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Research Article

Gaeolaelaps (Acari: Laelapidae) mites of Iran with description of a new species

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Abstract: Edaphic mites of the order Mesostigmata have important effects in soil ecosystems and food chains. In order to study the fauna of Laelapidae (Mesostigmata), soil samples were collected from different parts of Shahreza vicinity in Esfahan province, Iran, during 2010-2012. Among collected species a new species of *Gaeolaelaps* has been collected from soil and litter and described based on adult female specimens. Some morphological characters of *G. jondishapouri* Nemati & Kavianpour were discussed in this paper. A key to *Gaeolaelaps* species of Iran is provided.

Keywords: Mesostigmata, Laelapidae, *Gaeolaelaps*, Iran

Introduction

Soil-living laelapid mites compose a large part of soil and litter mesostigmatid fauna. *Gaeolaelaps* is a large genus of Laelapidae that includes many species from different habitats, but most are reported from soil and litter (Evans & Till, 1966; Costa, 1968 & 1974; Karg, 1989a, b, 1993, 2003; Rosario, 1981; Tenorio, 1982; Beaulieu, 2009). So far four new species of this genus, *G. iranicus* Kavianpour & Nemati, *G. farajii* Nemati & Mohseni, 2013; *G. orbiculatus* Nemati & Mohseni, 2013 and *G. jondishapouri* Nemati & Kavianpour, 2013 have been collected from soil and litter and described from Iran (Kavianpour *et al.*, 2013; Nemati & Kavianpour 2013; Nemati and Mohseni, 2013). Some species of this genus were reported from various parts of Iran by different researchers (Mossaddegh, 1997; Nemati *et al.*, 2000a; Kamali *et al.*, 2001; Haddad Irani-Nejad *et al.* 2003; Mosavi *et al.* 2004; Noei, 2007; Babaeian *et al.* 2010; Ramezani & Nemati, 2010; Nemati & Kavianpour, 2013; Kavianpour *et al.* 2013). Up to present 15 species of *Gaeolaelaps* have been recorded from Iran (Nemati & Mohseni, 2013). In this paper we describe a new species, collected from soil and litter in the central parts of Iran. This new species raises the number of known species of this genus from Iran to 16. A key to *Gaeolaelaps* species of Iran is provided.

Materials and Methods

The specimens of genus *Gaeolaelaps* were collected from various soil and litter samples from Shahreza city in Esfahan province. Mites were separated from soil and litter samples by use of Berlese funnels, cleared in lactic acid at 55 °C and mounted into Hoyer medium as permanent microscope slides. Line drawings were made by use of a drawing tube and figures were performed with Corel X-draw software. All measurements in the descriptions are given

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in micrometers (µm). The dorsal setae notation, leg and pedipalp chaetotaxy were conducted according to the Lindquist and Evans (1965) and Evans (1963a,b) systems of nomenclature, respectively. The female holotype and some of female paratypes are deposited in the Acarological Laboratory, Department of Plant Protection, Agricultural College, Shahrekord University Shahrekord, Iran, and one paratype is deposited in the Senckenberg Museum fur Naturkunde Gorlitz Am Museum 1 02826 Gorlitz Germany.

Results

Genus *Gaeolaelaps* Evans & Till

Geolaelaps Berlese, 1923: 254, *nomen nudum* (see Halliday & Lindquist 2007)
Gaeolaelaps Trägårdh, 1952: 66, *nomen nudum*.
Gaeolaelaps Evans & Till, 1966: 159, correct original spelling as clarified by Halliday & Lindquist (2007).
Type species: *Laelaps aculeifer* Canestrini (1884), by original designation (Evans & Till 1966).
Genus diagnosis: followed Beaulieu, 2009.

Gaeolaelaps mossadeghi Kavianpour & Nemati sp. n.

