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A New Laelapid Mite *Cosmolaelaps qassimensis* sp. nov (Gamasida: Laelapidae) from Agro-Ecosystem in Saudi Arabia

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ABSTRACT

Cosmolaelpas qassimensis sp. nov. was collected from soil samples containing leaf litter and soil surrounding the root system of date palm trees during 2013-2014 in Qassim, Saudi Arabia. Monthly survey showed that *C. qassimensis* was at its highest rate of occurrence (13.96 individuals/sample) in September. There were no significant differences between average number of mites collected in May, July, August and October, while it was rarely found (1.25 and 0.96 mites/sample) in January and February, respectively. Immature stages and adult female and male of *C. qassimensis* sp. nov. were extracted from a pure laboratory culture, which were maintained feeding on the acarid mite, *Tyrophagous putrescentiae* Schrank and kept at 26±1°C and 70±5% RH. They were illustrated and identified.

Key words: *Cosmolaelaps qassimensis* sp. nov., survey, identification, Qassim

INTRODUCTION

Mesostigmatid mites represent an important component of the belowground food web, where they are generally considered to be predators feeding on small arthropods, worms and nematodes (Al-Rehiayani and Fouly, 2005; Joharchi and Halliday, 2011). The laelapid family is considered one of the most important groups of soil predatory mites, where it usually feeds on soil arthropods and nematodes (Walter and Campbell, 2003; Joharchi *et al*., 2012). Some species in this family ecologically diverse, including obligatory and facultative parasites of vertebrates and insect pathogens (Evans and Till, 1966; Strong and Halliday, 1994; Lindquist *et al*., 2009).

Genus *Cosmolaelaps* Berlese consists of a large group of free-living predators in soil (Evans and Till, 1979; Karg, 1995; Ma *et al*., 2004; Karg and Schrolemmer, 2009; Fouly and Al-Rehiayani, 2011). This genus has been treated in previous studies either as a genus or as a subgenus of *Hypoaspis* Canestrini, 1885 (Xu and Liang, 1996; Faraji and Halliday, 2013). In 1993, Casanueva raised most of the groups considered as subgenera to the generic level and put them in the subfamily Hypoaspidinae. During the last two decades, many new species of *Cosmolaelaps* were identified and illustrated by several authors worldwide (Karg, 1995; Fouly *et al*., 1997; Bei *et al*., 2003; Ma *et al*., 2004; Bai and Wang, 2005; Karg and Schrolemmer, 2009; Joharchi and Halliday, 2011; Joharchi *et al*., 2011, 2012).

Based on literature and updated information, there is rare or no previous knowledge about classification of predatory mites in Saudi Arabia until came Fouly and Al-Rehiayani (2011) who

surveyed and described 38 species of predaceous mites belonging to different classification categories. They also described and illustrated two new laelapid species, *Hypospis dactylifera* and *H. zaheri* (Fouly and Al-Rehiayani, 2011).

The present study is a part of a project which has the main objective of increasing the knowledge of this poorly studied regional mite fauna, especially that of Laelapidae. Therefore, we illustrated and described female, male and developmental stages of a new species, *C. qassimensis* sp. nov., which was collected from soil samples under date palm trees *Phoenyx dactylifera* L. in Qassim district, Saudi Arabia. Specimens on which this study is based were taken from a pure culture which maintained on *Tyrophagous putrescentiae* as food and deposited in the mite collection of Department of Agricultural Zoology, Faculty of Agriculture, Mansoura University, Egypt.

MATERIALS AND METHODS

Mite collection: Soil samples of 5×2 kg including leaf litter under date palm trees grown at the Research Experimental Station in Melida province, College of Agriculture and Veterinary Medicine, Qassim University were monthly collected from March 2013 till February 2014. Mite individuals were collected by using modified Tullgern's funnels (Krantz, 1978), then mite individuals were preserved in 70% alcohol until microscope examination.

Identification of *Cosmolaealps qassimensis* sp. nov.: Morphological study was conducted by using an Olympus Camera DP25 attached to an Olympus Microscope BX51, both are connected to a HP Computer. The nomenclature and chaetotaxy of immature stages, adult male and female of *C. qassimensis* was pointed out according to the terminology of Evans (1963), Lindquist and Evans (1965), Evans and Till (1966, 1979) and Bregetova (1977).

