



A contribution to the knowledge of *Coccalicus clavatus* Willmann, 1952 (Trombidiformes, Iolinidae) new to Asian fauna

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ABSTRACT. The iolinid mite *Coccalicus clavatus* Willmann, 1952 was collected during a survey from the soil of Gilanegharb, Kermanshah, Iran in 2022. This species was first described in the family Alycidae by Willmann in 1952 and then André and Uusitalo transferred it to the family Iolinidae in 2006, accompanied by transferring species from the genus *Paratydaeolus* to the genus *Coccalicus*. Some challenges about species characters of this mite are discussed in this paper and the synonymy of *C. lukoschusi* and *C. clavatus* is proposed. The genus consists of 12 species with clavate trichobothria, and is related to various habitats like soil, stored products, under barks, on leaves of different plants, and on birds. They have been reported from Europe, Antarctica and North America and this is the first record of the *Coccalicus* mites from Asia.

Key words: Acari, Tydeoidea, *Paratydaeolus lukoschusi*, new record, Iran

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INTRODUCTION

The history of the genus *Coccalicus* Willmann started 71 years ago. Firstly, Willmann (1952) described *Coccalicus clavatus* as a member of the family Pachygnathidae (currently named Alycidae) and it became type species of the genus *Coccalicus* Willmann that was collected from old beach wrack after winter high floods on the Island of Wangerooge, Germany. After that, André (1980) described the genus *Paratydaeolus* based on the type species *Paratydaeolus lukoschusi* and considered the genus *Coccotydeus* Wood, 1965 a junior synonym of *Paratydaeolus*. Finally, André and Uusitalo (2006) transferred the genus *Coccalicus* to the family Iolinidae after examining Willmann's type specimen. They compared the leg chaetotaxy of *Coccalicus* with *Paratydaeolus* and synonymized *Paratydaeolus* under *Coccalicus*. Consequently, the genus *Coccalicus* was transferred from the Alycidae to the family Iolinidae (Tydeoidea) which was redefined by André and Fain (2000). The type species of the genus, *C. clavatus* was redescribed by André and Uusitalo (2006) and compared with *Coccalicus lukoschusi* (André, 1980) which had the same striation pattern and the shape of prodorsal trichobothria. Both species had the same geographical origin, the North of Western Europe.

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The genus *Coccalicus* can be distinguished from other genera of the family by the following diagnosis: prodorsum procurved; no eyes; sensilla clublike. Opisthosoma: dorsal chaetotaxy 11 (*d2* missing); poroidotaxy 4; genital organotaxy (1–4); adults with three pairs of genital and four pairs of aggenital setae; eugenital setae absent in females. Epimeral formula: (3-1-4-3). Legs: I (12(ω)-5-4-6-1), II (8(ω)-2-4-3-1), III (7-2-1-3-1), IV (7-2-1-2-0); palp chaetotaxy (5(ω)-2-2); solenidiotaxy 3; femur IV entire (André, 1980; Theron et al., 2012).

The mite *C. clavatus* was described based on a single tritonymph specimen (Willmann, 1952). André and Uusitalo (2006) concluded to have an open end to the story of *C. clavatus* until someone finds more specimens. The reason may be due to low differences in the diagnosis of *C. clavatus* and *C. lukoschusi*. This paper aims to open this discussion again and to review these characters using new data based on a new specimen of *Coccalicus* found from western Iran.

MATERIAL AND METHODS

In a survey of collecting mites from agroecosystems of Kermanshah province, a tiny tritonymph *Coccalicus* mite was collected from the soil of the Tange golem, Gilanegharb (34°05'00"N, 45°50'23"E, 805 m a.s.l), using Berlese-Tullgren funnel. It was collected on 20 May 2022, cleared in lactic acid and then slide-mounted in Hoyer's medium (Walter & Krantz, 2009). The specimen was studied under a BX51 Olympus microscope equipped with magnification changer and digital photographic camera. The specimen is deposited in acarological collection of Razi University. The nomenclature of idiosomal chaetotaxy follows Kazmierski (1998).