Figs. 1-6
Materials examined
Holotype female from soil of a garden at Shahreza (31°58'15.14"N, 51°50'53.63"E, alt. 1849 m), Esfahan province, Iran, coll., M. Kavianpour, 1 May 2011. Paratypes: three females, same data as holotype.
Diagnosis. Female; Dorsal shield with 39 pairs of setae, Lateral margin of dorsal shield concave from *s4* to *S3* and reticulation more distinct posterior to *J1*; peritremes short, extending to middle level of coxa II; pre-sternal shield and anterior margin of sternal shield are distinct, *st1* longer than *st2* and *st3*; anal shield subtriangular and wider than long; epistome subtriangular; fixed digit with 5 teeth; with normal podal plates posterior to coxae IV.
Description of the female (n = 4)
Dorsal idiosoma. Fig 1. Dorsal shield suboval, area from level of seta *s4* to *S3* concave, 408-431 long, 210-223 wide (at level of setae *r3*), reticulation as a network of small hexagonal shapes which is more distinct posterior to setae *J1* (Fig. 1), and extended on the whole wide of the shield in this part, dorsal shield with 39 pairs of thin simple setae, 22 pairs on podonotum (*j1-6*; *z1-6*; *s1-6*; *r2-5*) and 17 pairs on opisthonotum (*J1-5*, *Z1-5*, *S1-5*), including two pairs of *Px* (*Px2-3*) between *J* and *Z* series and *r6* and *R5* on the lateral area of weakly sclerotised cuticle surrounding shield. Podonotal setae generally slightly longer than opisthonotal setae, setal lengths: *j1-6* 15-21, *z1-2* 13-15, *z3-6* 18-21, *s1-6* 13-18, *r2-5* and *J1-6* 15-21, *Z1-4* 18-20, *Z5* longest 27, *S1-4* 15-18, *S5* 21;with eight pore-like structures on podonotum and nine pairs on opisthonotum.
Ventral idiosoma (Fig 2). Tritosternum with tubular base 26 and pilose laciniae 78-83. Pre-sternal plate well distinct and with thin horizontal lines. Sternal shield with distinct anterior margin, smooth except postero-lateral area, 109-114 long, width at level of *st2* 95-100. Sternal setae smooth, *st1* 26, *st2* (19-21) and *st3* (18), *iv1* slit-like, located behind *st1* and *iv2* pore-like between *st2*-*st3*. Setae *st4* 18-21 and pore-like *iv3* located on soft integument. Genital shield apparently smooth except for an inverted v-shaped line (in some paratypes with inconspicuous thin lines on the surface), tongue-shaped 120-124 long, (excluding hyaline flap at base of posterior margin of sternal shield) 57-62 wide, with parallel lateral margins, bearing genital setae *st5* (length 18). Paragenital pores (*iv5*) on soft integument near genital setae. Anal shield subtriangular, 60 long, 68-70 wide, post-anal seta equal to paranal setae (18). Cribrum extending antero-laterally to a point anterior to level of post-anal seta. Opisthogastric surface with: 1 pair of suboval metapodal plates; 1 pair of narrow, elongate paragenital platelets; seven pairs of smooth setae, *Zv1-2* and *Jv1-5* 12-15 long; and three pairs of pore-like structures, plus one pair of pores on lateral margin of anal shield. Stigmata surrounded by narrow stigmatal plate with small incision at its tip, Stigmata

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located nearly in middle level of coxae III-IV. Peritremes narrow and short, extending to middle margin of coxa II, peritrematal plate wider in middle part, and with one glandular poroid gp and one lyrifissure ip (Fig. 2), separated from exopodal shield. Post-stigmatal plate with two pores, and extending from anterior part of coxa IV to its posterior level. Exopodal plates fragmented, like small triangular plates between coxae II–III and III-IV; crescent-shaped podal plates located around posterior margin of coxae IV, Endopodal plates II/III fused to lateral margins of sternal shield, and III–IV almost elongate, narrow and angular.

Gnathosoma. Hypostome (Fig. 3) with 3 pairs of similar smooth simple setae; *h1* 21-25, *h2* and *h3* 9-12 and palp-coxal setae 23 µm. Hypostomal groove with six rows of three to seven denticles. Corniculi normal and horn-lik, extending at level of palp-femure. Chelicerae (Fig. 4) normal for genus, with arthrodial processes, moveable digit (50-56) with 2 teeth, middle article 131-135, fixed digit with 5 teeth, setaceous pilus dentilis small. Epistome subtriangular and irregularly denticulate laterally (Fig. 5). Palp chaetotaxy normal (sensu Evans 1963b), with simple setae except *al* on femur slightly thickened, spine-like, *al1* and *al2* of genu thickened, *al1* with tip rounded and *al2* spine-like, palp tarsal claw two-tined.