Statistical analysis: Data of survey was statistically analyzed by one way ANOVA, where Duncan's multiple range test was used to compare means of collected mite individuals by using Costat Software (1990).

RESULTS

Occurrence of *Cosmolaelaps qassimensis* sp. nov.: Survey study proved that there were significant differences between average total numbers of *C. qassimensis* individuals collected from soil sample surrounding root system of date palm trees. Samples collected in September showed the largest number of mites and followed by those collected in June, while February represented the lowest numbers {F = 221.92; df = 11, 108; p = 0.000, where, LSD 0.69 (p = 0.05)}. The present results showed that there were no significant differences between average total numbers of *C. qassimensis* collected in May, July, August and October (Fig. 1).

***Cosmolaelaps* Berlese (1903):**

- Family Laelapidae Trägårdh, subfamily Hypoaspidinae Vitzthum, Tribe Pseudoparasitini Vitzthum
- *Cosmolaelaps* Berlese (1903), sensu (Evans and Till, 1979)
- Type species, *Laelaps claviger* Berlese

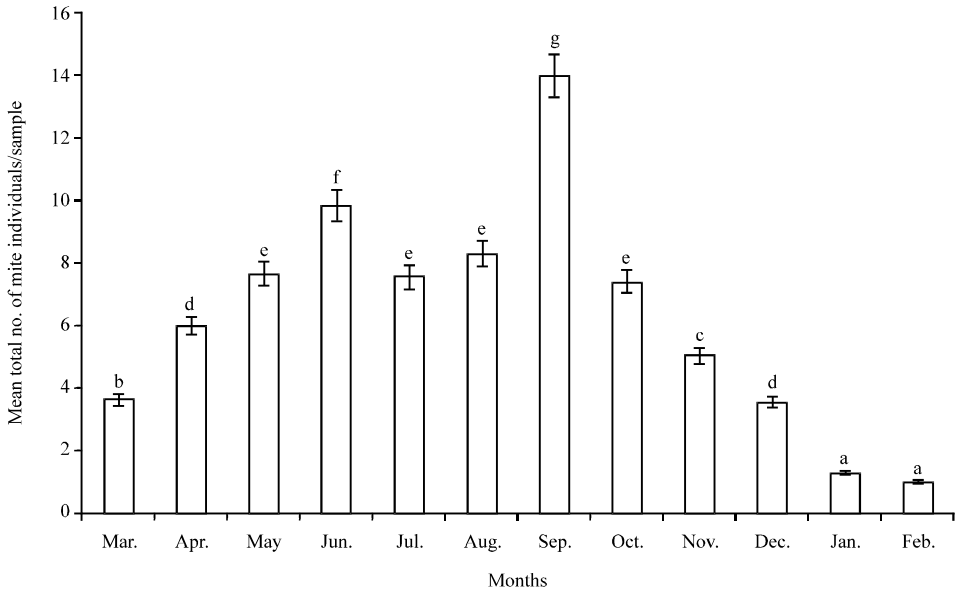

Fig. 1: Mean total number of *Cosmolaelaps qassimensis* sp. nov. collected from soil surrounding root system of date palm trees in Qassim region during 2013-2014. Columns have the same letter are not significantly differed (Duncan Multiple Range Test, (p = 0.05))

Description of *Cosmolaelaps qassimensis* sp. nov.

Female: Body light brown in color when alive, idiosoma oval-shape (682 µm long and 526 µm wide). Dorsal shield entire (595.52 µm long and 406.56 µm wide at the level of seta s6 (coxa IV), faintly reticulated in most surface but interrupted by a smooth area between setae j_5 and j_6, not covering the whole idiosoma. Thirty nine pairs of dorsal setae, 22 pairs of which on podonotum and 17 on opithonotum (Fig. 2). Setae j_1 lanceolate (31.72 µm) in addition to 38 pairs of scimitar-like setae including r, s, S and Z setae, which with a blunt side bulge at one third from their bases (Fig. 3a). Dorsal setae length in j-J; z-Z; s-S and r series ranged from 30.64 to 63.12, while setae z1 the shortest (23.60 µm). Three un-paired setae Jx_1 (52.56 µm), Jx_2 (47.32 µm) and Jx_3 (44.84 µm) inserted between J series on opithonotum and two pairs of px2 and px3 setae between J and Z series of each side. Dorsal shield with 10 pairs of pores of various shape and size except a pair of crescent-like pores occurs beside setae Z_5. Ten pairs of marginal setae arise on lateral membrane, each with a small projection near their bases (Fig. 2).