RESULTS

Taxonomic hierarchy

Class Arachnida Lamarck, 1801

Order Trombidiformes Reuter, 1909

Family Iolinidae Pritchard, 1956

Subfamily Tydaeolinae André, 1980

Genus *Coccalicus* Willmann, 1952

***Coccalicus clavatus* Willmann, 1952 (Figure 1)**

Diagnosis. The morphological characters of the Iranian specimen is similar to *C. clavatus* and *C. lukoschusi* but there are some variations in differential characters, which separate Willmann's specimen, André's *C. lukoschusi* and Iranian *Coccalicus*. Differences and variations are as follows:

Body size. Length of the idiosoma of tritonymph in the Iranian specimen is shorter than three paratype tritonymphs of *C. lukoschusi* (201 ± 14 µm) and *C. clavatus* (188 µm) tritonymph holotype. The length of the idiosoma is 135 ± 1 µm and the width 78 µm. This size is closer to *C. clavatus*.

The striation pattern. The striation pattern in this genus is very fine and difficult to discern. It is longitudinal on the prodorsum and transverse on the opisthosoma. The density of stria in *C. lukoschusi* is less than *C. clavatus*. According to André and Uusitalo (2006) in *C. lukoschusi*, the striation is slightly V-shaped between setae (*c1*). Between setae (*d1*), the striation is slightly transverse. In *C. clavatus* the striation is slightly transverse between setae (*c1*). Between setae (*d1*), the striation is slightly V-shaped. We compared their figures (Figures 2A and 2B in André & Uusitalo, 2006) with our digital image (Fig. 2) and did not find any significant difference between these three striations. In the Iranian specimen, as well as in the other two species of *Coccalicus*, the striation is slightly V-shaped between setae (*c1*) and between setae (*d1*), the striation is slightly reverse U-shaped.