Legs. Tarsi I-IV with claws and ambulacra. Leg I (392-4130) (excluding pre-tarsus): coxa (52-62), trochanter (34), femur (70-78), genu (55-62), tibia (62-68), tarsus (112-117); leg II 270: coxa (45), trochanter (30), femur (45), genu (39), tibia (39), tarsus (72); leg III 241: coxa (31), trochanter (36-41), femur (49-59), genu (26-28), tibia (28-31), tarsus (62); leg IV (Fig. 6), (372-382): coxa (23-36), trochanter (57-60), femur (80-85), genu (54), tibia (52-55), tarsus (91-104); Leg I is the longest, and longer than leg IV. Chaetotaxy of all leg segments normal for *Gaeolaelaps* (sensu Evans 1963a) and is as follows:

Leg I: coxa 0 0/1 0/1 0; trochanter 1 0/2 1/1 1; femur 2 2/1 3/3 2; genu 2 3/2 3/1 2; tibia 2 3/2 3/1 2. Leg II: coxa 0 0/1 0/1 0; trochanter 1 0/2 0/1 1; femur 2 3/1 2/2 1; genu 2 3/1 2/1 2; tibia 2 2/1 2/1 2 (*av* and *pv* slightly thickened); tarsus 3,3/2,3/2,3 + *mv*, *md*. Leg III: 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; tarsus3 3/2 3/2 3 + *mv*, *md*. Leg IV: coxa 0 0/1 0/0 0; trochanter 1 0/2 0/1 1; femur 1 2/1 1/0 1; genu 2 2/1 3/0 1; tibia 2 1/1 3/1 2; tarsus 3,3/2,3/2,3 + *mv*, *md*. All legs setae are simple and slender, except for some setae of leg IV: ventral setae of genu, tibia and tarsus, *pd* of femur, *al1-3* and *pl1-3* of tarsus are slightly thickened and spine-like.

Insemination structures. Not seen, apparently unsclerotized.

Male**:** Unknown**.**

Etymology: This species is named in honor of Prof. Mohammad Saeid Mossadegh, retired professor of Plant Protection Department, Agricultural College, Shahid-Chamran University, Ahwaz, Iran, who is a pioneer in entomology and acarology, especially mites associated with honey bees in Iran.

Discussion

A key to the world *Gaeolaelaps* species with short peritreme was presented in Nemati and Mohseni, 2013. Most of the *Gaeolaelaps* species with short peritreme have been described by Karg (Karg, 1962; 1965; 1979; 1982; 1994; 2000 & 2006). The new species belongs to the complex with short peritreme which extended to the middle level of coxa II.

Gaeolaelaps mossadeghi Kavianpour & Nemati sp. n., is similar to *G. arabicus* (Hafez et al., 1982); *G. latopuga* (Karg, 2006); *G. loksai* (Karg, 2000); *G. cerata* (Karg, 1982); *G. similisetae* (Karg, 1965) and *G. nolli*, (Karg, 1962).

Gaeolaelaps mossadeghi Kavianpour and Nemati sp. n., has distinct anterior margin of sternal shield and two well sclerotized and separated pre-sternal plates; it has crescent-shaped podal plates posterior to coxa IV and endopodal III–IV almost elongate, narrow