Tritosternum with base (32.72 µm) and long pilose laciniae (88.32 µm) (Fig. 3b). Presternal area punctuate with faintly transverse striae. Sternal shield faintly reticulate, longer than wide (116.44 µm long and 104.40 µm wide at the level of setae St_2), its anterior corners expand laterally, concave posteriorly, extends distally to middle of coxae III, bearing 3 pairs of simple subequal sternal setae (St_1 = 44.64; St_2 = 42.88 and St_3 = 43.36 µm) and 2 pair of lyriform pores, of which the anterior pair situated at the inner side of St_1; the second pair obliquely longer and situated posterior to setae St_2. Metasternal setae (St_4 = 44.02 µm) arise on a narrow endopodal shield and posterior to a pair of small circular pores (Fig. 4). Genital shield drop-shaped (197.05 µm long and 102.25 µm wide), covered with faintly network striae and with a pair of genital simple setae (32.28 µm). Anal shield subtriangular with 2 pairs of adanal setae (26.88 µm), situated laterally on a line running through the middle of anus. Postanal seta longer than adanals

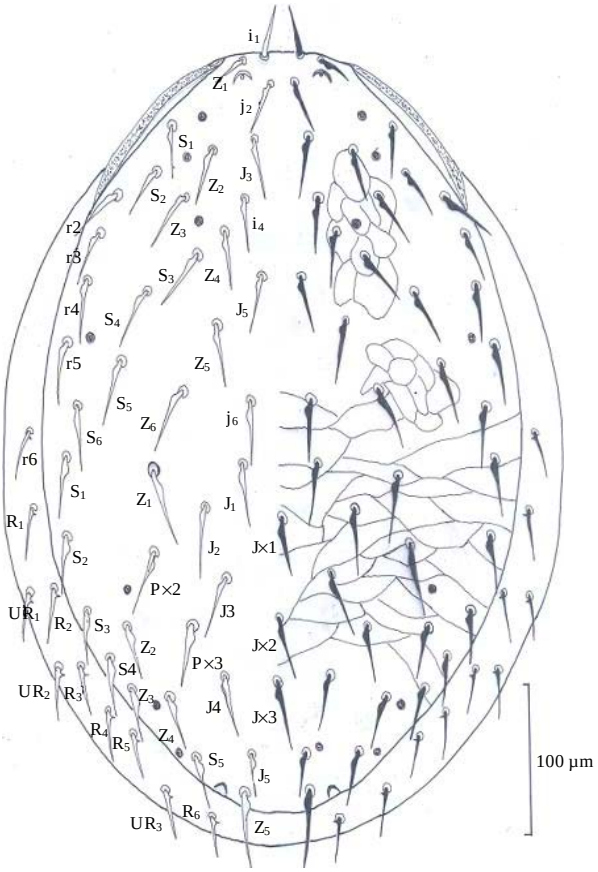

Fig. 2: *Cosmolaelaps qassimensis* sp. nov. dorsal surface of female

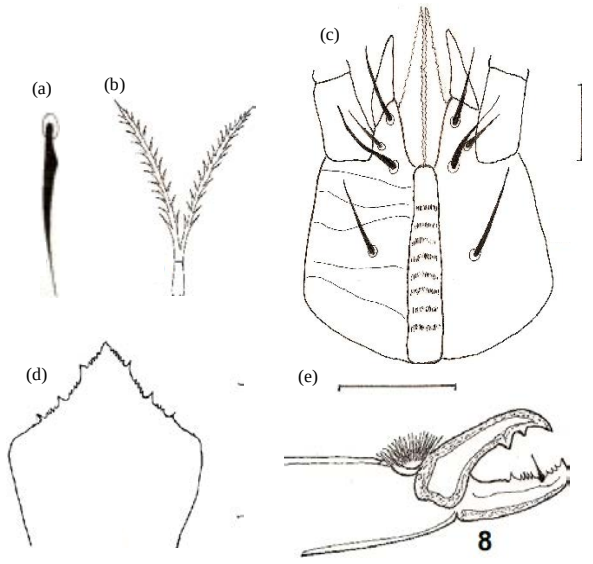

Fig. 3(a-e): *Cosmolaelaps qassimensis* sp. nov., female, (a) Dorsal setae, (b) Tritosternum, (c) Gnathosoma, (d) Tectum and (e) Chelicerae (Scale bar = 50 µm)