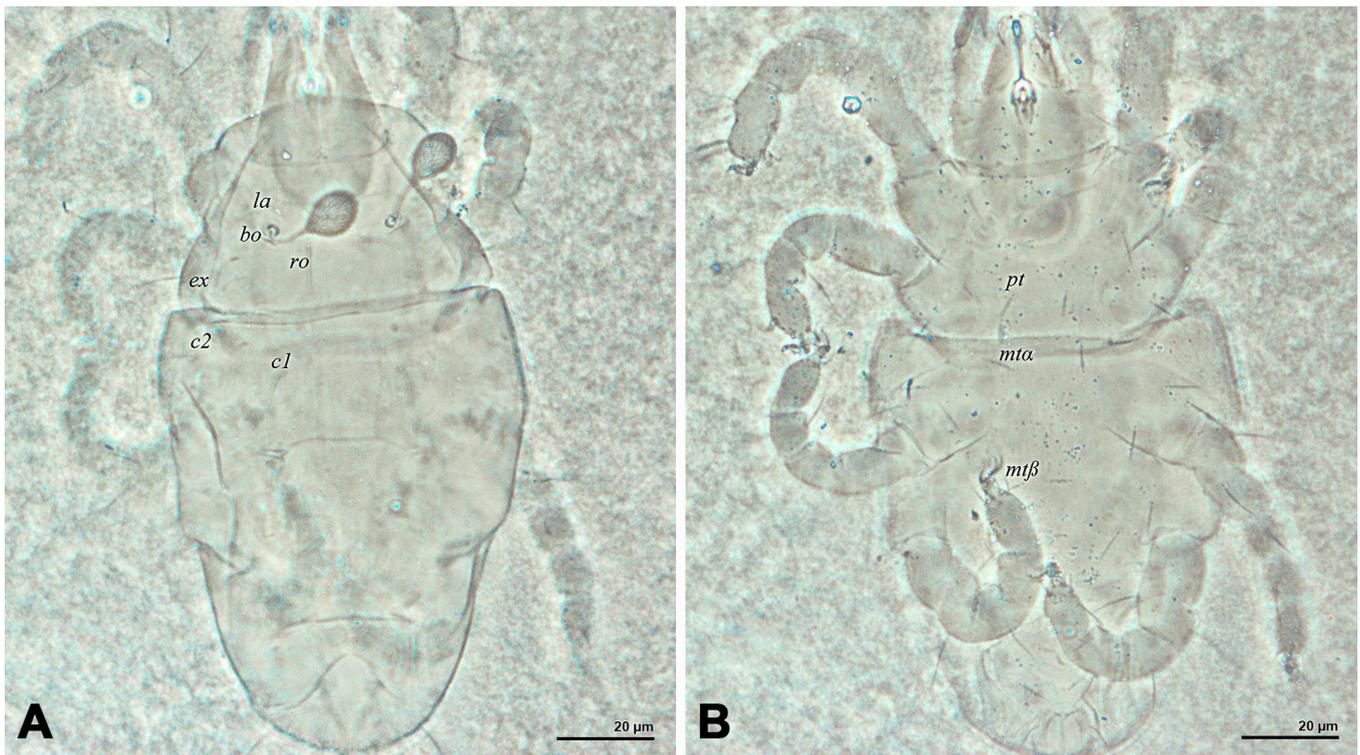


Figure 1. *Coccalicus clavatus* Willmann, 1952 collected from Gilanegharb, Kermanshah province. **A.** Dorsum; **B.** Venter.

Shape of bothridial setae. The two species are also separated by the prodorsal trichobothria. Overall, the trichobothria are clubbed in both species but according to André and Uusitalo (2006), those of *C. clavatus* seem to be more rounded. In the Iranian specimen left trichobothrium ($22 \pm 1 \mu\text{m}$) is a little bit more rounded and the right one's shape is near to the *C. lukoschusi* (Fig. 3). However, the shape of trichobothria depends on species, the stase, the individual, specimen treatment (lactic acid or not...), pressure on the coverslip during mounting, the orientation, drawings and the artistic talent of the author. It seems that the position of the bulb in the microscope slide is also important to see its exact shape. Not only the trichobothria have different shapes, but also the density of barbules covering the bulb was reported greater in *C. lukoschusi* than in *C. clavatus* (Figure 4 in André & Uusitalo, 2006). A higher density of barbules was also observed in the adult of *C. lukoschusi*. The density of barbules in Iranian *Coccalicus* seems similar to *C. clavatus*. We took two images with different zooms from each *bo* seta of Iranian *Coccalicus* (Fig. 3) and showed that the density of barbules seems different in various zooms. Checking this challenging character depends on the microscope's quality and appropriate zoom.

The density of striae. The density of striae between lamellar setae (*la*) counted 55 from figure 2 of André and Uusitalo (2006) for *C. clavatus* and 49 for *C. lukoschusi*. This number counted as 42 in the Iranian specimen (Fig. 3E). It seems that this number is positively related to body size and varies in the different stages of life.

The relative position of prodorsal setae. The position of prodorsal setae is also reported as a differential character in two species. In *C. clavatus*, the distance between setae (*la*) is greater than that between setae (*bo*), while the ratio is reversed in *C. lukoschusi* (1.01 vs 0.97). In other words, setae *la* are in line with or exterior to *bo* in *C. clavatus*, whereas they are in a more internal position in *C. lukoschusi* (André & Uusitalo, 2006). In collected specimens from Gilanegharb, setae *la* are more or less in line with *bo* setae and have no internal nor external position to *bo* (Fig. 3E). Also, the difference between these distances in two other collections (Willmann, and André) is negligible and difficult to concern.

