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Article

A new ant-associated species of *Laelaspis* (Acari: Mesostigmata: Laelapidae) from Iran

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ABSTRACT
In this paper, a new species of the genus *Laelaspis* Berlese, *L. angustiseta* **sp. nov.** is described based on morphological characters of the adult female specimens collected in association with *Tapinoma erraticum* (Latreille) and *Tapinoma simrothi* Krausse (Hymenoptera: Formicidae) in Chaharmahal va Bakhtiari Province, Iran.

KEY WORDS: Adult; Dermanyssoidea; description; female; myrmecophilous mites; taxonomy.

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INTRODUCTION

The nest of ants is a unique habitat for different mite species in various parts of the world. Mites are the most abundant arthropod group in ant nests. The species composition of mites found in ant nests is very diverse. Similar to other myrmecophilus, mites are ectoparasites or live commensally in ant colonies: they are scavengers, predators, ectoparasites or phoretic on ant bodies (Gwiazdowicz 2008; Kamczyc and Gwiazdowicz 2013). Some laelapid mites have been collected directly from ant colonies and some of them separated from the soil of ants' nests. *Laelaspis* was erected by Berlese (1903) as a subgenus of *Laelaps* Koch, 1839, with the type species *Laelaps astronomicus* Koch, 1839. It was considered as full generic status by some authors (Berlese 1921, 1924; Vitzthum 1931; Radford 1950; Hunter 1961, 1964; Hunter and Davis 1962), whereas considered as a subgenus of *Hypoaspis* Canestrini, 1885 by others (Berlese 1903; Baker and Wharton 1952; Van Aswegen and Loots 1970; Karg 1978, 1979, 1982, 1989, 1993a, b, 1994, 2000). In this study it is considered as a genus of the subfamily Hypoaspidinae. Overall, about 45 species of *Laelaspis* have been described worldwide mainly in association with different ant species (Moreira 2014; Kazemi 2015; Kazemi *et al.* 2016). Some ant genera from which *Laelaspis* mites have been collected are *Aphaenogaster* Mayr, 1853, *Myrmica* Latreille, 1804, *Eciton* Latreille, 1804, *Neivamyrmex* Borgmeier, 1940 and *Iridomyrmex* Mayr, 1862. Khalili-Moghadam and Saboori (2015) reported some species of laelapid mites of different genera including *Laelaspis*, *Pogonolaelaps* Nemati and Gwiazdowicz, 2016, *Gaeolaelaps* Evans and Till, 1966 and *Myrmozercon* Berlese, 1902 associated with the nests of

Tapinoma simrothi Krausse, 1911 *Pheidole pallidula* (Nylander, 1849) and *Monomorium destructor* (Jerdon, 1851) in Chaharmahal va Bakhtiari Province, Iran. Up to now, 17 species of *Laelaspis* have been reported from Iran, including eight new species found mostly in association with ants and rarely in soil and litter (Joharchi *et al.* 2012a, b; Babaeian *et al.* 2013; Kazemi and Rajaei 2013; Ramroodi *et al.* 2014; Kazemi 2015; Kazemi *et al.* 2016).

In a survey done on some mesostigmatic mites associated with ants in the central part of Iran during 2016–2018, a new species of *Laelaspis* was collected from *Tapinoma erraticum* (Latreille, 1798) and *Tapinoma simrothi* nests. The genus diagnosis given by Kazemi (2015) preceded a note made later by Kazemi *et al.* (2016).

MATERIALS AND METHODS

Samples were collected from ant nest materials from Lordegan County, Chaharmahal va Bakhtiari Province in central part of Iran. Mites were extracted from samples using Berlese funnels, placed in lactic acid at 55°C for clearing, and then mounted in Hoyer's medium on permanent microscope slides for examination. Line drawings were made using a drawing tube and figures were created with Corel X–draw software, based on the scanned line drawings. Measurements of structures expressed as minimum-maximum ranges in micrometers (μm) were obtained using scaled ocular lens of Olympus BX–43 and calibrated Digimizer Software. The dorsal setae notation followed that of Lindquist and Evans (1965). Leg and palp setal notations and chaetotactic formulae are adapted from Evans (1963a, b). Length of the dorsal shield is the distance from its anteromedian edge anterior to bases of setae *j1* to its posteromedian edge posterior to bases of setae *Z5*; width of dorsal shield is measured at widest part; length of the sternal shield was measured along midline from anterior edge to its posterior margin, width measured between coxae II-III (widest part) and slightly above the insertion of *st2* (narrowest point); the length of anal shield is midline from the anterior margin to the posterior edge of the cribrum, and width was measured at widest point. Setae were measured at the level of insertions to their tips and distance between setae as the distance between their insertions. For curved setae and all morphological characters with oblique situation at first, high-quality microscopic photographs were taken and then the length of the curved setae and oblique parts were measured by calibrated Digimizer software. Length of leg segments was measured dorsomedially, and tarsi were measured without the stalk and pretarsus. The term lyrifissure and pore are used to refer to slit-shaped and circular or oval-shaped cuticular openings, respectively. We have attempted to identify all pore-like structures, but we acknowledge that some may have been overlooked.

RESULTS

Genus *Laelaspis* Berlese, 1903

Laelaspis (*Laelaspis*) Berlese 1903: 13.
Laelaspis (*Laelaspis*). — Berlese 1904: 422.
Laelaspis. — Ewing 1909: 64 (in part).
Laelaspis. — Berlese 1921: 157; Vitzthum 1929: 22; Evans 1957: 231; Hunter 1961: 672; Bregetova 1977: 542; Zaher 1986: 195; Casanueva 1993: 40; Joharchi *et al.* 2012: 2000; Karg and Schorlmmer 2013: 203.
Hypoaspis (*Laelaspis*). — Vitzthum 1943: 762; Evans and Till 1966: 160; van Aswegen and Loots 1970: 193; Karg 1979: 99; Karg 1982: 234; Karg 1989: 118; Karg 1993a: 136; Faraji *et al.* 2008: 208.
Hypoaspis. — Karg 1979: 66 (in part); Karg 1993a: 135.

