

TWO HETEROSTIGMATIC MITE SPECIES
(ACARI: DOLICHOCYBIDAE, PODAPOLIPIDAE)
ASSOCIATED WITH *SCARABAEUS PIUS*
(COLEOPTERA: SCARABAEIDAE) FROM IRAN

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During a study on insect-associated heterostigmatic mites (Acari: Prostigmata) in southern Isfahan Province, Central Iran, two colonies of mites were found on *Scarabaeus pius* (Illiger, 1803) (Coleoptera: Scarabaeidae): *Pavania lanceolata* sp. n. Bahramian et Hajiqaanbar (Dolichocybidae) that is easily discernible by some modified foliate setae on tarsi I–III; and *Tarsopolipus massai* Husband, 1989 (Podapolipidae) for which *Scarabaeus pius* is a new host record.

Key words: Heterostigmata, *Pavania*, *Tarsopolipus*, new species, host record.

INTRODUCTION

Beetles of the superfamily Scarabaeoidea are one of the most typical coleopterans, and even insects, to carry various kinds of mites. The mites from groups Mesostigmata, Prostigmata and Astigmatina encompass representatives associated with these beetles (e.g. MASAN & HALLIDAY 2009, COSTA 1963, OCONNOR 1982, HOUCK & OCONNOR 1991, BOCHKOV & KLIMOV 2005, KALISZEWSKI *et al.* 1995). In Prostigmata, some heterostigmatic families such as Dolichocybidae (HAJIQAANBAR & KHAUSTOV 2010), Scutacaridae (EBERMANN *et al.* 2003), Pygmephoridae (KHAUSTOV & TRACH 2012), Microdispidae (HAJIQAANBAR *et al.* 2012) and Podapolipidae (HUSBAND 1989) include species that have relationships with this group of beetles. Some mentioned families have only phoretic relationship with scarab beetles (like Dolichocybidae, Pygmephoridae and Scutacaridae) however, some others are parasite of their hosts (like Podapolipidae).

The purpose of this paper is to describe a new species belonging to the genus *Pavania* associated with the *Scarabaeus pius* (Coleoptera: Scarabaeidae), compare the species with closely related congeners and report of the previously described species *Tarsopolipus massai* on the aforementioned scarab beetle, that provide a new host record for this parasitic mite.

MATERIAL AND METHODS

Mites were removed from a scarabaeid beetle collected directly from their habitat, livestock dung pads. Mite specimens were cleared in lactophenol solution and mounted in Hoyer's medium. Terminology follows mostly that of LINDQUIST (1986) and in part (chaetotaxy of tarsus I of the *Pavania*) RAHIMINEJAD *et al.* (2011). The morphology of the mites was studied by a light microscope with phase contrast (Olympus BX51). All measurements in the description are given in micrometers for the holotype and four paratypes in parentheses. In descriptions of the leg setation the number of solenidia is given in parenthesis. Details of geographical coordinates have been recorded using GPS. The scarabaeid host beetle was identified by G. V. Nikolaeov (Al-Farabi Kazakh National University, Almaty, Kazakhstan). The holotype is deposited in the Acarological Collection, Department of Entomology, Faculty of Agriculture, Tarbiat Modares University, Tehran, Iran. One paratype is deposited in the Collection of Department of Animal Taxonomy and Ecology, A. Mickiewicz University, Poznan, Poland, and an other paratype in U.S. National Museum of Natural History, Washington D.C., U.S.A. Host beetle is retained with the holotype.

TAXONOMY

Family Dolichocybidae Mahunka, 1970

Pavania lanceolata Bahramian et Hajiqanbar sp. n.

(Figs 1–7)

Diagnosis. The new species is characterized by some setae modified being foliate on the tarsi I–III (setae pv' , pv'' , u' and u'' on the tarsus I; u' , tc'' , pv' , pv'' on tarsus II and pv'' on tarsus III); dorsal idiosomal setae smooth, blunt-ended (except v_2 , sc_2 and h_2 pointed); seta c_2 two times longer than c_1 ; seta f at least three times longer than e ; seta h_2 about 6.8 times longer than h_1 ; ventral idiosomal setae smooth and needle-like; pharynx obvious, with four muscle lobes on each side.