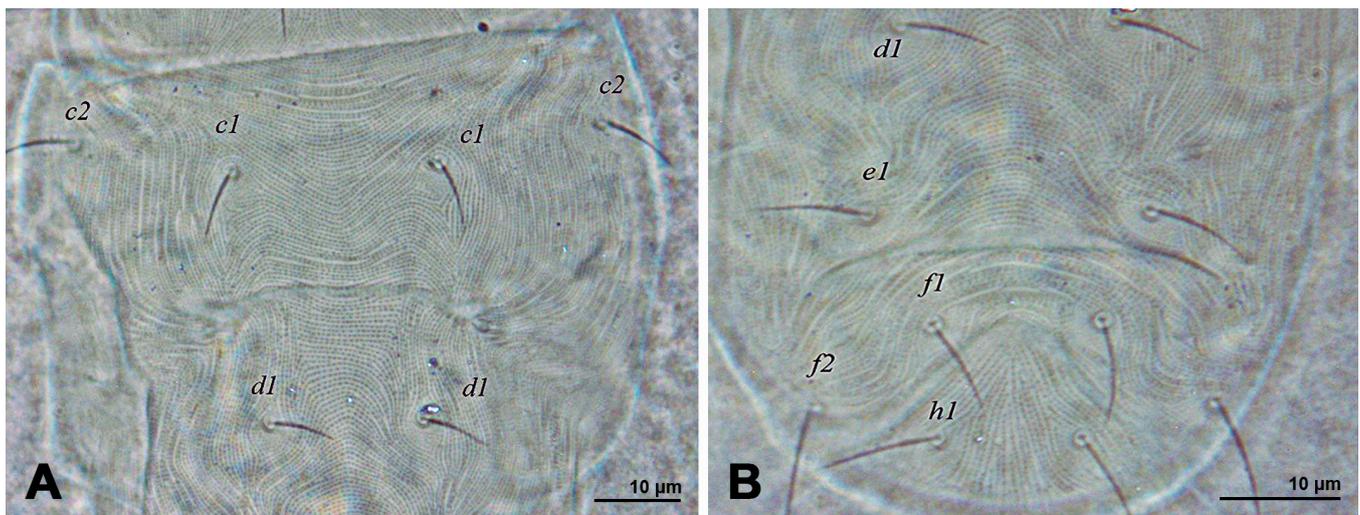


Figure 2. *Coccalicus clavatus* Willmann, 1952 - Iranian specimen, dorsal hysterosomal striation. **A.** Striation between *c* and *d* setae; **B.** Opisthosomal striation.

Habitat. Both species are recorded from Western Europe, *C. lukoschusi* from Germany and *C. clavatus* from the Netherlands. However, *C. clavatus* was collected from old beach wrack after winter high floods, while *C. lukoschusi* was found on the Blue Tit, *Parus caeruleus* Linnaeus (André and Uusitalo, 2006). The Iranian specimen was found in the soil of the riverside. Hence, Willmann's specimen as well as our specimen are tritonymphs and each only one specimen whereas the collection from the Netherlands (André, 1980) which has different stages and contains 13 specimens, has collected from the original habitat of mite that is related to Blue Tit. Specimens from Germany and Iran maybe had detached from the bird and fallen into the soil. Iran also is one of Blue Tit habitats and the location of the collected specimen has pure nature containing a river, trees, and shrubs and can be suitable for birds like that. Another possible hypothesis is that these mites can also live in soil or live on a creature that may be found in soil. The simple and small stylets (7 µm) in the Iranian specimen does not suggest being parasitic mite. Therefore, we rather propose to recognize the Iranian specimen as *C. clavatus* based on most morphological characters as well as habitat. There are some characters in this specimen which do not completely fit to previous records and show that the mentioned diagnoses between these species are small morphological variations (Table 1) and in this case all of three collections refer to probably one species. Of course, this propose would be open until collecting more specimens of these mites.

Table 1. Differential morphological characters of *Coccalicus clavatus*, *C. lukoschusi* and Iranian specimen.

Character	<i>C. lukoschusi</i>	<i>C. clavatus</i>	Iranian specimen
Specimens and stages	1 Larva 5 Deutonymphs 2 Tritonymphs and 5 females	1 tritonymph	1 tritonymph
Length of idiosoma	201 ± 14 µm	188 µm	133–135 µm
Number of striae (NS) between La (Ve)	49	55	42
<i>c1-c1(d1-d1)</i> striation	V-shape	V-shape	V-shape
<i>d1-d1(d2-d2)</i> striation	Inverted U- shape	Inverted U- shape	Inverted U- shape
<i>la</i> distance to <i>bo</i> distance	<i>la - la</i> < <i>bo-bo</i>	<i>la - la</i> > <i>bo-bo</i>	<i>la - la</i> = <i>bo-bo</i>
Shape of trichobotrium	Less rounded clubbed	More rounded clubbed	One is more rounded and another one is less rounded
Density of barbules on trichobotrium	More barbules	Less barbules	Less barbules
Host	Blue Tit, <i>Parus caeruleus</i> L.	Old beach wrack after winter high floods	Soil in the riverside
Locality	The Netherlands	Germany	Iran