Type species: *Iphis astronomicus* Koch, 1839

Diagnosis

The genus diagnosis of Kazemi (2015) was followed as well as a note which was considered by Kazemi *et al.* (2016).

Laelaspis angustiseta sp. nov. (Figures 1–22)

Type materials

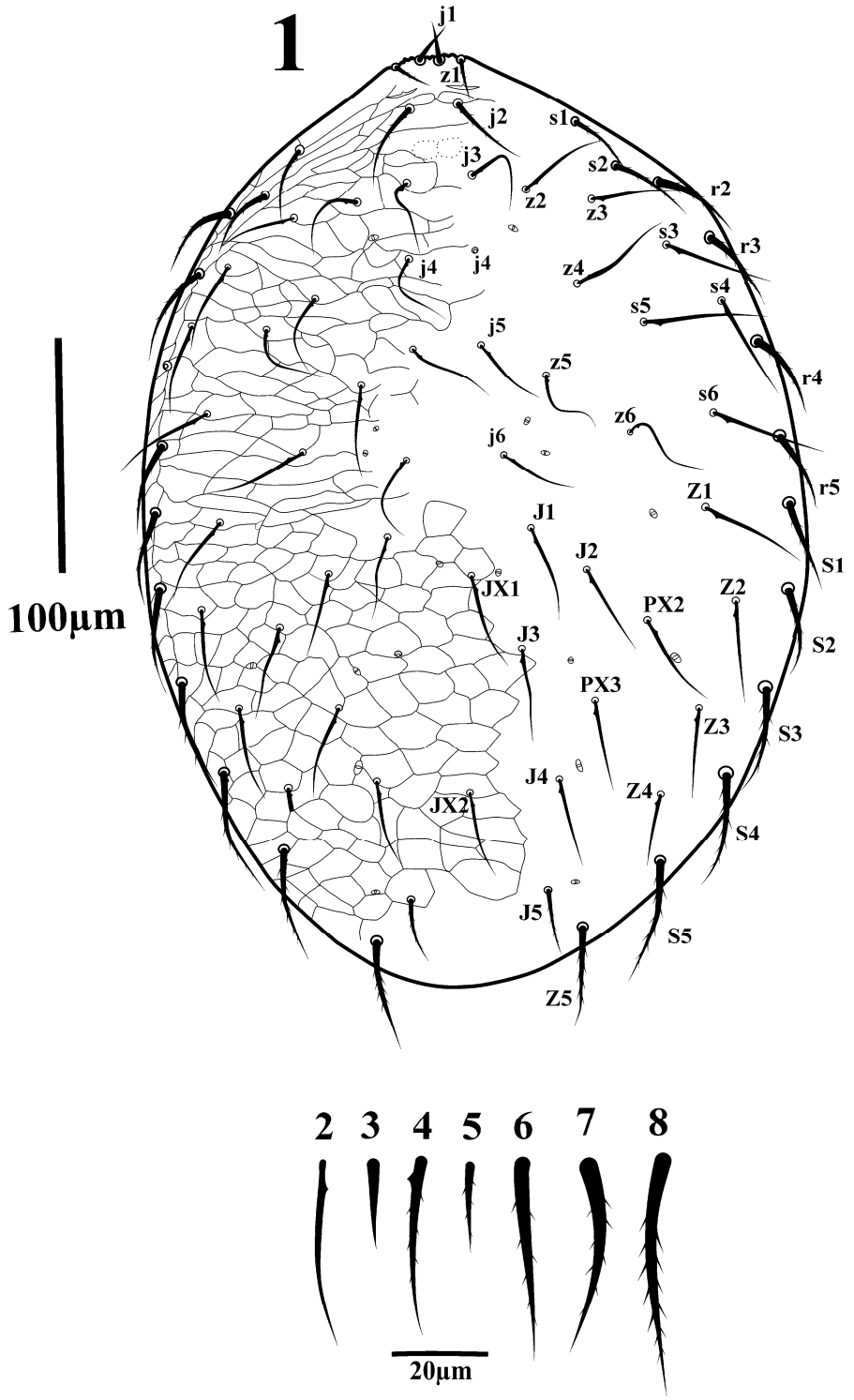
Holotype, female, Lordegan county (31° 31' 03" N, 50° 29' 32" E, 1756 m a.s.l.), Chaharmahal va Bakhtiari Province, from nest of *Tapinoma erraticum*, coll., A. Khalili-Moghadam, 11 April 2017, deposited in the Acarological collection, Jalal Afshar Zoological Museum (JAZM), Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran. Paratypes: one female, same data as holotype, deposited in Senckenberg Museum für Naturkunde Görlitz Am Museum 1 02826 Görlitz, Germany; two females, same data as holotype and two females, Kohrang County (32° 35' 15" N, 50° 12' 01" E, 2391 m a.s.l.), from nest of *Tapinoma simrothi*, coll., A. Khalili-Moghadam, 26 May 2017, deposited in the Acarological Laboratory, Plant Protection Department, Agricultural College, Shahrekord University, Shahrekord (APAS) Iran.