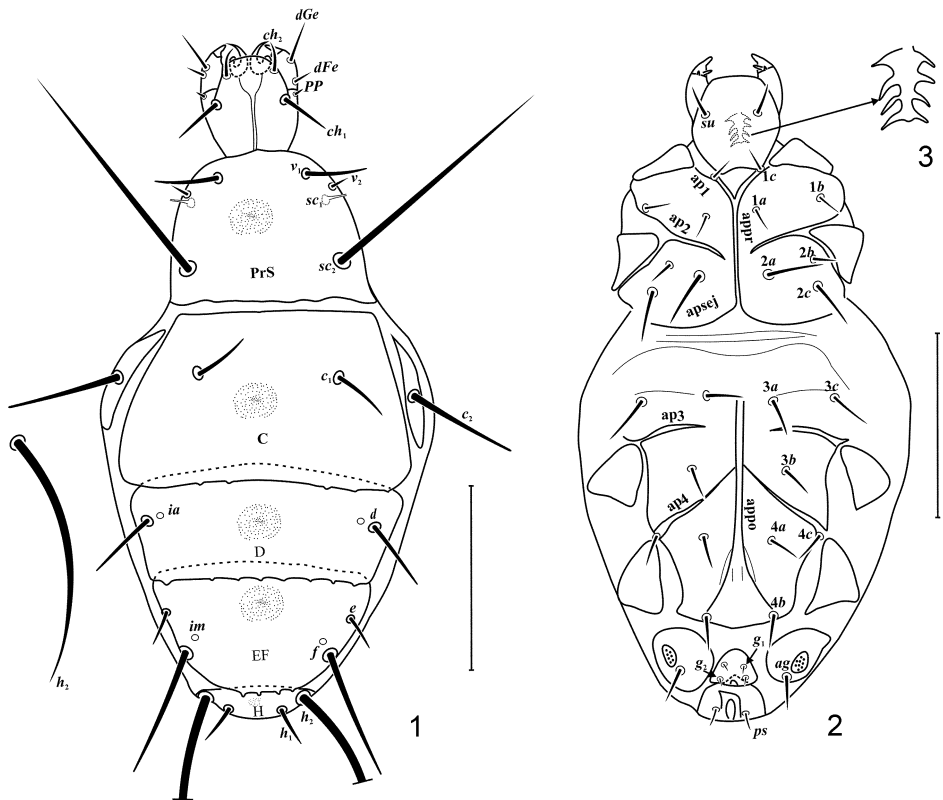
Description. Female (holotype). Length of idiosoma 124 (128–128), width 76 (72–79).

Gnathosoma (Figs 1–2). Length 23 (23–24), width 19 (21–23). Gnathosomal capsule subquadrangular in dorsal aspect, longer than wide. Cheliceral setae ch_1 12 (13–13), blunt ended; ch_2 6 (6–6), pointed. Dorsomedian apodeme apparent. Cheliceral stylets 6 (6–6) curved and falcate. Subcapitular setae su 5 (7–8), stiff and located on anterior half of subcapitulum. Pharynx visible with four muscle lobes (Fig. 3). Palpi evident, exceeding apex of gnathosoma capsule. Femorogenu with setae dGe 7 (7–9) and dFe 3 (3–3), both pointed; tibiotarsus with 2 solenidia; minute palpcoxal setae pp inserted near to articulation of each palp on gnathosoma capsule.