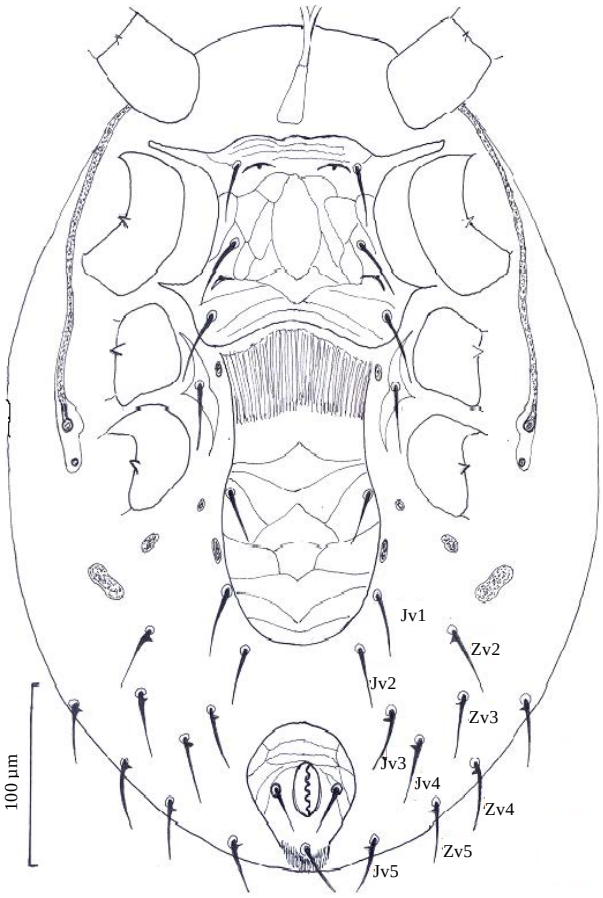

Fig. 4: *Cosmolaelaps qassimensis* sp. nov. ventral surface of female

(34.08 µm). Metapodal shield (32.16 µm) club-shaped as twice as long as the secondary one (18.22 µm) (Fig. 4). Two pairs of platelets (para-genital) arise beside genital shield, of which the anterior pair crescent-shaped while the posterior pair circular. Ten pairs of setae inserted on the soft opithogastric membrane, of which 2 pairs of simple setae between genital and anal shields, while the rest with small and sharp projection near their bases. Peritreme well developed, lies between coxa III and IV, with a small circular pore behind the stigma, peritremal plate extends anterodorsally to reach the posterior base of setae z1 (Fig. 4).

Corniculi horn-like (68.82 µm), internal mala well developed. Deutostrnum with eight rows of denticles. Four pairs of hypostomatic setae, of which hyp3 and capitular setae (36.72 µm) anterior hyp1 (33.76 µm) and hyp2 (25.84 µm) (Fig. 3c). Tectum anterior margin triangular, irregularly denticulate with central apical point (Fig. 3d).

Fixed digit of chelicerae (59.44 µm) with a big basal tooth, 7 small teeth plus a distinct pilus dentilis, while movable digit (52.68 µm) with 2 blunt teeth (Fig. 3e).

Legs: Measurements of legs I-IV 546.48, 444.16, 414.88 and 624.80 µm, respectively. Most ventral setae on legs I-IV spine-like. Chaetotactic of femura I-IV 13, 11, 6, 6; genua I-IV13, 11, 9, 9; tibiae I-IV 13, 10, 8, 10, respectively (Fig. 5).