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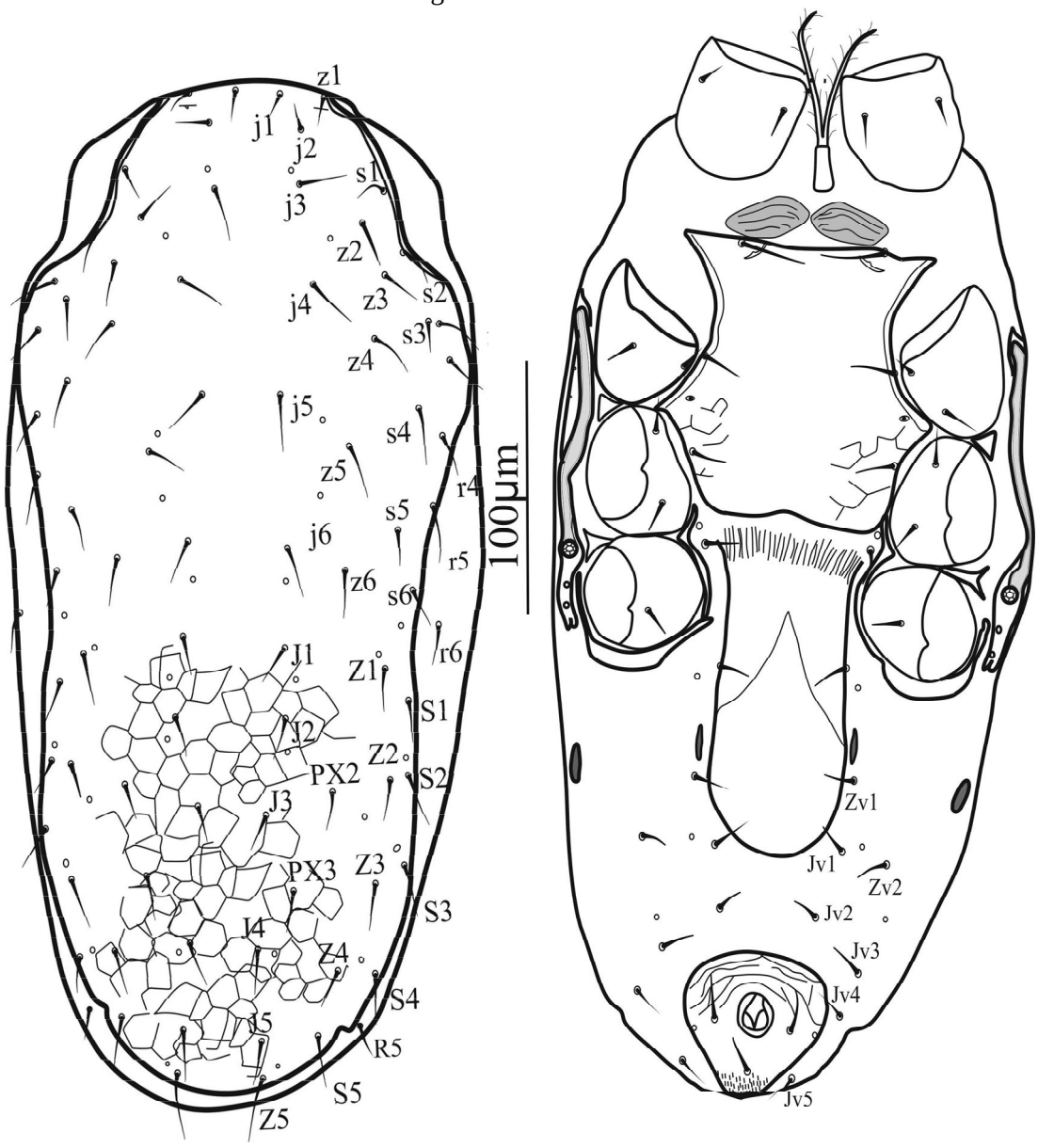
and angular; it has anal plate wider than long; its dorsal shield with reticulation more distinct posterior to *J1* setae in whole dorsal shield; *st1* longer than *st2-3*, while *G. arabicus* has sternal shield with no defined anterior margin; without well sclerotised presternal shields and the anterior margin of the sternal shield with triangular punctuated area; without podal plate posterior to coxa IV and endopodal plate III-IV like small triangulat plates; the length of anal shield is 1.5 times as its width; dorsal shield with smooth surface; *st1* nearly equal to *st2-3*.



Figures 1-2 *Gaeolaelaps mossadeghi* Kavianpour & Nemati sp. n., Female. 1 Dorsum, 2 Venter.

