia on tibiae III and IV absent ................................................................. P. rotracta Savastianov, 1980 (Russia)
   — Seta $pv'$ on tarsi III and IV simple, solenidia on tibiae III and IV present .................. P. tahanae Savastianov and Abo-Korah, 1985 (Egypt)

10. Setae $h_2$ less than 3.5 times longer than $h_1$ ................................................................. 11
    — Setae $h_2$ more than 3.5 times longer than $h_1$ .......................................................... 15

11. Setae $c_1$ never reaching beyond bases of setae $f$; setae $c_1$ shorter than $h_2$; setae $d$ shorter than $h_2$ .................................................................................................................. 12
    — Setae $c_1$ reaching beyond bases of setae $f$; setae $c_1$ longer than $h_2$; setae $d$ and $h_2$ subequal ................................................................. P. perhirsuta Mahunka, 1973 (Ghana)

12. Setae $sc_2$ subequal to distance between their bases .................................................... 13
    — Setae $sc_2$ distinctly longer than distance between their bases ................................. P. perhirsuta Mahunka, 1973 (Ghana)
13. Setae c₁, d, e and f blunt-ended ................................................................. 14
   — Setae c₁, d, e and f pointed .............................................................. P. bembidii Khaustov, 2005 (Crimea)
14. Setae h₁ almost three times longer than ps, solenidion φ₂ with rounded tip .......... P. carabidophila Khaustov, 2005 (Russia: Krasnodarskiy Kray, Primorskiy Kray)
   — Setae h₁ almost subequal with ps, solenidion φ₂ with attenuated tip ......................... P. africana Khaustov and Frolov, 2018b (South Africa)
15. Setae h₂ more than six times longer than h₁ .................................................. 16
   — Setae h₂ less than six times longer than h₁ ................................................... 19
16. Setae sc₂ less than 2.5 times longer than v₁; setae f less than twice as long as e; setae e shorter than v₁ ................................................................. 17
   — Setae sc₂ at least 3.5 times longer than v₁; setae f more than twice as long as e; setae e longer than v₁ ................................................................. P. endroedyi Mahunka, 1975 (Ghana)
17. Setae sc₂ more than twice as long as v₁; setae f and d subequal; setae c₁ never reaching beyond posterior border of tergite C ......................................................... 18
   — Setae sc₂ less than twice as long as v₁; setae f longer than d; setae c₁ reaching beyond posterior border of tergite C ......................................................... P. brasiliensis Mahunka, 1970b (Brazil)
18. Setae 2a as long as 2c and both longer than c₁, d and f; setae m protruding beyond anterior border of gnathosoma ................................. P. elongata Hajiqanbar and Khaustov, 2010 (Iran)
   — Setae 2a longer than 2c and both shorter than c₁, d and f; setae m never protruding beyond anterior border of gnathosoma ................................. P. simplex Mahunka, 1973 (Ghana)
19. Setae f distinctly longer than e; setae e and h₁ subequal ..................................... 20
   — Setae e and f subequal; setae e longer than h₁ ............................................ P. tadjikistanica Sevastianov, 1980 (Tadjikistan, Iran)
20. Setae 2c subequal with 2a .............................................................................. 21
   — Setae 2c about two times longer than 2a . . P. riparia Sevastianov, 1980 (Ukraine, Slovakia)
21. Setae f more than two times longer than e ...................................................... 22
   — Setae f less than 1.5 times longer than e ...................................................... P. khlavensis Sobhi and Hajiqanbar, 2017 (in Sobhi et al. 2017) (Iran)
22. Most dorsal idiosomal setae weakly barbed and blunt-ended; setae c₁ longer than c₂; setae sc₂ less than twice as long as c₁ ........................................... P. kamalii Hajiqanbar and Khaustov, 2010 (Iran)
   — Dorsal idiosomal setae smooth and pointed; setae c₂ longer than c₁; setae sc₂ more than twice as long as c₁ ........................................... P. justiformis Lombardini, 1949 (Italy, Iran)

Genus Dolichocybe Krantz, 1957

Type species: Dolichocybe keiferi Krantz, 1957, by original designation.

