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Re-description of the female of *Kampimodromus langei* Wainstein & Arutunjan (Acari: Phytoseiidae) based on normal and abnormal specimens, with the first description of its male

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**Original research**

**ABSTRACT**

*Kampimodromus langei* Wainstein and Arutunjan (Acari: Phytoseiidae) is reported for the first time for the Turkish fauna. It is re-described and illustrated, based on normal and abnormal female specimens from material collected from *Quercus cerris* L. var. *cerris* (Fagaceae) trees in Samsun Province on the north coast of Turkey. In addition, the male is described for the first time in this study. Our examination of a series of female specimens of *K. langei* showed no remarkable differences compared to its original description and subsequent redescriptions. However, on both sides of a female specimen, we observed an additional dorsal seta inserted at the location of seta *S1* known from other groups of Mesostigmata closely related to phytoseiid mites. The dorsal shield of the abnormal specimen is also illustrated and its setal measurements are provided. To the best of our knowledge of phytoseiids, the extra setas has been reported only for *Typhlodromus (Typhlodromus) laurae* Wainstein. The possibility of the more rearward location of anterior dorsal setae *z6* and *s6* which is known for some phytoseiid species, as well as the presence of extra seta/e on other species of phytoseiid mites, are also briefly discussed.

**Keywords** Kampimodromini; predatory mite; fauna; new record; abnormality; extra dorsal seta

**Introduction**

The members of the mite genus *Kampimodromus* Nesbitt (Acari: Phytoseiidae) are considered to be Type III generalist predators living on pubescent leaves (McMurtry *et al.* 2013). Among them, *K. aberrans* (Oudemans) is an effective predator of phytophagous mites on a number of crops that include apples, grapes and hazelnuts (Kreiter *et al.* 2000; Kasap 2005; Ozman-Sullivan 2006; Duso *et al.* 2014). Natural populations of some other *Kampimodromus* species such as *K. ericinus* Ragusa di Chiara & Tсолakis, *K. keae* (Papadoulis & Emmanouel), *K. langei* Wainstein & Arutunjan and *K. ragusai* Swirski & Amitai have been reported from *Quercus* spp. trees in some European countries (Ragusa di Chiara and Tсолakis 1994; Tixier *et al.* 2008; Papadoulis *et al.* 2009; Cargnus *et al.* 2012; Doker *et al.* 2017, 2018; Faraji and Hoekstra 2021).
In this study, we report *K. langei* for the first time for Turkish fauna. It is re-described and illustrated, based on normal and abnormal female specimens. Also, the male is described for the first time in this study.

**Material and methods**

This study was conducted in 2021 in several remnant oak forests on the Kurupelit campus of Ondokuz Mayis University in Samsun Province, Turkey. Most of the surveys were done periodically in June, July, August, September and October. Leaves of oak trees were inspected with the aid of a 10X hand magnifying lens and those with phytoseiid mites were collected. The collected leaves were wrapped in paper, placed in a labeled plastic bag and stored in an ice-box until transferred to the laboratory. They were then refrigerated until checked for mites under a stereomicroscope. All of the collected mites were stored in 70% alcohol until cleared in lactophenol and mounted on slides in Hoyer’s medium. The slides were then kept in an incubator at 55 °C for one week. The mites were identified and illustrated by the second author. The permanent slides were examined under an Olympus® CX-41 microscope. Illustrations were prepared by using a U-Da drawing attachment (Camera Lucida). The taxonomic system used followed Chant and McMurtry (2007), and the setal nomenclature used followed Lindquist and Evans (1965), as adapted by Rowell *et al.* (1978). The dorsal and ventral setal pattern used was that of Chant and Yoshida-Shaul (1989, 1991, 1992). The nomenclature for solenostomes for the dorsal idiosoma follows that of Athias-Henriot (1975). Leg chaetotaxy follows that of Evans (1963). Measurements are given in micrometers and presented as the mean, followed by the range in parentheses. The examined specimens are deposited in the mite collection of the Acarology Laboratory, Cukurova University, Adana, Turkey.