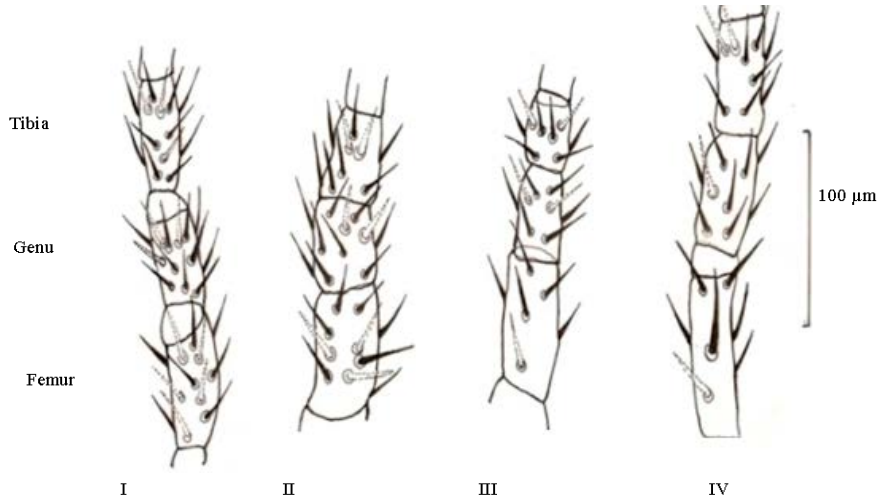

Fig. 5: *Cosmolaelaps qassimensis* sp. nov., Legs I-IV

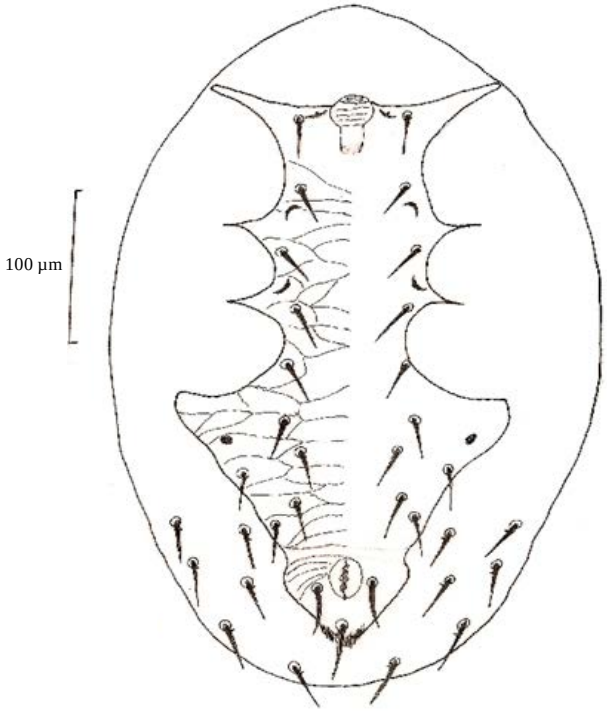

Fig. 6: *Cosmolaelaps qassimensis* sp. nov, ventral surface of male

Male: Smaller than female, length of dorsal shield 449.12 and 305.22 µm wide at the level of coxa IV. Chaetotaxy of dorsal setae as in female. Holoventral shield (364.40 µm long and 106.54 µm wide) faintly reticulated, with 10 pairs of sub-equal simple setae, 2 pairs of crescent-shaped pores as well as a pair of circular pores (Fig. 6). Fixed digit with a single blunt

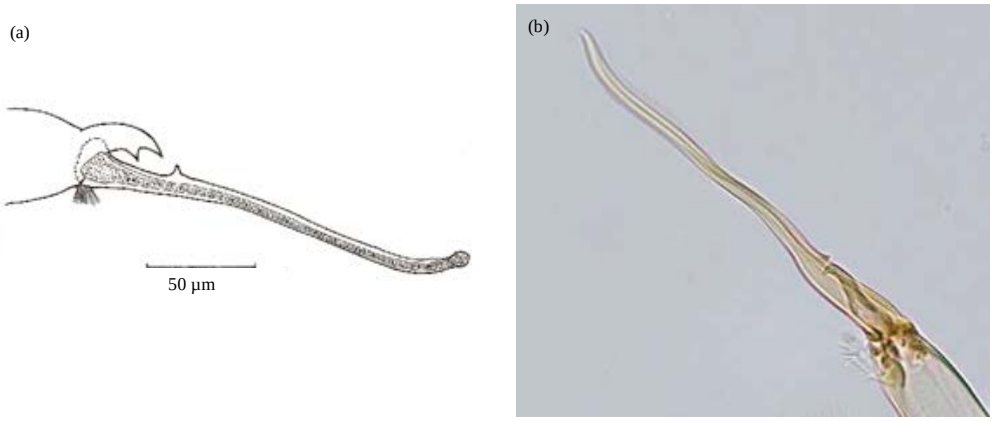

Fig. 7(a-b): Male chelicera (Scale bar = 50 µm)