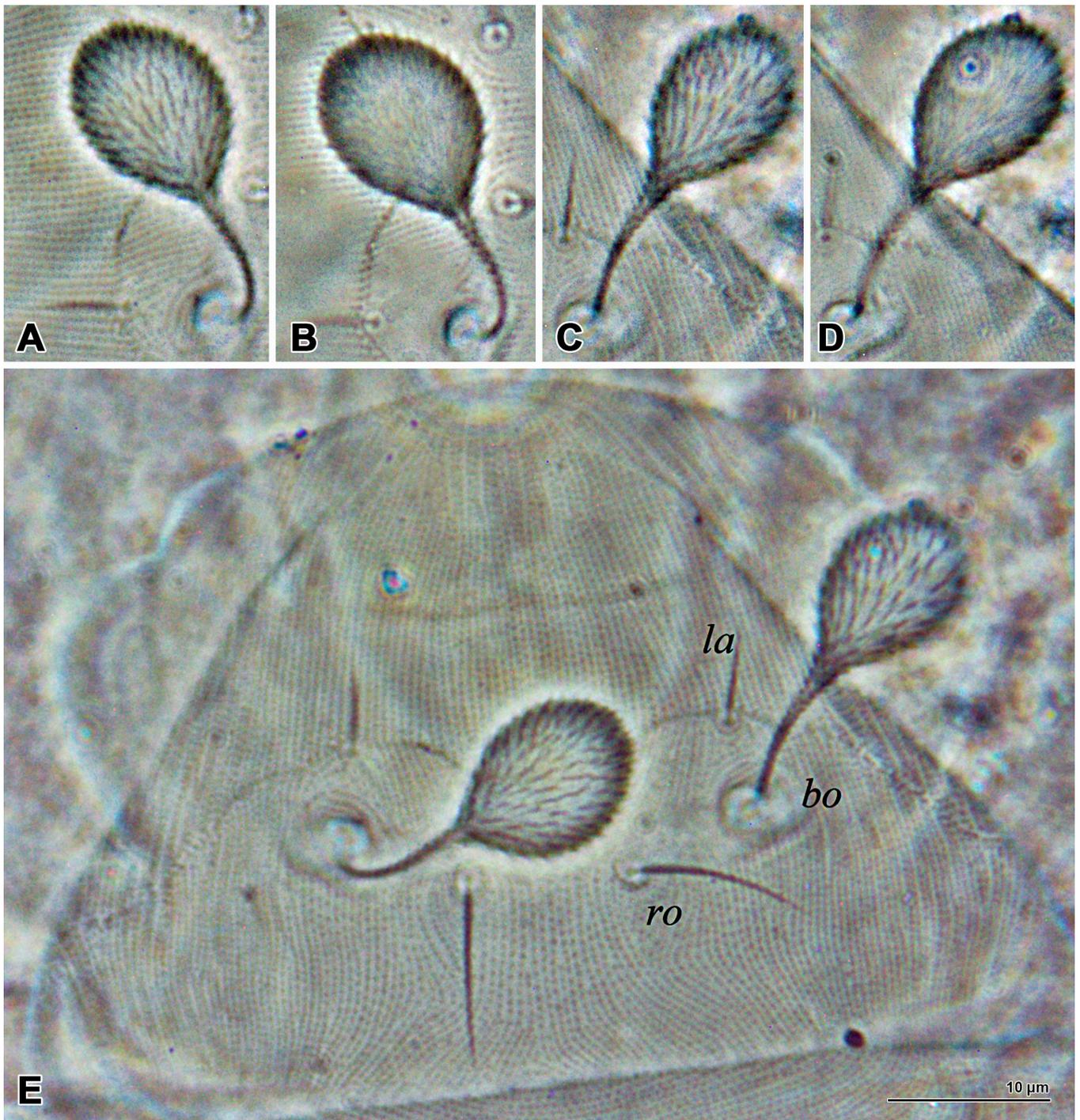


Figure 3. *Coccalicus clavatus* Willmann, 1952 - Iranian specimen. **A-B.** Left bothridial seta (*bo*) with two different zooms; **C-D.** Right bothridial seta with various zooms (length of *bo* 21 µm). **E.** Prodorsal striation.