Idiosomal dorsum (Fig. 1). Elliptic in shape. All dorsal shields ornamented with sparse dimples; posterior margins of C, D and EF shields with backward undulating projections. All dorsal idiosomal setae smooth. Prodorsal shield subtrapezoid, anterior margin convex, with setae v_1 13 (12–14); v_2 5 (4–5), sc_2 49 (49–50). Trichobothridia (Sc_1) present, broken in holotype and paratypes. Setae v_1 shorter than distance between their bases and blunt, v_2 short and located posterolaterally to v_1 , seta sc_2 long and pointed. Median shield

of tergite C including setae c_1 13 (12–12), each lateral shield with one seta c_2 25 (22–25), both setae blunt; seta c_2 2-times longer than c_1 . Tergite D bearing setae d 15 (14–15), blunt; cupuli ia situated laterally to seta d . Tergite EF with blunt setae e 8 (8–9) and f 27 (26–28), one pair of cupuli im placed anterolaterally to setae f , seta f more than 3-times longer than e . Tergite H with setae h_1 9 (8–9) blunt ended and h_2 61 (59–61) long and pointed, seta h_2 about 6.8 times as long as h_1 . Distances between dorsal idiosomal setae: v_1-v_1 21 (22–23), v_2-v_2 27 (25–29), v_1-v_2 6 (8–9), sc_2-sc_2 35 (35–35), c_1-c_1 32 (30–33), $d-d$ 52 (53–56), $e-e$ 41 (43–45), $f-f$ 33 (33–35), $e-f$ 10 (10–10), h_1-h_1 13 (12–12), h_2-h_2 25 (23–25), h_1-h_2 8 (6–8).

Idiosomal venter (Fig. 2). All ventral idiosomal setae smooth and needle like; apodemes II and III not reaching to presternal apodeme; apodeme IV joined to the poststernal apodeme. Coxal field I with setae $1a$ 5 (5–6), $1b$ 5 (6–6), $1c$ 5 (4–5). Coxal field II with setae $2a$ 12 (12–14), $2b$ 6 (5–6), $2c$ 12 (10–12); setae $2a$ and $2c$ subequal, both longer than $2b$. Coxal field III with setae $3a$ 10 (8–11), $3b$ 8 (7–), $3c$ 10 (9–10); setae $3a$ and $3c$ subequal in length and both longer than $3b$. Coxal fields IV with setae $4a$ 7 (7–7), $4b$ 8 (7–11), $4c$ 8 (7–9), all subequal.



Figs 1–3. *Pavana lanceolata* sp. n., female: 1–2 = gnathosoma and idiosoma, 1 = dorsal view, 2 = ventral view (scale bars 50 μ m); 3 = pharynx (scale bar 10 μ m).

Genital plate with setae g_1 2 (2–3) and g_2 2 (2–2). Aggenital plates each bearing 1 seta ag 8 (6–7) and 1 small porous area. Pseudanal plate with setae ps 3 (3–4).

Legs (Figs 4–7). All setae of the legs smooth. Leg I (Fig. 4): with pair of claws and short, sessile empodium; setal formula: 4–2–6(2)–11(2). Tarsus: with setae pv' , pv'' , u' and u'' characteristically modified, lanceolate; setae tc' and tc'' subequal and longer than other tarsal setae; proral (p' , p'') and fastigial (ft' , ft'') setae subequal; solenidion ω_1 4 (3–4) finger shaped and prominent; solenidion ω_2 2 (2–2) baculiform. Tibia: with eupathidium k stiff, tapering; solenidion ϕ_1 6 (4–5) stalked and finger shaped, longer than baculiform ϕ_2 4 (3–4); seta d longer than other setae of the segment. Genu: setae v' shorter than l' ; seta l' subequal to tibial seta l' . Femur: seta d subequal to tarsal setae tc' and tc'' and more than three times longer than l'' .