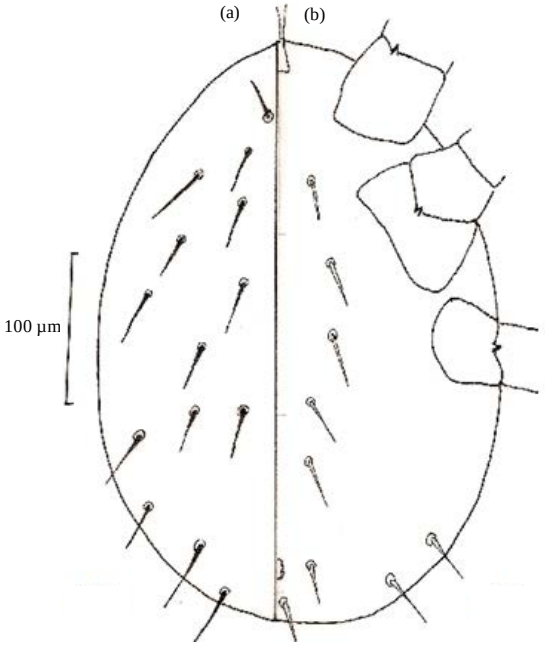

Fig. 8(a-b): *Cosmolaelaps qassimensis* sp. nov., larva, (a) Dorsal shield and (b) Ventrum

tooth near its tip, while the movable one unidentate and fused with extremely long hose-shaped spermatodactyl (142.24 µm long) (Fig. 7a, b). Measurements of legs I-IV 462.24, 334.40, 323.20 and 488.84 µm, respectively. Legs unarmed, structure and chaetotaxy as for female.

Larva: Hypostome with only 2 pairs of setae. Idiosoma (360.16 µm long and 247.36 µm wide), dorsal shield entire smooth, with 14 pairs of simple setae, of which setae z_2, Z_4 and J_5 the longest (Fig. 8a). Tritosternum with 2 laciniae. Ventral surface with 7 pairs of subequal setae. Postanal setae longer than adanals. Peritreme absent. (Fig. 8b). Legs I-III measure 364.20, 249.52 and 246.60 µm, respectively.

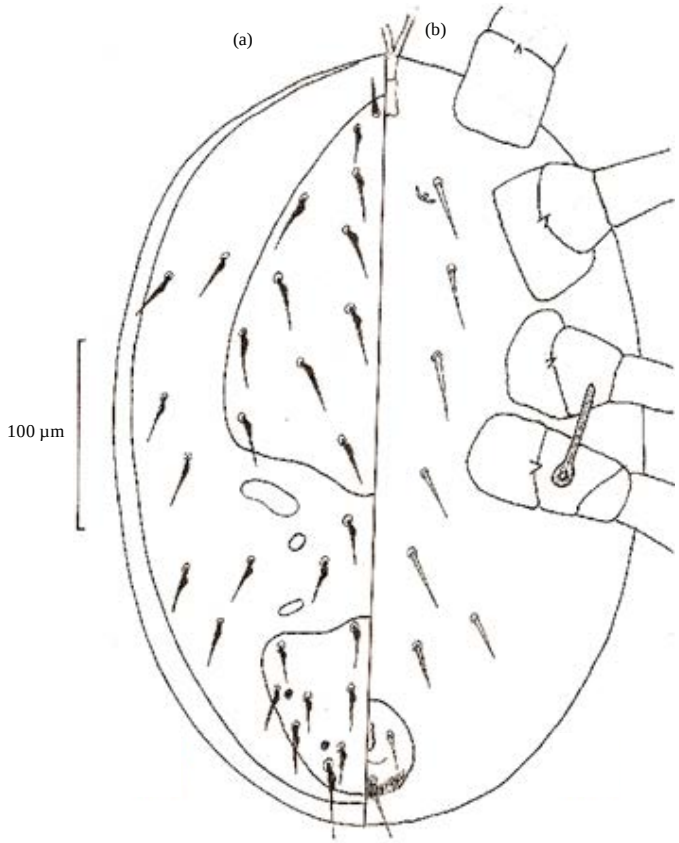

Fig. 9(a-b): *Cosmolaelaps qassimensis* sp. nov., Protonymph (a) Dorsal shield and (b) Ventrum