Description of female (Four specimens measured)

Dorsal idiosoma (Figs. 1–9) – Dorsal shield oval-shaped (Fig. 1), covering entire idiosoma, with lateral strip bent in at level of *s1* to *S5* (Fig. 9), faint polygonal ornamentation more distinct throughout opisthonotal region a little anterior to setae *j6,* reticulation similar to wider cells in most podonotal area and with lineate-reticulate ornamentation at its anterolateral part; shield 395–420 long, width at level of setae *r5* 298–315, shield with 39 pairs of thin and simple setae bearing a basal small knob (Fig. 2), 22 pairs on podonotal area (*j1–6*; *z1–6*; *s1–6*; *r2–5*) and 17 pairs on opisthonotal region (*J1–5*, *Z1–5*, *S1–5*), two unpaired setae *JX1* (located posterior to *J1*) and *JX2* (between *J4–J4*) and including *PX2* between *J2* and *Z2* and *PX3* a little outside *J3* and *J4*. Dorsal setae varies in thickness and length. The lengths of podonotal setae are as follows: *j1* (18–20) slightly thicker than other setae in series (Fig. 3), *j2* (34–38) distinctly barbed (Fig. 4), *j3* (40–45) *j4* (34–38) *j5* (38–43) *j6* (40–45); *z1* (18–20) slightly barbed (Fig. 5), *z2* (34–38), *z3* (36–40), *z4* (41–47), *z5* (37–39), *z6* (45–50); *s1* (28–32), *s2* (35–37), *s3* (43–47), *s4* (46–53), *s5* (44–49), *s6* (49–53); *r2* (37–40), *r3* (39–42), *r4* (38–39), *r5* (38–42) and *r6* (18–22) located in ventral side opposite to coxae III,. Setae in *r* series barbed and thicker than all other podonotal setae. The shape of some dorsal setae (e.g. *r*, *S* and *Z5* setae) were shown in Figures 6–8. The lengths of opisthonotal setae are as follows: *J1–4* (40–46), *J5* (31–35), *Z1–2* (45–49), *Z3* (42–44), *Z4* (37–38), *Z5* (51–53); *S1* (38–42), *S2* (37–40), *S3* (49–53), *S4* (54–58), *S5* (55–59), *PX2–3* (44–48) and *JX1–2* (42–46). Podonotal and opisthonotal regions with 11 pairs of pore-like structures, as shown in Figure 1.

Ventral idiosoma (Fig. 10) – Tritosternum with tubular base and pilose laciniae (53–58). Pre-sternal area with weakly lineate ornamentation, pre-sternal plates absent and probably fused to anterior margin of sternal shield. Sternal shield with thin reticulation in anterior and lateral surfaces, median surface smooth, 80–85 long, 130–135 wide (at level of projection between coxae II–III) and 80–84 at level of *st2*, with a notch anteromedially at level of tritosternum placement; posterior margin concave. Sternal setae smooth, *st1* (34–38), *st2* and *st3* (32–36), *iv1* and *iv2* slit-like, located slightly behind setae *st1* and *st2* respectively. The distances between *st1–st1* (45–48), *st2–st2* (59–65) and *st3–st3* (98–100). Setae *st4* (33–35) and pore-like *iv3* located on integument on the surface of angulate endopodal III–IV near posterior margin of the sternal shield. Epigynal shield elongate and broad, 220–225 long from anterior to posterior margins, 120–125 wide at *st5* level, 175–178 wide at broadest point nearly at level of *ZV1–ZV1* and 155–157 wide at level of *JV1–JV1*; the ratio

of length (*L*) to width (*W*) at three different points of epigynal shield (width at levels of *st5*, *ZV1* and *JV1* placement) are as follows: *st5*–*st5* ($L/W_{st5\text{-}st5}$) 1.81, $L/W_{ZV1\text{-}ZV1}$ 1.27 and $L/W_{JV1\text{-}JV1}$ 1.43–1.44, shield gradually narrowed from widest point, posteriorly rounded and covered anterior margin of anal shield, inverted-inner V stria with seven long, rather narrowly V-shaped ending in two irregular distal cells; setae *st5* (38–41), two pairs of elongate setae *ZV1* (51–53) and *JV1* (57–60) inserted on lateral margins and on the surface of the epigynal shield.



Figures 1–8. *Laelaspis angustiseta* **sp. nov.** (female) – 1. Dorsal idiosoma; 2. Dorsal seta; 3. *j1* seta; 4. *j2* seta; 5. *z1* seta; 6. *r* seta; 7. *S* seta; 8. *Z5* seta.