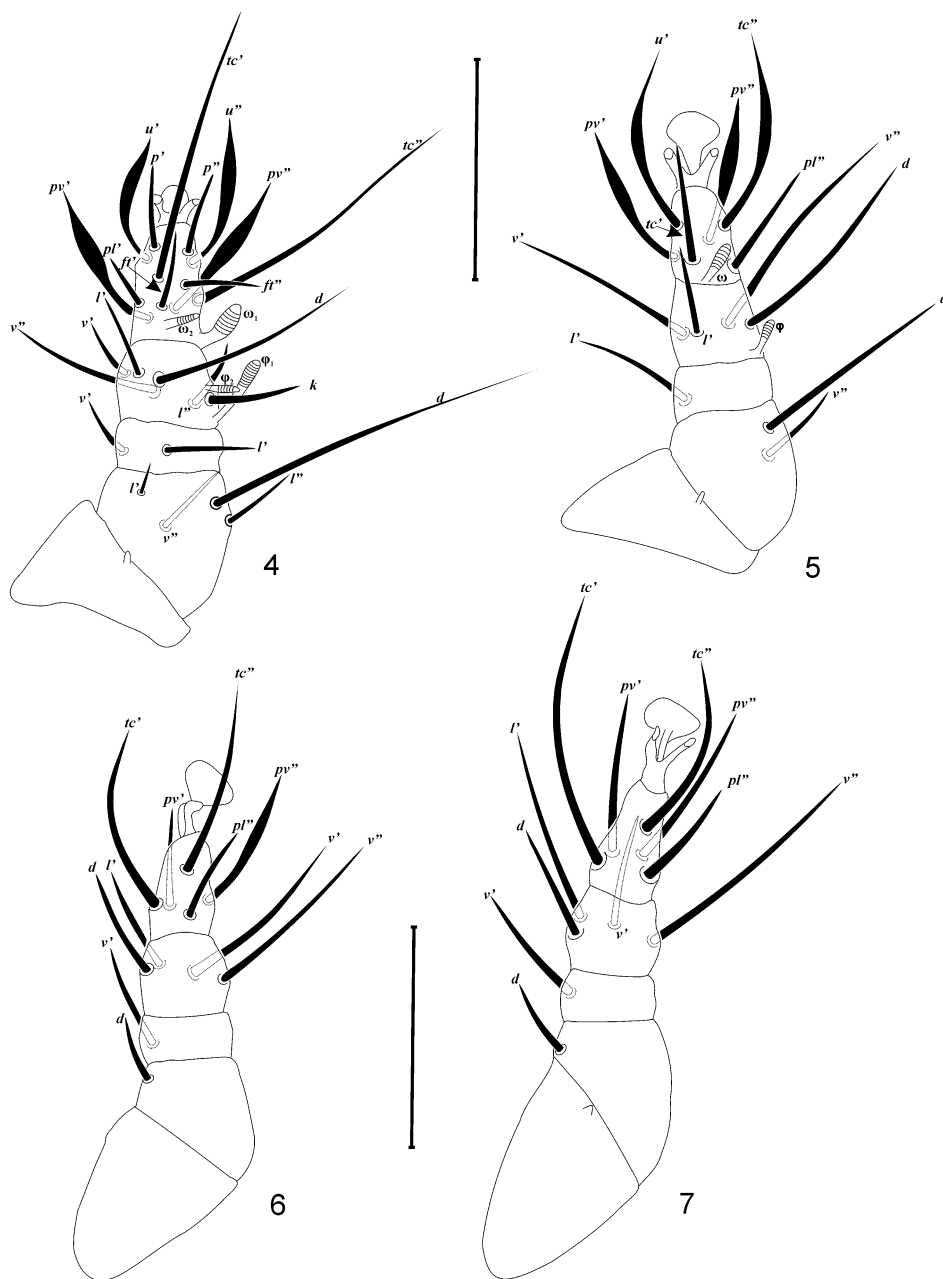
Leg II (Fig. 5). Setal formula: 2–1–4(1)–6(1). With pair of claws and large, stalked empodium. Tarsus: setae pv' , pv'' , u' and tc'' characteristically modified, lanceolate; solenidion ω 3 (3–4) finger shaped; setae pl'' and tc' subequal. Tibia: solenidion ϕ 3 (2–3) similar to ω but thinner; seta l' shortest on the segment. Genu: seta l' subequal to tibial seta l' . Femur: seta d on femur about 2.5 times as long as seta v'' .