DISCUSSION

Originally, the genus *Coccalicus* was monospecific when it described first; after conjugation with *Paratydaeolus* by André and Uusitalo (2006) and the last species description by Theron & Ueckermann (2012), it included 12 species. We suggest decreasing this number to 11 species by this synonymy. *Coccalicus* species are small, live in various habitats (soil, stored products, bark, leaves, birds), have

been reported from Europe, Antarctica and North America and now this is the first record of these mites from Asia. According to André and Uusitalo (2006), these mites may have more diversity worldwide because of the diversity in habitats that they occupy. Otherwise, the number of *Coccalicus* species described so far is low. Their small size and lack of biological information like their importance in agriculture were André and Uusitalo (2006) guess for this matter. Described species of this genus are as follows: *C. alpinus* (Schiess, 1982); *C. athaliahea* (Theron & Ueckermann [in Theron et al.], 2012); *C. canadensis* (Momen & Sinha, 1982); *C. clavamomen* (Momen & Lundqvist, 1996); *C. clavatus* Willmann, 1952; *C. enigmaticus* (Usher & Edwards, 1986); *C. expressus* (Kuznetsov [in Livshits & Kuznetsov], 1973); *C. lanceoclaviger* (Livshits [in Livshits & Kuznetsov], 1973); *C. loadmani* (Wood, 1965); *C. lukoschusi* (André, 1980); *C. opimus* (Kuznetsov, 1979) and *C. rafalskii* (Każmierski, 1980).

AUTHOR'S CONTRIBUTION

The authors confirm their contribution in the paper as follows: M. Darbemamieh: sampling, mounting and identification of the specimens, preparation of the photographs and writing the manuscript and correspondence; A. Saboori: help in identification of the specimens, and preparation of the identification facilities and funds; verifying the information and discussions and revising the manuscript. Both authors read and approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

The reference specimen listed in this study are deposited in the Acarological collection of Razi University, Kermanshah and are available from the curator, upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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اطلاعات جدید از گونه *Coccalicus clavatus* Willmann, 1952 (Trombidiformes, Iolinidae) و نخستین گزارش این کنه از قاره آسیا

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چکیده: کنه یولینید *Coccalicus clavatus* Willmann, 1952 طی یک پژوهش از خاک شهرستان گیلان غرب استان کرمانشاه در سال ۲۰۲۲ جمع‌آوری شد. این گونه اولین بار توسط Willmann در سال ۱۹۵۲ و در خانواده Iolinidae توصیف شده است و سپس André و Uusitalo در سال ۲۰۰۶ آن را در خانواده Iolinidae طبقه‌بندی کرده و هم‌زمان سایر گونه‌های نزدیک را از جنس *Paratydaeolus* به جنس *Coccalicus* منتقل کردند. برخی ابهامات در رابطه با ویژگی‌های این گونه در این مقاله مورد بحث قرار گرفته و مترادف بودن *C. lukoschusi* و *C. clavatus* پیشنهاد شده است. جنس *Coccalicus* اکنون شامل ۱۲ گونه کنه دارای تریکوبوتری‌های چماقی است که با زیستگاه‌های مختلف مانند خاک، مواد انباری، زیر پوستک درختان، روی برگ‌ها و بدن پرندگان مرتبط هستند. این گونه‌ها از اروپا، قطب جنوب و آمریکای شمالی جمع‌آوری شده‌اند و این نخستین گزارش از این جنس در قاره آسیا است.

واژگان کلیدی: کنه‌ها، Tydeoidea، *Paratydaeolus lukoschusi*، گزارش جدید، ایران