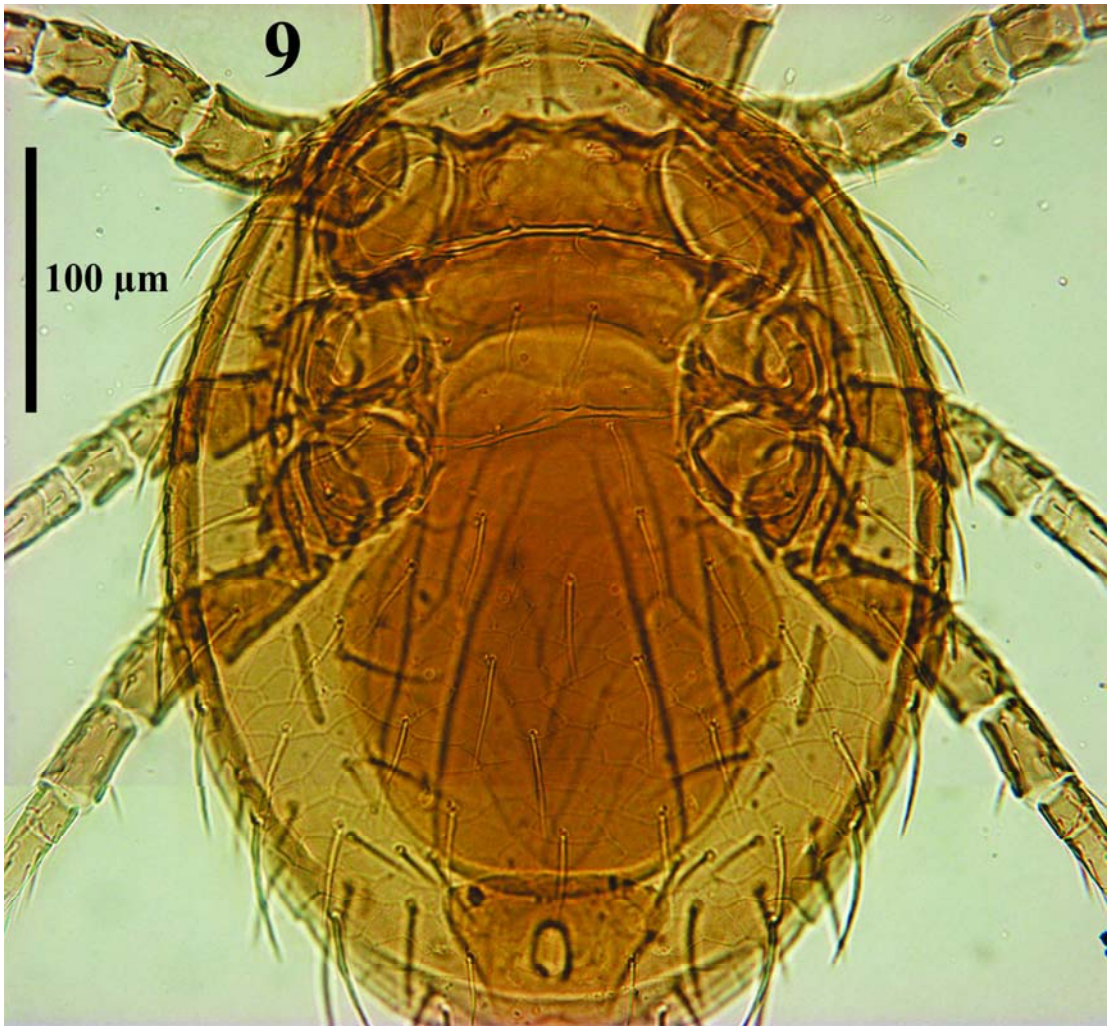


Figure 9. *Laelaspis angustiseta* **sp. nov.** (female) – Details of Lateral strip of dorsal shield.

Setae *JV2* inserted adjacent to the lateral margins of epigynal shield off shield surface. Paragenital pores (*iv5*) located on soft integument between lateral margins of the epigynal shield and coxae IV. Subtriangular anal shield reticulated, 66–70 long, 84–85 wide, paranal setae (17–19) slightly shorter than post-anal seta (20–22), with one pair of pore-like structure (*gv3*) on lateral margins of angular portion. Cribrum extending around post-anal seta. Opisthogastric surface with one pair of elongate metapodal plates (40–42 × 7), 14 pairs of setae, *R1–2* smooth and the others barbed, *ZV4–5* with distinct barbs throughout, *ZV2* (24–29), *ZV3* (31–34), *ZV4* (41–42), *ZV5* (51–52), *JV2* (35–40), *JV3* (25–30), *JV4–JV5* (49–52), *R1* (18–21), *R2–R3* (24–26), *R4* (32–34), *R5* (39–42) and *UR* (32–36); and five pairs of pore-like structures. Peritreme long and narrow, extending almost to anterior margin of coxa I, peritrematal plate separated from the exopodal shield, wider in middle part, bearing two pore-like structures (*ip* and *gp*) on lateral margin of the shield at level between coxae II–III (Fig. 10). Stigma located between coxae III–IV, surrounded by the nearly broad stigmatal plate and narrower apically poststigmatal plate that extending beyond coxa IV. The surface of poststigmatal plate bearing minute pore-like structures posterior to stigmatal opening, apparently a large glandular structure with two circular openings and another one at the distal end of the plate (Fig. 10). Exopodal plates contiguous, fused anteriorly with anterolateral extensions of the sternal shield at the anterior part of coxa II and posteriorly with expanded podal plate behind coxa IV adjacent to *iv5*. Endopodals II–III fused with lateral margins of the sternal shield, III-IV wide angular with three pieces of platelets posteriorly as in Figure 10.