Leg III (Fig. 6). Setal formula: 1–1–4–5. With a pair of claws and large, stalked empodium. Tarsus: seta pv'' characteristically modified, lanceolate; setae pl'' and pv' subequal and shortest on the segment. Tibia: setae v' and v'' subequal; seta d subequal to l' and both shorter than v' and v'' . Genu: seta v' subequal to tibial setae d and l' . Femur: seta d shorter than seta v' on genu.

Leg IV (Fig. 7). Setal formula: 1–1–4–5. With a pair of claws and large, stalked empodium. Tarsus: seta tc' longest on the segment; setae pv' and pv'' subequal. Tibia: seta d and v' subequal and shorter than other setae on the segment. Genu: seta v' subequal to tibial seta d and v' . Femur: seta d shorter than other leg setae.

Male. Unknown.

Differential diagnosis. The species *Pavania lanceolata* Bahramian et Hajiqanbar sp. n. is readily distinguished from all other species of the genus by some modified lanceolate setae on tarsus I (pv' , pv'' , u' , u''), tarsus II (u' , tc'' , pv' , pv'') and tarsus III (pv''). Based on drawings of MAHUNKA (1975), at least, tarsus II seta u' in *Pavania endroedyi* Mahunka, 1975 is foliate. Regardless of this trait, the new species is similar to its congeners *Pavania fusiformis* Lombardini, 1949; *P. endroedyi* and *P. kamalii* Hajiqanbar et Khaustov, 2010 in presence of trichobothridia and setae f longer than e . The new species differs from *Pavania fusiformis* by seta c_2 twice as long as c_1 (seta c_2 less than twice as long as c_1 in *P. fusiformis*), seta d longer than c_1 (setae c_1 and d subequal in *P. fusiformis*), seta sc_2 about 3.5 times longer than c_1 (seta sc_2 about 2.5 times longer than c_1 in *P. fusiformis*). The new species differs from *Pavania endroedyi* by seta c_2 two times longer than c_1 (setae c_1 and c_2 subequal in *P. endroedyi*), seta v_1 longer than e (setae e longer than v_1 in *P. endroedyi*), distance $d-d$ longer than $e-e$ (distance $e-e$ longer than $d-d$ in *P. endroedyi*). The new species also differs from *Pavania kamalii* by seta c_2 twice as long as c_1 (seta c_1 longer than c_2 in *P. kamalii*), seta f at least three times longer than e , (seta f about two times longer than e in *P. kamalii*), seta d longer than c_1 (seta c_1 longer than d in *P. kamalii*).



Figs 4–7. *Pavana lanceolata* sp. n., female, dorsal view of legs: 4 = I, 5 = II, 6 = III, 7 = IV (scale bars 20 μ m).

Type material. Holotype (MB-20130508-1) and four paratypes, recovered from a vial containing ethanol (75%) and one specimen of *Scarabaeus* (*Scarabaeus*) *pius* (Illiger, 1803) beetle (Coleoptera: Scarabaeidae). The host beetle was collected from its habitat i.e. livestock dung pads, located in Iran, Southern Isfahan Province, near Semirom town, 31.26°N, 51.29°E, 2,460 m, 8 May 2013, leg. M. Bahramian.

Etymology. The new species is named due to lanceolate shape of some setae on tarsi I-III.

Family Podapolipidae Ewing, 1922

Tarsopolipus massai Husband, 1989

Material examined. A large colony including all life stages of the mite from under the elytra of *Scarabaeus* (*Scarabaeus*) *pius* (Coleoptera: Scarabaeidae), the same host specimen as for *Pavania lanceolata* sp. n. Host beetle collected from livestock dung pads, Central Iran, Isfahan Province, around Semirom town, 31.26°N, 51.29°E, 2,460 m, 8 May 2013, leg. M. Bahramian.