**New record for Turkey**

*Kampimodromus langei* Wainstein & Arutunjan

(Figures 1, 2)

*Kampimodromus langei* Wainstein & Arutunjan, 1973: 55, Fig. 2.

**Diagnosis** — Dorsal setal pattern 10A:8C, one female specimen with extra dorsal seta on both sides, dorsal shield striated, bearing five pairs of large solenostomes (*gd1, gd2, gd6, gd8* and *gd9*). Dorsal setae serrated, except *j4, j5, j6, J2, J5* and *Z1* smooth, *J2* and *Z1* with few barbs in some specimens. Peritreme extending to level of seta *z2*. Sternal shield smooth with three pairs of setae, genital shield smooth. Ventrianal shield smooth with three pairs of preanal setae and one pair of rounded pores. Calyx of spermatheca cup-shaped; atrium small, nodular, attached to calyx without neck. Fixed digit with three teeth, and movable digit with one tooth. Genu II and Genu IV each with eight setae, and tibia IV seven setae. Macroseta *StIV* present and with blunt tip. Male dorsal shield reticulated and with setae *r3* and *R1*. Male ventrianal shield striated, with three pairs of setae (*JV1, JV2* and *ZV2*), and one specimen had unpaired seta *JV3* on right side. Male spermatodactyl L-shaped with slightly developed toe.

**Re-description**

**Female**

(n=10)

**Dorsum** — (Figures 1A, B). Dorsal setal pattern 10A:8C (*r3* and *R1* off shield), one specimen with an extra dorsal seta on both sides (*S5* present, identical to location of *S1*). Dorsal shield striated, with waist at level of seta *R1*. A lateral cavity anterior to seta *S5* on right side visible on the illustrated specimen. Bearing five pairs of solenostomes (*gd1, gd2, gd6, gd8* and *gd9*).
Figure 1 Kampimodromus langei Wainstein & Arutunjan, 1973 female. A – Dorsal shield of a normal specimen, B – Dorsal shield of the abnormal specimen (with extra seta SS), C – Ventral idiosoma, D – Chelicera, E – Spermathecae, F – Leg IV (genu, tibia and basitarsus). Figures A, C, D, E and F are from the same specimen. Scale bars: 100 µm for Figures A, B and C; 20 µm for D and E, 50 µm for F.
Atrium small, nodular; attached to calyx without neck. Major duct long, minor duct not visible.

ST5 width at level of genital setae (JV3) (one specimen had an unpaired seta (s4), (275–310), width (at level of JV3) 149 (145–153), width (at level of S2) 158 (155–160)). Dorsal setae serrated, except j4, j5, j6, J2, J5 and Z1 smooth. Setae J2 and Z1 with few bristles in some specimens. Measurements of dorsal setae as follows: j1 19 (18–20), j3 27 (25–30), j4 12 (10–13), j5 11 (10–13), j6 13 (13–15), J2 20 (18–23), J5 5 (4–6), z2 27 (25–28), z4 29 (28–30), z5 11 (10–13), Z1 18 (15–20), Z4 41 (40–43), Z5 48 (45–50), s4 33 (30–35), SS 35 (only one specimen), S2 38 (35–40), S5 19 (18–20), r3 38 (35–40) and RI 27 (25–30). Peritreme extending to level of seta z2.

Venter — (Figure 1C). Ventral setal pattern 14: JV-3:ZV. Sternal shield smooth, lightly sclerotized; with irregular posterior margin, three pairs of setae (ST1, ST2 and ST3) and two pairs of pores (iv1 and iv2); length (ST1–ST3) 56 (55–58), width (ST2–ST2) 56 (55–58); metasternal setae ST4 and one pair of pores (iv3) on metasternal shields. Genital shield smooth, width at level of genital setae (ST5) 44 (43–45). Ventrianal shield elongate, with waist at level of seta JV2. Three pairs of pre-anal setae (JV1, JV2 and ZV2); and one pair of rounded pores (gV3) posteromedian to JV2, distance between pre-anal pores 22. One pair of para-anal seta (Pa) and unpaired post-anal seta (Pst). Length of ventrianal shield 91 (88–95), width at level of setae ZV2 (widest point) 51 (50–53), at level of anus (at level of muscle marks, widest point) 46 (45–48). Setae ZV1, ZV3, JV4 and JV5 and six pairs of poroids on integument surrounding ventrianal shield. Setae JV5 serrated, longer than other ventral setae, 27 (25–28) in length.