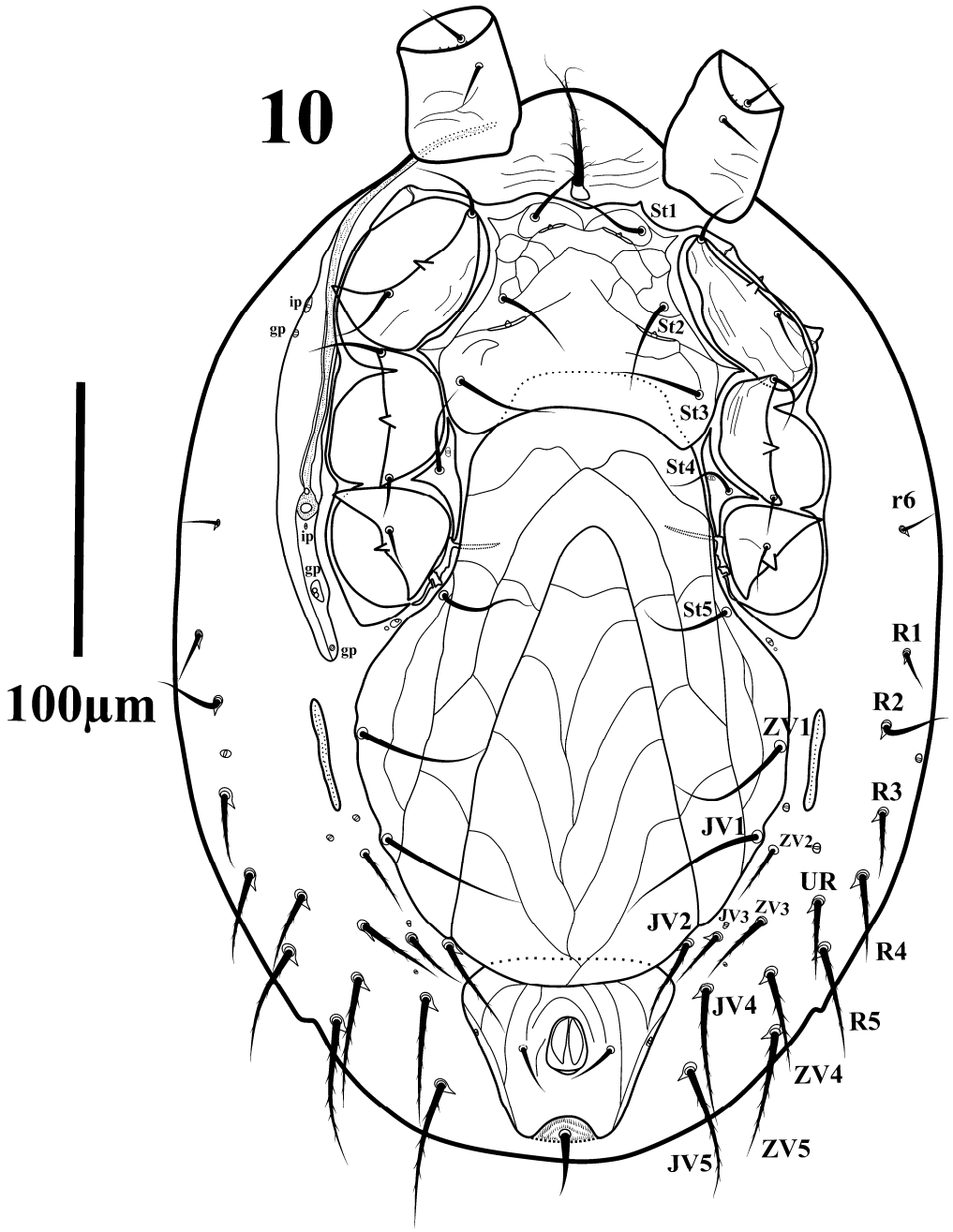
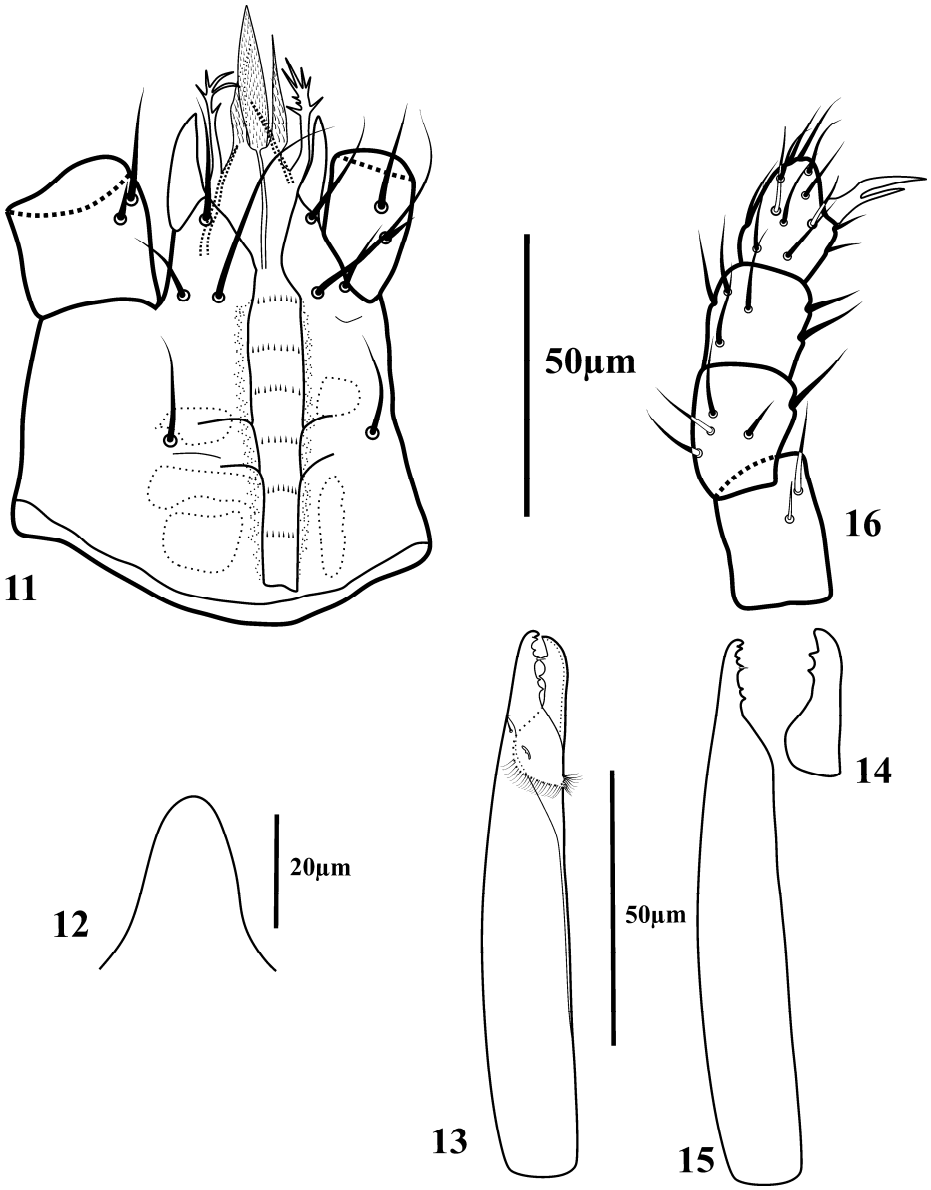


Figure 10. *Laelaspis angustiseta* **sp. nov.** (female) – Ventral view of idiosoma.