World distribution. Italy, Iran, France, Spain, East Africa.

Remarks. This is a new association between this parasitic mite and the scarab beetle *Scarabaeus pius*. All previous host records of this mite are *Scarabaeus semipunctatus* reported by HUSBAND (1989) in Italy, France, Spain and East Africa; by HAJIQANBAR *et al.* (2007) in the vicinity of Galugah Forest, Mazandaran Province, northern Iran; and by MORTAZAVI and HAJIQANBAR (2012) in Kerman Province, Iran.

DISCUSSION

The genus *Pavania* now includes 20 species of which 9 (c. 50%) are phoretic on 4 genera of Scarabaeidae: *Copris*, *Onthophagus*, *Gymnopleurous* and Scarabaeidae (CROSS 1965, SEVASTIANOV 1980, HAJIQANBAR & KHAUSTOV 2010, RAHIMINEJAD *et al.* 2011, LOGHMANI *et al.* 2013, present study). Including *Scarabaeus pius* as a new host record for mites of the genus *Pavania*, the number of *Scarabaeus* species carrying mites of this genus is raised to 8 (see Table 1). All mentioned host beetles are dung dwelling as this habitat provides a rich source of fungi for mite nutrition. Although no life history of the species of *Pavania* has already been reported, they appear to be fungivorous in this substrate and, perhaps help in spreading fungi spores.

There are five podapolipid genera parasitizing scarab beetles: *Dilopolipus* Husband, *Archipolipus* Husband, *Stenopolipus* Husband, *Scarabapolipus* Husband et Kurosa, and *Tarsopolipus* Berlese. Nine species of the genus *Tarsopolipus* are associated with three scarabaeid genera *Drepanopodes*, *Kheper* and *Scarabaeus*. Including *S. pius*, six species of *Scarabaeus* are exploited by mites of the genus *Tarsopolipus*. Heretofore, *Tarsopolipus massai* was found only on

Table 1. Current knowledge on mites of the genus *Pavania* associated with beetles of the family Scarabaeidae.

Mite	Host	Locality	Reference
<i>P. riparia</i>	<i>Copris lunaris</i> Linneaus, 1758	Ukraine, Slovakia	SEVASTIANOV 1980
<i>P. tadjikistanica</i>	<i>Onthophagus</i> sp.	Tajikistan	SEVASTIANOV 1980
<i>P. fusiformis</i>	<i>Scarabaeus sacer</i> Linneaus, 1758	Italy	CROSS 1965
<i>P. gymnopleuri</i>	<i>Gymnopleuros mopsus persianus</i> Reitter, 1909	Iran	HAIJANBAR & KHAUSTOV 2010
<i>P. sabzevarensis</i>	<i>Gymnopleuros mopsus persianus</i> Reitter, 1909	Iran	HAIJANBAR & KHAUSTOV 2010
<i>P. onthophagi</i>	<i>Onthophagus gibbosus gibbosus</i> Scriba, 1790	Iran	HAIJANBAR & KHAUSTOV 2010
<i>P. kamalii</i>	<i>Scarabaeus</i> spp.	Iran	HAIJANBAR & KHAUSTOV 2010
<i>P. setiformis</i>	<i>Onthophagus (Palaeonthophagus)</i> <i>vitulus</i> (Fabricius, 1776)	Iran	LOGHMANI <i>et al.</i> 2013
<i>P. lanceolata</i> sp. n.	<i>Scarabaeus pius</i>	Iran	this study

Scarabaeus semipunctatus, however, the current study revealed *Scarabaeus pius* as a new host record for this parasitic mite.

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Acknowledgements – We are grateful to Dr. G. V. Nikolaev (Al-Farabi Kazakh National University, Almaty, Kazakhstan), for identifying the scarabaeid beetle host.

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Revised version received February 24, 2014, accepted December 20, 2014, published April 30, 2015