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 (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
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
Gaeolaelaps Berlese, 1923: 254, nomen nudum (see Halliday & Lindquist 2007)
Type species: Laelaps aculeifer Canestrini (1884), by original designation (Evans & Till 1966).
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). Trito sternum 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 posterior-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 st1-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 setae. 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
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 III–II 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-like, extending at level of palp-femure. Chelicerae (Fig. 4) normal for genus, with arthrodiatal 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 3,3,3,3,3 + 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; tarsus 3 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 3,3,3,3,3,3 + 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, Ahvaz, 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. arabisicus* (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...
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.
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 ZS = 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 ZS = 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 ZS = 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 ZS = 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 anal 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).
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.........
   - 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)
- 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 opisthonal setae, fixed digit of chelicerae with 12-14 teeth ......................................................
- 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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کنهای Gaeolaelaps (Acari: Laelapidae) ایران و توصیف یک گونه جدید

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چکیده: کنهای خاکی میان‌سیکمانی نش مهمی در اکوسیستم‌ها و زنگرهای غذایی خاک دارد. به منظور مطالعه کنهای خاکی خاک‌های نماهنگی‌از اسکی، استان اصفهان، ایران در سال‌های 1390-1391 میلادی، شیب خاک و غیره از مناطق مختلف شهرستان مزبور جمع‌آوری شد. کنهای با استفاده از یک مرحله استخراج، به‌کمک محلول اسید لاکتیک در دمای 50 درجه سلسیوس شفاف و با استفاده از محلول هوریزون آن‌ها اصلی‌های میکروسکوپی تهنه‌ای از بین ریخته‌ای نمونه‌های بن‌خود، از خاک جمع‌آوری و توصیف شد. Gaeolaelaps mossadeghi Kavianpour & Nemati sp. n. گونه‌ای برخی از ویژگی‌های مورفولوژیک گونه G. jondishapouri Nemati & Kavianpour با استفاده از میکروسکوب مجهز به دید شیب فارکنتیست مورد مطالعه و به‌پایینی قرار گرفت. کلید شناسایی گونه‌های ایران ارائه شده است.

واژگان کلیدی: G. mossadeghi, G. jondishapouri, Mesostigmata, Laelapidae, Gaeolaelaps, ایران