Dolichocybe firjusae Sevastianov and Chydyrov, 1994

(Figs 14–16)

Redescription

Female (Figs 14–16)
Figure 14 *Dolichocybe firjusae* Sevastianov and Chydyrov, 1994, female (holotype): A – dorsum of the body, B – venter of the body. Legs omitted.
Body elongate, weakly sclerotized. Length of idiosoma 180, width 77.

**Gnathosoma** — Gnathosomal capsule, excluding palps, almost oval, its length 20, width 15. Dorsally with two pairs of smooth and pointed cheliceral setae (cha, chb). Setae cha 12 distinctly longer than chb 6. Dorsal median apodeme indistinct. Postpalpal setae (pp) rod-like. Venter of gnathosoma with one pair of smooth, pointed subcapitular setae m 17. Palps freely articulated to gnathosomal capsule, with smooth and pointed setae dFe and dGe dorsolaterally, setae dGe 12 pointed, more than two times longer than blunt-ended dFe 5. Palps ventrally with two subequal solenidia. Palp tibiotarsus with short ventrolateral seta (probably tibial l”) and distal eupathidium-like tiny seta. Palps terminated with well-developed tibial claw. Cheliceral stylets small, indistinct. Pharynx thin-walled, elongate, with weak lateral projections.

**Idiosomal dorsum (Figs 14A, 16)** — All dorsal shields smooth. Prodorsal shield with three pairs of setae (v₁, v₂, sc₂) and a pair of clavate, smooth trichobothria sc₁ with rounded apex; setae v₁ and v₂ located on the same transverse line. Setae v₁, v₂, and c₁ blunt-ended, other dorsal setae pointed. Setae h₁ and h₂ smooth, other dorsal setae weakly barbed. Cupules ia on tergite D and ip on tergite EF small, round; other cupules not evident. Lengths of dorsal setae: v₁ 14, v₂ 23, sc₂ 44, c₁ 13, c₂ 25, d 18, e 19, f 25, h₁ 13, h₂ 76. Distances between setae: v₁–v₁ 10, v₂–v₂ 22, sc₂–sc₂ 20, c₁–c₁ 30, d–d 36, e–e 36, f–f 30, h₁–h₁ 13, h₁–h₂ 5.

**Idiosomal venter (Figs 14B, 16)** — All ventral plates smooth. Setae 3a, 3c, and ag weakly barbed, other ventral setae smooth; setae g₁ and g₂ blunt-ended, other ventral setae pointed. Only ap3 and ap4 weakly developed, other apodemes indistinct. Coxal fields I-IV each with three pairs of setae. Lengths of ventral setae: 1a 13, 1b 11, 1c 10, 2a 17, 2b 11, 2c 23, 3a 12, 3b 13, 3c 15, 4a 9, 4b 10, 4c 12, ag 14, g₁ 3, g₂ 4, ps 7.
Legs (Fig. 15) — Leg setation as in previous species. Leg I (Fig. 15A). Tarsus with two small claws; empodium indistinct. Setae $d$ of femur, $l'$ of genu, $d$ of tibia, $tc'$ and $pl''$ of tarsus weakly barbed; over leg setae smooth. Seta $k$ and eupathidia blunt-ended, other leg setae pointed. Trochanter dorsally with one large spine-like projection. Lengths of solenidia $\omega_1$, $\omega_2$, $\varphi_1$, $\varphi_2$; solenidia $\varphi_2$ and $\omega_2$ peg-like, solenidion $\varphi_1$ distinctly clavate, solenidion $\omega_1$ finger-shaped. Leg II (Fig. 15B). Tarsal claws simple, hooked; empodium large, flipper-like. Solenidion $\omega$ 4 finger-shaped, solenidion $\varphi$ 1 very small, peg-like, difficult to discern. Trochanter dorsally without spine-like projections. All leg setae pointed. Setae $tc''$, $u''$ and ($pv$) of tarsus smooth, other setae weakly barbed. Leg III (Fig. 15C). Claws and empodium of same shape as on tarsus II. All leg setae pointed. Seta $d$ of tibia and all tarsal setae smooth, other leg setae weakly barbed. Leg IV (Fig. 15D). Claws and empodium of same shape as on tarsus III.
All leg setae pointed. Seta \( d \) of tibia and all tarsal setae smooth, other leg setae weakly barbed.