Protonymph: Hypostome with 3 pairs of setae forming a triangular shape. Tritosternum with 2 laciniae. Idiosoma (433.32 µm long and 320.32 µm wide), divided into smooth subtriangular podonotum with a produced posteriorly 234 µm long and 188.48 µm wide and with 11 pairs of scimitar setae except j_1 lanceolate. The opithonotum shield semi-obscure (107 µm long and 126.40 µm wide) with 8 pairs of scimitar setae, of which setae Z5 the longest and with 2 pairs of circular pores. Dorsal membrane with 3 pairs of platelets between podonotum and opithonotum, of which the anterior pair four times as big as other platelets. Seven pairs of scimitar-like setae arise free around dorsal shields (Fig. 9a). Ventrum with 7 pairs of simple setae and one pair of lyriform pores arise posterior to setae St_1. Anal shield pear-shaped with postanal setae longer than adanals. Peritreme present, short and extends ventrally to the level of coxae III. Legs I-IV measure 418.80, 288.56, 269.68 and 397.92 µm, respectively (Fig. 9b).

Deutonymph: Hypostome as that of protonymph. Dorsal shield entire (497.20 µm long and 336.26 µm wide) but with two lateral grooves at the same level of setae J_1 and with a complete number of setae as that of female. Setae j_1 lanceolate while the other dorsal setae scimitar-like. Eight pairs of pores arise also on dorsal shield of which a pair of a crescent-shaped arises between j_1 and j_2 and another pair beside S_5 (Fig. 10a). Tritosternum as that of protonymph. Peritreme well developed, extends anterodorsally to the level between setae z_1 and s_2. Ventrum smooth, with

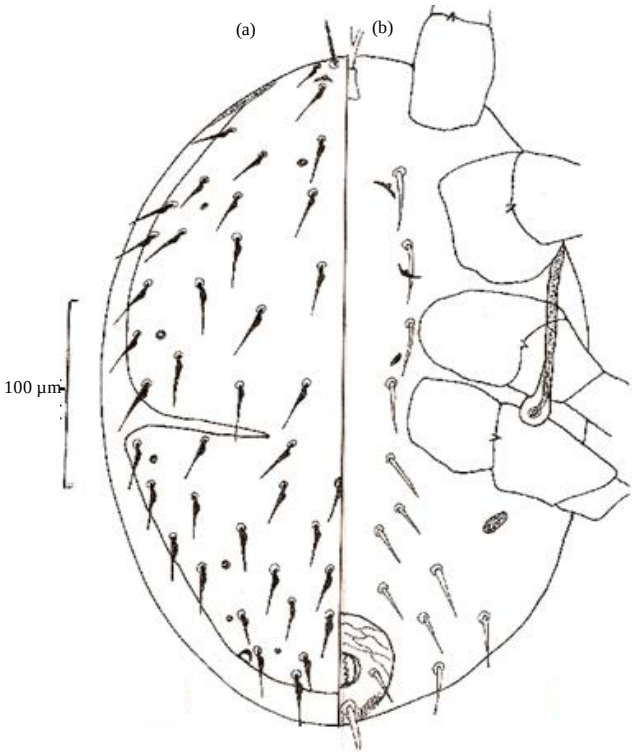

Fig. 10(a-b): *Cosmolaelaps qassimensis* sp. nov., Deutonymph, (a) Dorsal shield and (b) Ventrum

Table 1: Hypostome and its difference with other species

Parameters	*H. (C.) chianensis* (Gu, 1990)	*H. (C.) hrydi* (Samsinak, 1961)	*C. qassimensis* sp. nov.
No. and shape of dorsal setae	39 pairs-setae j1, z1, Z5 simple, the rest scimitar-like	39 pairs-setae j1, z1 Z5 simple, the rest scimitar-like	39 pairs, of which 38 pairs scimitar -like setae, while setae j_1 lanceolate
Tectum	Roof-like, smooth, with thin denticulation on the two sides	With a central pointed prong flanked by asymmetric side projections and the rides with teeth sloping backward	With anterior margin triangular, irregularly denticulate with central apical point
Female fixed digit	With 6 teeth	With 5 teeth	With 8 teeth
Male spermatodactyl	Fused movable digit-spermatodactyl short twice as long as fixed digit	Fused movable digit-spermatodactyl short twice as long as fixed digit	Fused movable digit-spermatodactyl with a single blunt tooth , very long hose-shaped and five times as long as fixed digit