Gnathosoma (Figs. 11–16) – Hypostome (Fig. 11) with three pairs of smooth simple setae; *h1* (20), *h2* (15–17) and *h3* (35–39). Palpcoxal setae (*pc*) 18–20 long. Deutosternal groove with 6 denticulate rows of 6–9 denticles and one smooth row at anteriormost. Corniculi horn-like. Internal malae with two lateral extensions fringed one-third apically and two separated pilose median extensions, both laterals and median extensions extending well beyond the tip of curniculi. Labrum almost elongate and pilose. Epistome rounded with lateral of anterior margin smooth (Fig. 12). Chelicerae (Fig. 13) chelate dentate, moveable digit (24–28) with two teeth (Fig. 14), middle article (90–100) ending in a fixed digit (23–27) (Fig. 15), bearing a moderately enlarged tooth at level of setaceous pilus dentilis insertion, 2 teeth proximally and 2 distally ending in terminal hook, bears a

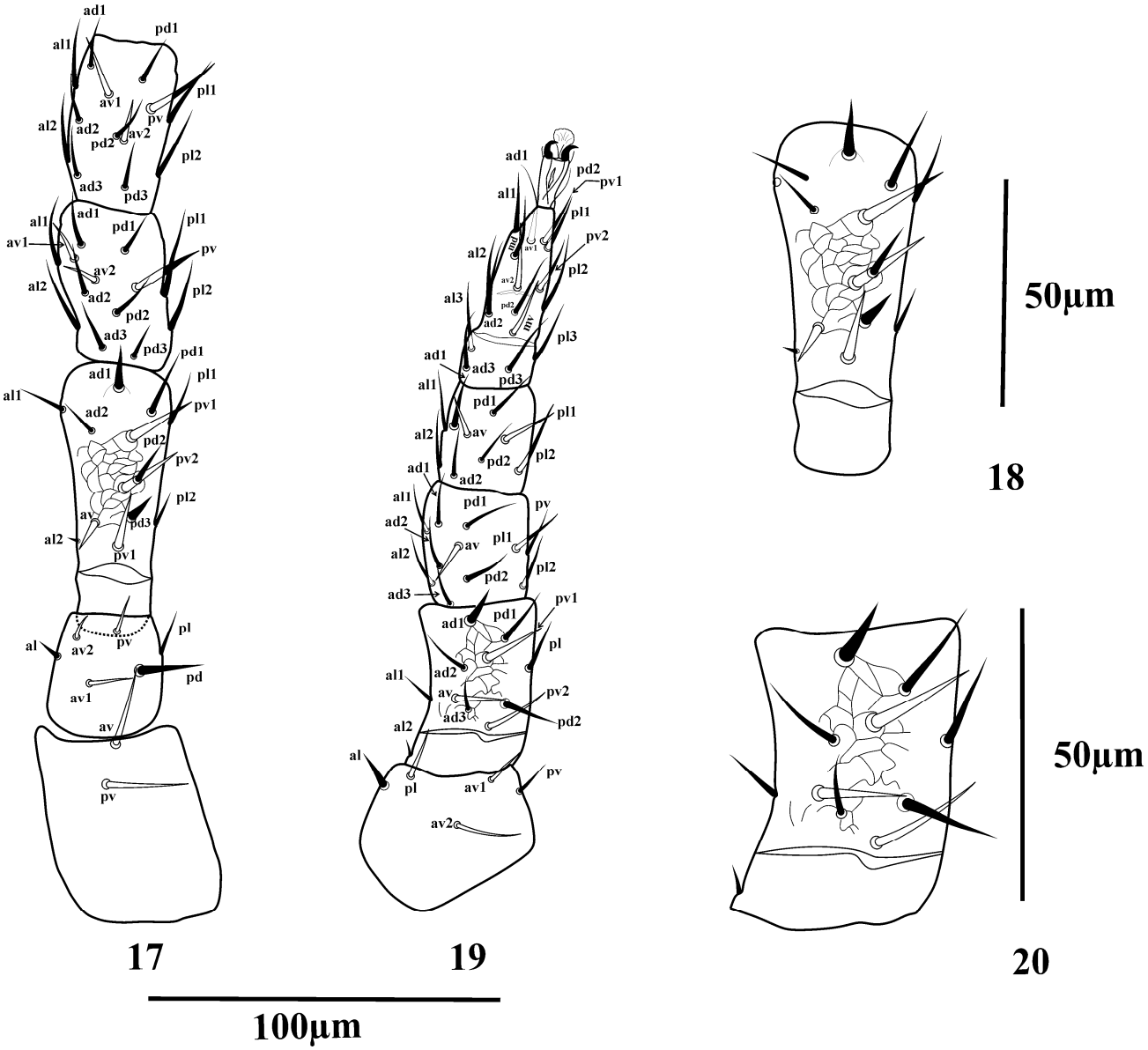
slender acicular dorsal seta, arthrodial processes developed. Palp segment lengths: trochanter (22–27), femur (23–26), genu (16–19), tibia (18–22), tarsus (15–19). Palp chaetotaxy normal, (sensu Evans and Till 1965), with simple setae; palp apotele two-tined (Fig. 16) with 16–18 long from base to anterior tip of longer fork.



Figures 11–16. *Laelaspis angustiseta* **sp. nov. (**female) – 11. Hypostome; 12. Epistome; 13. Chelicera; 14. Detail of moveable digit; 15. Fixed digit; 16. Palp.