**Male unknown.**

**Material examined**

Female holotype, slide No. 908, Turkmenistan, Chardzhou Prov., vicinity of settlement Karabekaul, soil on cotton field, 24 Sept. 1982, Chydyrov P.R. leg.

**Discussion**

The main differences between the genera *Dolichocybe* and *Pavania* according to Cross (1965) are the shape of cheliceral styles (falcate and well developed in *Pavania* and small, indistinct in *Dolichocybe*) and position of palps (palps arising ventrolaterally in *Pavania* and laterally in *Dolichocybe*). In fact, the position of palps is rather uniform in all dolichocybid mites and can not be used as a generic-level character. The shape and size of styles are also highly variable. In typical *Pavania* (like most species associated with dung beetles), styles are really large and falcate. In typical *Dolichocybe* (*D. keiferi, D. subcorticalis* Khaustov, 2006, *D. sibiriensis* Khaustov, 2017, *D. firjusae*) styles are small and indistinct. However, at least in *Pavania protracta* and *P. tahanae*, size of the cheliceral styles is intermediate between typical for *Pavania* and for *Dolichocybe*. Therefore, the shape of cheliceral styles is a vague character, difficult to use in separation of the genera *Dolichocybe* and *Pavania*. Rahiminejad et al. (2011) redefined the genus *Dolichocybe* and used the following characters to separate *Dolichocybe* from *Pavania*: “gnathosoma apparently longer than wide; chelicerae small and indistinct; tarsus I with 10 or 11 setae; tibiae III and IV with one minute solenidion each; with deep constriction between propodosoma and hysterosoma separated by soft and transversely striated cuticle” (in *Dolichocybe*); “gnathosoma almost as long as wide; chelicerae large and distinct; tarsus I with 11 setae; tibiae III and IV with no solenidia; without deep constriction between propodosoma and hysterosoma” (in *Pavania*). Based on our study, the number of setae on tarsus I is the same in *Pavania* and *Dolichocybe* and can not be used in separation of these genera. The presence of solenidia on tibiae III and IV in *Dolichocybe* is also problematic character. In fact, solenidia on tibiae III and IV are apparently absent in *D. keiferi* (type species) (Cross 1965), *D. hippocastani* Rack, 1967, *D. picea* Rack, 1967 (Rack 1967), and absent in *D. subcorticalis, D. sibiriensis* (Khaustov 2006, 2017) and *D. firjusae* (present study). Potentially solenidia on tibiae III and IV are present in *Pavania brasiliensis* Mahunka, 1970, at least Mahunka (1970) depicted a tiny solenidion on the tibia III. Therefore, the presence of solenidia on tibiae III and IV also can not be used for separation of these genera. It is also difficult to understand the extent of constriction between propodosomal and hysterosomal.

Two redescribed herein species, *Pavania protracta* and *P. tahanae*, have intermediate characters between *Dolichocybe* and *Pavania*: body shape is similar to that in *Pavania* (not strongly elongate), gnathosoma is rather small (as in *Dolichocybe*), cheliceral styles are of medium size (intermediate), constriction between propodosomal and hysterosomal is not deep (as in *Pavania*). In addition, both of these species have unusually short — considerably shorter than tarsal claws — empodia on tarsi II-IV. *Pavania tahanae* also has solenidia on tibiae III and IV (like some “*Dolichocybe*”). Both species were collected in soil (not phoretic on insects) and potentially could represent a non-phoretic form of *Pavania/Dolichocybe* complex. At present female dimorphism has been evident only in the genus *Formicomotes* Sevastianov, 1980. Non-phoretic form of *F. heteromorphus* Magowski, 1988 has much shorter empodia than phoretic form (Magowski 1988). In this paper, we retain all species in the genera in which they were originally described. The redefinitions of the genera *Dolichocybe* and *Pavania* are necessary based on rediscription of their type species and more discoveries of new species in these two close genera (particularly *Dolichocybe*) are required (phoretic or in soil) to see what characters are more variable.
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