12 pair of simple setae and 2 pairs of lyriform pores and a pair of oval ones arise between coxae III and IV. Anal shield pear-shaped with postanal setae longer than adanals. Metapodal shield present arise posteriorly to coxae IV. Setae J_5 scimitar-like (Fig. 10b). Legs I-IV measure 494.56, 354.32, 354.20 and 535.84 µm, respectively.

Notes: This species is considered a new and stands nearly to *Hypoaspis* (*Cosmolaelaps*) *chianensis* (Gu, 1990) and *Hypoaspis* (*Cosmolaelaps*) *hrydi* (Samsinak, 1961) but it can be separated by having the following differences (Table 1).

Materials examined: Holotype female and paratypes of 14 females and 8 males were collected from soil sample surrounding root system of date palm trees, Melida district, Buraydah West, Saudi Arabia on 12/9/2012. After that, an adult female was coupled with a male from a pure culture of *C. qassimensis* sp. nov. and provided with *T. putrescentiae* as food and kept at 26±1 and 65±5% RH for their whole life span.

Ethomology: The name qassimensis refers to the district from which the specimens were collected.

DISCUSSION

The present results showed that there were no significant differences between the average total number of *C. qassimensis* sp. nov., which was collected in May, July, August and October. That may be due to different environmental factors such as temperature, irrigation and associated soil fauna. Also, availability of food sources such as prey mites, insects and nematodes may have a considerable effect of survival and natural increase of *C. qassimensis*. Similar results were obtained by several authors who noticed that species of *Cosmolaelaps* as well as *Hypoaspis* can feed on different foods such as eggs and larvae of housefly *Musca domestica* L., vinegar fly, *Drosphila melanogaster* Morgan (Sherif and Afifi, 1980); mushroom sciarid fly, *Lycoriella solani* Winnertz (Enkegaard *et al*., 1997); springtail *Folsomia fimetaria* L. (Baatrup *et al*., 2005); egg masses of root-knot nematode *M. javanica* and citrus nematode *Tylenchulus semipentrans* (Cobb) and acarid mite *Caloglyphus rodreguezi* Samsinak (Al-Rehiayani and Fouly, 2005); springtails *F. candida* Willem and *F. fimetaria* L.; *T. putrescentiae* (Schrank) (Freira and de Moraes, 2007); acarid mite *C. michaeli* Oudemans and an oligochaeta worm *Enchytraeus cryticus* (Salmane and Brumelis, 2008).

On the other hand, the classification of laelapid mites is still confusing where the diagnostic differences between their genera and subgenera are still not clearly defined. Many acarologists have used different concepts for genera and subgenera especially predatory laelapid mite species belonging to the genus *Hypoaspis* Canestrini, 1884. Gu (1990) described *C. chianensis* as a new species and mentioned that it is similar to *C. hrydi* Samsinak (1961). Ma (2006) stated that as a result of the taxonomic confusion in the genus *Hypoaspis* and its subgenera, several species have been described in different countries with different names and sometimes a single species has, therefore, synonyms. Therefore, he found that *H.* (*C.*) *shenyangensis* (Bei *et al*., 2003) is considered a synonym to *H.* (*C.*) *hrydi* Samsinak (1961). *H.* (*C.*) *hefeiensis* (Xu and Liang, 1996) is also a synonym to *H.* (*C.*) *chianensis* (Gu, 1990). Joharchi and Halliday (2011) and Joharchi *et al*. (2012) stated that the existing classification of these taxa has been developed mainly using European fauna.

Therefore, a stable classification will not be possible until more taxa are described from different parts of other continents and from a wide range of host associations. Recently, Moreira *et al*. (2014) updated the characterisation of *Cosmolaelaps* because they found it was poorly described in its original description as well as in subsequent publications. They discussed the synonymy of *Cosmolaelaps* species and described more five new species from Brazil. Surely, the incomplete description of many *Cosmolaelaps* species makes it difficult to be subgroups. It is more difficult for scientists to do such studies without previous complete published data in some countries such as Saudi Arabia.

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