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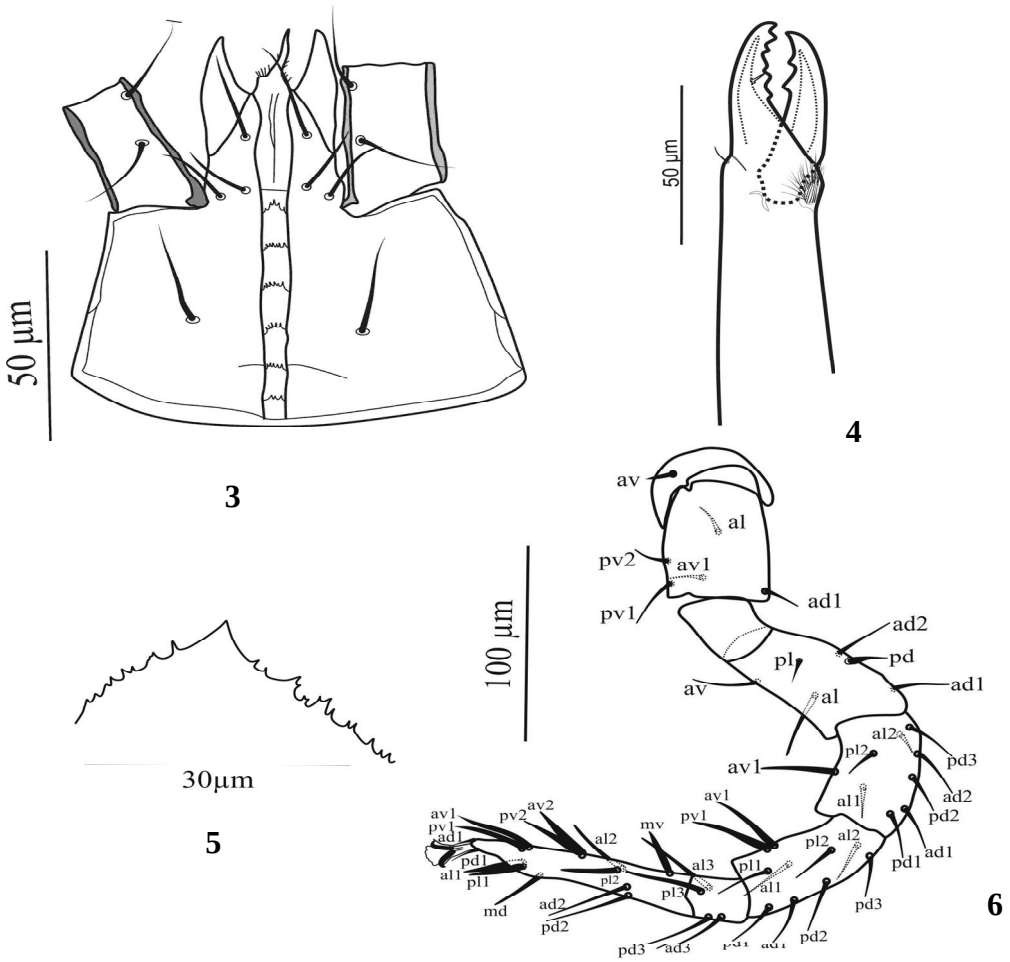

Figures 3-6 *Gaeolaelaps mossadeghi* Kavianpour & Nemati sp. n., Female. 3 Hypostome, 4 Chelicera, 5 Epistome, 6 Leg IV.

Gaeolaelaps mossadeghi Kavianpour and Nemati sp. n., may be differentiated from *G. latopuga* by having longer dorsal setae (15-27), a subtriangular epistome, apparently smooth genital shield flanked by one pair of small platelets, *st1* longer than *st2* and *st3*, and fixed digit with five teeth, while in *G. latopuga* there are shorter dorsal setae (11-14), a rounded epistome, reticulated genital shield not flanked by platelets, *st1* shorter than *st2* and *st3* and fixed digit with six denticles.

Gaeolaelaps mossadeghi Kavianpour & Nemati sp. n., differs from *G. loksai* by the sub-triangular epistome, genital shield narrower than anal shield, genital shield not close to anal shield, distance between these two shields more than 1/3 length of anal shield, genital shield with lateral lines wellnigh parallel, shorter dorsal setae (15-27), having one pair of narrow platelets near the genital shield, distance of *J2-J2* almost equal to *J1-J1* whereas *G. loksai* has an arcuated epistome, wide genital shield wider than anal shield, genital shield extending close to anal shield, distance between these two shields less than 1/3 length of anal shield, non parallel lateral borders of genital shield, longer dorsal setae (30-37), having two platelets near the genital shield and distance of *J2-J2* is more than twice that of *J1-J1*.