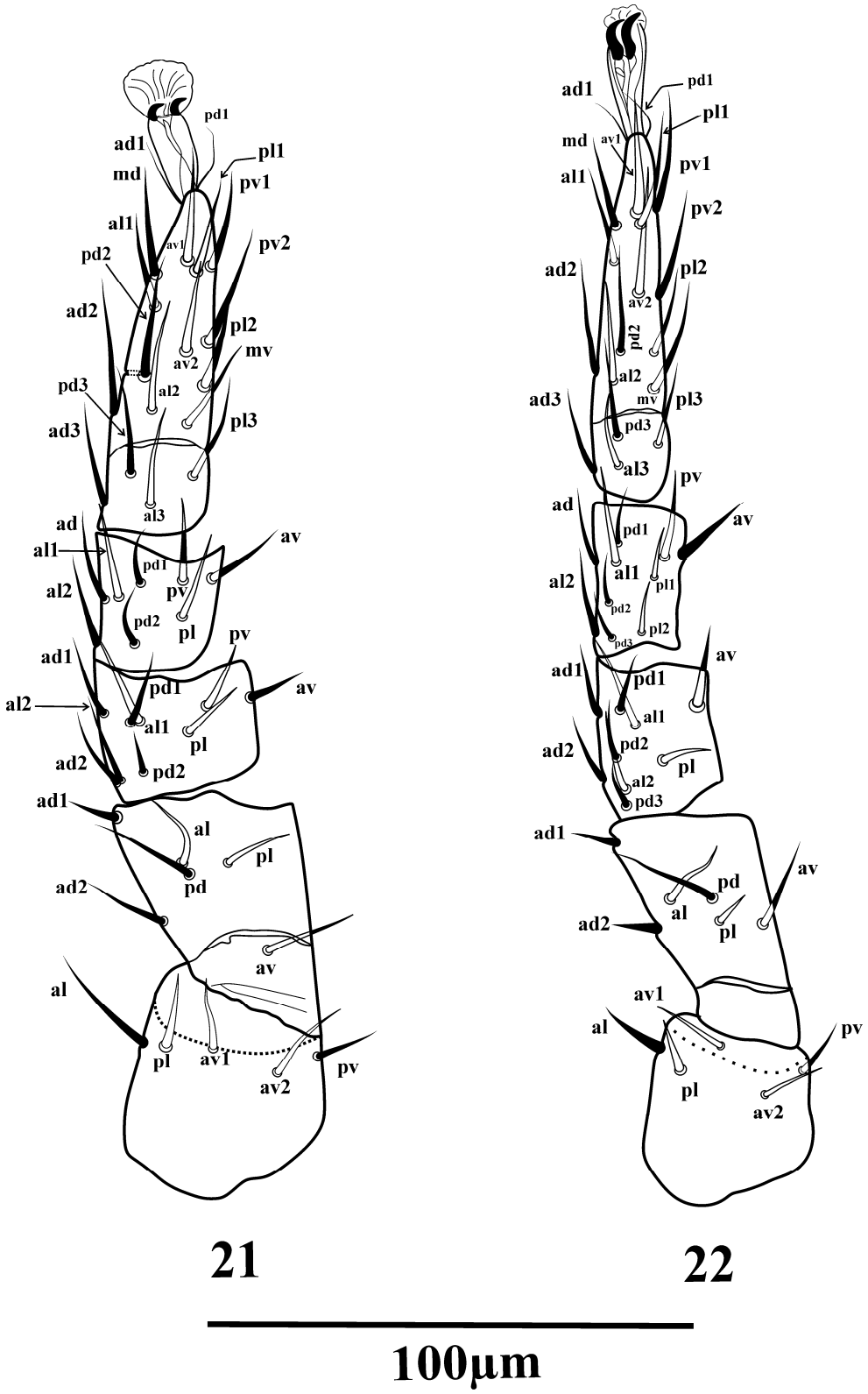
Legs – Tarsi I–IV with claws and ambulacra. **leg I** 315–337, coxa (46-53), trochanter (30–33), basi-femur (14–16), telo-femur (52–53), genu (37–39), tibia (46–49), tarsus (91–94); **leg II** 211–228, coxa (22–26), trochanter (31–33), basi-femur (14), telo-femur (33–36), genu (28–30), tibia (27–29), tarsus (57–59); **leg III** 187–203, coxa (21–23), trochanter (27–34), basi-femur (14–16), telo-femur (25), genu (24–26), tibia (23–25), tarsus (54–55); **leg IV** 253–267, coxa (21–23), trochanter (38–41), basi-femur (15–17), telo-femur (38), genu (33–34), tibia (35–37), tarsus (75–76). Legs I and IV longer than legs II and III. Chaetotaxy of all leg segments normal for Laelapidae (sensu Evans and till, 1965). All leg setae smooth and pointed. Chaetotaxy of legs is as follows: **Leg I** (Fig. 17): coxa 0 0/1 0/1 0; trochanter 1 0/2 1/1 1(*pd* thicker than other setae on the segment;

femur 2 2/1 3/3 2 (with conspicuous reticulated ventral surface as in Figure 18, *al2* thinner and smaller than other setae on the segment; *ad1, pv1–3, pd3* and *av* thicker than the others on the segment); genu 2 3/2 3/1 2 (with *pv* ticker than other setae on the segment); tibia 2 3/2 3/1 2 (*pv* ticker than other setae on the segment). **Leg II** (Fig. 19): coxa 0 0/1 0/1 0; trochanter 1 0/2 0/1 1; femur 2 3/1 2/2 1 (with conspicuous reticulated ventral surface as in Figure 20, *pv* thicker than the other setae on the segment and *al2* thinner and smaller than the others); genu 2 3/1 2/1 2; tibia 2 2/1 2/1 2; tarsus 3, 3/2, 3/2, 3 + *mv*, *md*. **Leg III** (Fig. 21): coxa 0 0/1 0/1 0; trochanter 1 0/2 0/1 1; femur 1 2/1 1/0 1; genu 2 2/1 2/1 1; tibia 2 1/1 2/1 1; tarsus 3 3/2 3/2 3 + *mv*, *md*. **Leg IV** (Fig. 22): coxa 0 0/1 0/0 0; trochanter 1 0/2 0/1 1(with *al* thicker than other setae on the segment; femur 1 2/1 1/0 1 (*al1* and *al2* thicker than other setae on the segment; genu 2 2/1 3/0 1; tibia 2 1/1 3/1 2; tarsus 3, 3/2, 3/2, 3 + *mv*, *md*. Ventral setae of all segments are slightly thicker than the others.