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G. mossadeghi Kavianpour & Nemati sp. n., is separated from *G. cerata* by these characters: shorter dorsal setae (15-27 and *Z5* = 27), *J1* and *J4* not reaching to base of next setae in series, *z3* present, *st1* longer than *st2* and *st3*, apparently smooth genital shield with one pair of small platelets in its borderline, and having only *Zv1-2*, whereas in *G. cerata* there are longer dorsal setae (30-50 and *Z5* = 52), *J1* and *J4* reaching to the base of next setae in series, *z3* absent, *st1* shorter than *st2* and *st3*, reticulated genital shield without one pair of platelets in its borderline, and having *Zv1-5*.

G. mossadeghi Kavianpour & Nemati sp. n., is similar to *G. nolli* and *G. similisetae*, but it differs from the first species by its subtriangular epistome, fixed digit of chelicerae with five teeth, shorter dorsal setae (15-27 and *Z5* = 27), only with *R5*, *st1* longer than *st2* and *st3*, dorsal shield with hexagonal reticulation more distinct from *J1* to posterior margin, without very elongate setae on tarsus IV, while *G. nolli* has a rounded epistome, fixed digit of chelicerae with 6 or 7 teeth, longer dorsal setae (40-45 and Z5 = 58), with *R1* and *R5*, *st1* shorter than *st2* and *st3*, hexagonal reticulation from posterior margin of dorsal shield to *j6* and from *j6* to upside with scale like ornamentation, and with two very elongate setae on tarsus IV.

Differences between *G. mossadeghi* Kavianpour & Nemati sp. n., and *G. similisetae* include: subtriangular epistome, tongue shape genital shield with lateral lines almost parallel, smooth genital shield with one pair of narrow plates near the lateral lines of genital shield, *j1* equal to *j2*, reticulation of dorsal shield from *J1* to downward, without reticulation in podonotal area and lateral borders of dorsal shield, dorsal shield in amid slightly concave, fixed digit of chelicerae with five teeth, lateral margins of anal shield not concave, whereas *G. similisetae* has a rounded epistome, non-parallel lateral borders of genital shield, reticulated genital shield, dorsal shield completely reticulated, *j1* longer than *j2*, lateral borders of dorsal shield not concave, fixed digit of chelicerae with four teeth, and lateral margins of anal shield concave.

Notes on *Gaeolaelaps jondishapouri*

Gaeolaelaps jondishapouri was described according to the specimens that were collected from soil in Ahwaz, Khuzestan province, Iran by Nemati and Kavianpour, 2013 with some important morphological characters such as: Female; dorsal shield with 39 pairs of setae (including *px2-3*), *r6* and *R1-6* being off dorsal shield on soft lateral cuticle, posterior part of dorsal shield with abrupt contraction between *S4* and *S5* setae; *st1* on weakly sclerotised presternal area out of sternal shield, *iv1-2* slit-lik; epigynal shield flask-shaped; peritremes long, extending almost to posterior part of coxa I. According to the new precise observations on ventral side of *G. jondishapouri* specimens with Olympus, BX52 equipped with phase contrast system we have drawn detailed situation of anterior margin of sternal shield and the position of *st1* location in female and male specimens (Figs. 7-9). Some other morphological variations were observed in sternal, genital and anal shields, and also some degree of variations in peritrematal and post-stigmatal plates (Figs. 7-10). Anterior margin of sternal shield in female with nearly deep notch in middle part, setae *st1* located on line at presternal area, and sternal margin runs adjacent to the posterior part of *st1* alveoli. Sternal shield of female with anterolateral corners extended into narrow arms (endopodal extensions) flanking coxae II anteriorly in various degrees of extensions (Figs. 7-8).

Variations were also observed in shape, dimensions and the pattern of reticulation of genital and anal shields (Figs. 7-8) and also peritrematal and poststigmatal plates in female (Fig. 10).

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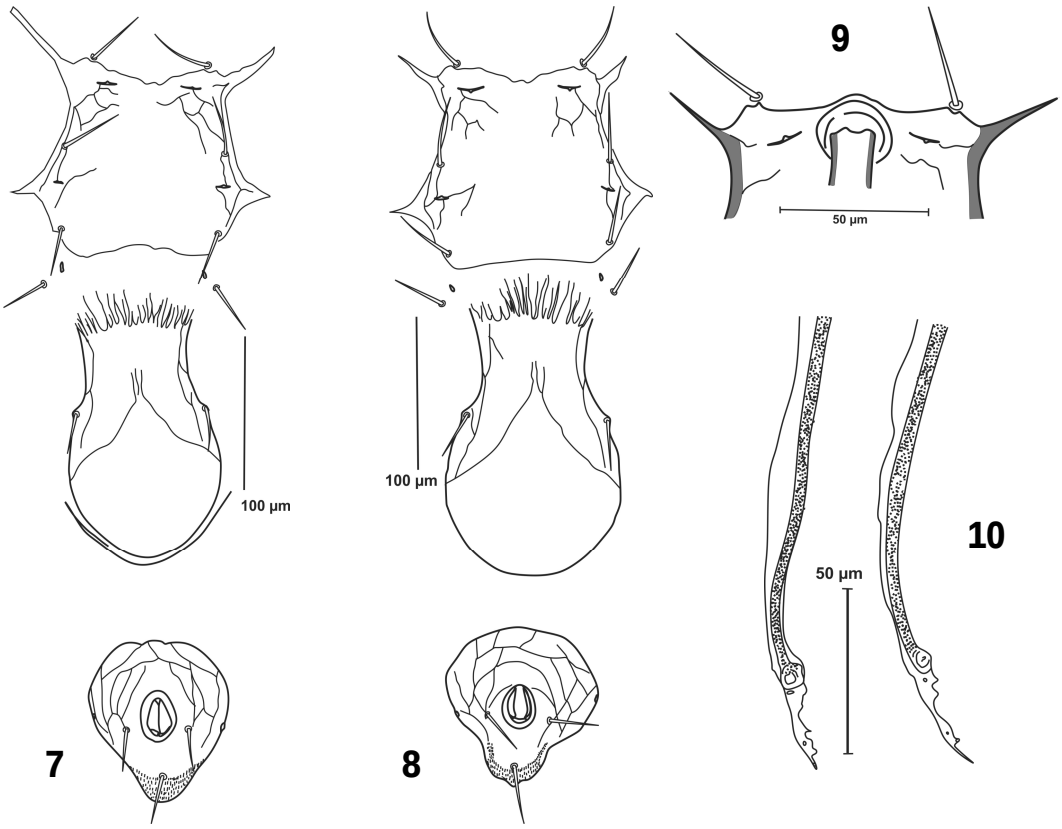

Figures 7-10 *Gaeolaelaps jondishapouri* Nemati and Kavianpour, 7-8. Variations in ventral side (female), 9. Anterior part of holoventral shield in male, 10. Variations in peritrematal and poststigmatal plates in female.

Key to the female *Gaeolaelaps* of Iran

1- Peritreme short, reaches to middle or anterior level of coxa II……...2
- Peritreme longer, reaches at least to posterior level of coxa I……5
2. Peritreme short, reaches to middle level of coxa II……3
- Peritreme short, reaches to anterior level of coxa II……4
3. Tarsus IV with two very elongate setae…….
***G. nolli* (Karg, 1962) = *G. praesternalis* (Willmann, 1949) after Evans & Till, 1966**
- Tarsus IV without two very elongate setae ….
***G. mossadeghi* Kavianpour and Nemati sp. n.**
4. Anal shield nearly rounded and wider than long; sternal shield reticulated thoughout with small smooth area at posterior part; idiosoma 489–491 µm long, 270–276 µm wide ……
…….***G. orbiculatus* Nemati & Mohseni, 2013**
- Anal shield with semi-circular anterior margin, straight postero-lateral margins, and a pair of minute angular lateral projections, sternal shield smooth throughout; idiosoma 408–439 µm, long, 205–218 wide ……..
……..***G. farajii* Nemati & Mohseni, 2013**
5- Dorsal shield sudden constriction caudally..6
- Dorsal shield normal or less attenuated posteriorly…….9
6- Leg II with thickened spines, specially a thick spine on femur II; movable digit of chelicerae with 2 teeth; palp tarsal claw three-tined……...7
- Without thickened spines on leg II and femur II; palp tarsal claw two-tined…….8
7- Leg I shorter than idiosoma; epistome with a row of equal denticles; dorsal shield without a curvature…….***G. angusta* (Karg, 1965)**