Figures 17–20. *Laelaspis angustiseta* **sp. nov.** (female) – 17. Leg I; 18. Femur I; 19. Leg II; 20. Femur II. Figures were prepared from dorso-ventral view of right legs.

***Insemination structures* –** Not seen.



Figures 21–22. *Laelaspis angustiseta* **sp. nov.** (female) – 21. Leg III; 22. Leg IV. Figures were prepared from dorso-ventral view of right legs.

***Male* –** Unknown.

Etymology

The name "angustiseta" refers to the thin and slender dorsal setae.

Note

The shape of striae within the median area of inverted V-shaped striation of epigynal shield is important in identifying *Laelaspis* species. Hunter (1961) stated that these patterns and the numbers of these striae were constant in several members of *L. vitzthumi* (Womersley, 1950). Our observations on this character in different species showed some variations in the pattern of epigynal shield reticulation but the constant pattern of V-shaped striae in inner area of inverted-V-shaped striation. So this character could be considered as an important trait in *Laelaspis* mites.

Remarks

The new species described in this paper is unique in some morphological characters. The combination of the following traits separated it from all other species in the genus. Most of the dorsal shield setae are thin and slender with small knob basally, except most *r* and *S* series, the presence of *z1* and *j2* distinctly barbed, unique shape of lateral and median extensions of internal malae, the presence of three pairs of setae (*st5*, *ZV1* and *JV1*) on epigynal shield and the presence of apparently a large glandular structure with two circular opening on median part of poststigmatal plate.

Laelaspis angustiseta **sp. nov.** is similar to some species such as (1) *L. calidus* Berlese, 1924; (2) *L. imitatus* Reitblat, 1963; (3) *L. pennatus* Joharchi *et al*., 2012; (4) *L. mossadeghi* Babaeian and Joharchi, 2013 and (5) *L. guilaniensis* Ramroodi *et al.,* 2014 in general appearance, but is easily distinguished from mentioned species based on some important morphological character explained as follows:

(1) *Laelaspis angustiseta* **sp. nov.** may be similar to *L. calidus* but is easily separated from it based on the length and width of idiosoma 399–405 and 311-315 in the first species while in the second one 530–534 and 393–400 respectively; the sizes of some dorsal setae in *L. angustiseta*: *j1* and *z1*(18–19) and *Z5* (52–53) while in the second species *j1* (30–32), *z1* (45) and *Z5* (77–79); the length and width of epigynal shield in the first species 222–225 and 175 while in the later 290–300 and 240–247; length of the first leg in our new species 315–337 while in the later it is much longer (500–505); epistome in *L. angustiseta* **sp. nov.** is smooth arched while in the later mucrunate with prominent median extension; the reticulation of epigynal shield in inverted V-shaped area differs between two species; fixed cheliceral digit in the new species has five teeth versus seven in *L. calidus* and with different distribution of teeth alongside of digit; post-anal seta is acicular and smooth in the new species while in *L. calidus* is serrated.

(2) *Laelaspis angustiseta* **sp. nov.** could be distinguished from *L. imitatus* based on the epigynal shield reticulation. Epigynal shield in *L. angustiseta* **sp. nov.** with median inverted- V-shaped striation enclosing eight deep polygonal areas formed by oblique lines while in *L. imitatus* this part consists of the same number of straight quadrangle areas. Some other differences, include the thickness of dorsal setae which are thinner and slender in the new species. *Laelaspis imitatus* has 40 pairs of dorsal shield setae including *PX1–3*, in addition to three unpaired *JX* setae (Reitbalt, 1963) while *L. angustiseta* **sp. nov**. has 39 pairs of setae on dorsal shield including only two pairs of PX (*PX2–3*) in addition to two unpaired.

(3) *Laelaspis pennatus* easily separated from *L. angustiseta* **sp. nov.** due to the very long dorsal shield setae in the first species, setae long enough to reach well past base of next posterior setae, while most of dorsal shield setae in the later are much shorter and not reach the base of the next setae in series.

(4) *Laelaspis angustiseta* **sp. nov.** may be similar to *L. mossadeghi*, but could be separated based on the number of setae on the surface of epigynal shield (three pairs in *L. angustiseta* **sp. nov.** and two pairs in the later), the shape and striation of epigynal shield (circular and bearing a minute

point on its posterior margin in *L. mossadeghi* and with completely rounded and lacking such point at posteromedian part of epigynal shield in *L. angustiseta* **sp. nov.**), setae *ZV2*, *JV1–2* smooth and other setae distinctly plumose in *L. mossadeghi,* while all ventral setae except *ZV1* and *JV1* are barbed in *L. angustiseta* **sp. nov.**

(5) *Laelaspis guilaniensis* can be easily separated from the new species based on some characters cited on related literature. Ramroodi *et al.* (2014) stated that the movable digit of chelicerae is without teeth and post-anal seta serrate, while the movable digit of chelicera in the new species with two teeth and postanal seta simple. The lengths and thickness of dorsal shield setae in mentioned species are different, i.e., thicker and longer in the first one.

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گونهٔ جدید مرتبط با مورچه از جنس *Laelaspis* (Acari: Mesostigmata: Laelapidae) از ایران

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چکیده

در این مقاله، گونهٔ جدیدی از جنس *Laelaspis* Berlese با نام ***L. angustiseta* sp. nov.** بر اساس ویژگی‌های نمونه‌های مادهٔ مرتبط با مورچه‌های *Tapinoma erraticum* (Latreille) و *Tapinoma simrothi* Krausse (Hymenoptera: Formicidae) در استان چهارمحال و بختیاری ایران توصیف می‌شود.

واژگان کلیدی: کنهٔ کامل؛ Dermanyssoidea ؛ توصیف؛ ماده؛ کنه‌های مورچه‌دوست؛ آرایه‌شناسی.

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