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- Leg I longer than idiosoma; epistome with 2 teeth longer than the others; dorsal shield with a curvature in posterior part ……...…….. …….***G. queenslandicus*** **(Womersley, 1956)**
8- Movable digit of chelicerae with 2 larger and several smaller teeth; dorsal shield without *Px* setae …..***G. angustiscutatus*** **(Willmann, 1951)**
- Movable digit of chelicerae with 2 teeth; dorsal shield with two pairs of *Px* setae ……. ***G. jondishapouri*** **Nemati and Kavianpour, 2013**
9- Tarsus of leg IV with spine-like setae thicker than normal ……10
- Tarsus of leg IV without spine-like setae …12
10- Some of podonotal setae elongate, twice as length of opisthonotal setae, fixed digit of chelicerae with 12-14 teeth …… …….. ***G. aculeifer*** **(Canestrini, 1883)**
- Podonotal setae not elongate, Z5 is approximately equal to J5; fixed digit of chelicerae with less than 12 teeth ……...11
11- *iv2* slit-like; *ad1* on femur IV short and spine-like ……...***G. deinos*** **(Zeman, 1982)**
- *iv2* pore like; *ad1* on femur IV elongate and simple....***G. oreithyiae*** **(Walter & Oliver, 1989)**
12- Seta *st1* located in presternal region off sternal shield ……***G. minor*** **(Costa, 1968)**
- Seta *st1* located on sternal shield ……...13
13- Genital shield with diagonal parallel lines in both sides that reach together in median area of shield; without elongate setae on tarsus IV……..……***G. glabrosimilis*** **(Hirschmann, Bernhard, Greim & Gotz, 1969)**
- Genital shield without diagonal parallel lines in both sides; with elongate setae on tarsus IV……....14
14- Dorsal setae short, nearly none of them reach to the base of next setae…… ***G. praesternalis*** **(Willmann, 1949) after Karg (1971)**
- Dorsal setae relatively long, some of them reach to the base of next setae……..……15
15- With *Px2-3* and *S1*; with two elongate setae on tarsus IV, para-anal setae slightly shorter than or as long as post-anal seta ……. ……... ***G. kargi*** **(Costa, 1968)**
- Without *Px2* and *S1*; with four elongate setae on tarsus IV, post-anal seta considerably longer than para-anal setae …… …..…..***G. iranicus*** **Kavianpour & Nemati, 2013**

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کنه‌های (Acari: Laelapidae) *Gaeolaelaps* ایران و توصیف یک گونه جدید

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چکیده: کنه‌های خاکزی میان‌استیگمایان نقش مهمی در اکوسیستم‌ها و زنجیره‌های غذایی خاک دارند به منظور مطالعه کنه‌های خاکزی خانواده Laelapidae در حومه شهرضا، استان اصفهان، ایران در سال‌های 91-1390 نمونه‌هایی از خاک، خاکبرگ و غیره از مناطق مختلف شهرستان مزبور جمع‌آوری شد. کنه‌ها با استفاده از قیف برلز استخراج، به‌کمک محلول اسید لاکتیک در دمای 50 درجه سلسیوس شفاف و با استفاده از محلول هویر از آنها اسلایدهای میکروسکوپی تهیه شد. از بین برخی از نمونه‌های این خانواده، گونه‌ی *Gaeolaelaps mossadeghi* Kavianpour & Nemati sp. n. از خاک جمع‌آوری و توصیف شد. برخی از ویژگی‌های مورفولوژیک گونه *G. jondishapouri* Nemati & Kavianpour با استفاده از میکروسکوپ مجهز به دید شئی فازکنتراست مورد مطالعه و بازبینی قرار گرفت. کلید شناسایی گونه‌های جنس *Gaeolaelaps* ایران ارائه شده است.

واژگان کلیدی: Mesostigmata، Laelapidae، *Gaeolaelaps*، ایران

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