Chelicera — (Figure 1D). Fixed digit 23 (23–25) long with three apical teeth, and pilus dentilis; movable digit 23 (23–25) long, with one tooth.

Spermatheca — (Figure 1E). Calyx short, cup-shaped, flaring distally, 8 (8–10) in length. Atrium small, nodular; attached to calyx without neck. Major duct long, minor duct not visible.

Legs — (Figure 1F). Length of legs (base of coxae to base of claws): leg I 237 (230–240); leg II 191 (185–195); leg III 174 (168–175); leg IV 222 (215–225). Macrosetae StIV blunt tip 18 (18–20) in length. Chaetotaxy as follows: Leg I: coxa 0 0/1 0/0 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II: coxa 0 0/1 0/0 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/1 2/1 1, tibia 1 1/1 2/1 1. Leg III: coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 2/1 0/1 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/1 1. Leg IV: coxa 0 0/1 0/0 0, trochanter 1 0/1 0/2 1, femur 2 1/1 0/0 1, genu 1 2/1 2/0 2, tibia 1 1/1 2/0 2.

Male

(n=9)

Similar to female in many aspects.

Dorsum — Dorsal setal pattern 10A:8C (r3 and R1 on shield). Dorsal shield sclerotized, reticulated, bearing five pairs of solenostomes (gd1, gd2, gd6, gd8 and gd9); length of dorsal shield 220 (218–223), width (at level of s4) 116 (113–118). Serration of dorsal setae as in female. Measurements of dorsal setae as follows: j1 14 (13–15), j3 27 (25–30), j4 12 (10–13), j5 12 (10–13), j6 14 (13–15), J2 25 (23–26), J5 5 (4–6), z2 29 (28–30), z4 34 (33–35), z5 14 (13–15), Z1 19 (18–20), Z4 31 (30–33), Z5 33 (30–35), s4 41 (38–42), S2 32 (30–36), S5 11 (10–12), r3 31 (30–33) and R1 22 (20–25). Peritreme extending to level of seta z2.

Venter — (Figure 2A, B). Sterngonotal shield smooth, sclerotized, with five pairs of setae (ST1, ST2, ST3, ST4 and ST5). Distance between bases of ST1–ST5 98 (95–100). Ventrianal shield triangular, striated, bearing three pairs of pre-anal setae (JV1, JV2 and ZV2) (Figure 2A), (one specimen had an unpaired seta (JV3 on left side) (Figure 2B), a pair of para-anal (Pa) and unpaired post-anal seta (Pst), and with one pair of rounded pores (gV3) posteromedian to JV2, distance between pre-anal pores 19 (18–20). Length of ventrianal shield 95 (93–98), width (at anterior corners widest point) 105 (99–110). Setae JV3 slightly serrated, 15 (13–18) in length.

Chelicera — (Figure 2C, D). Fixed digit with three teeth, two apical and one well-behind pilus dentilis; movable digit with one tooth; spermatophoral process L-shaped, with toe slightly developed. The left and the right sides of the illustrated specimen, as well as some other
specimens on both sides seemed to have different shape of spermatophoral process, with toe twisted in those cases.

**Legs** — Length of legs (base of coxae to base of claws): leg I 207 (205–210); leg II 191 (188–193); leg III 149 (148–150); leg IV 210 (205–213). Basitarsus IV with short macroseta, \textit{StIV} 16 (15–18) in length. Leg chaetotaxy as in female.

**Material examined**

Ten females and 9 males were collected from \textit{Quercus cerris} var. \textit{cerris} in remnants of oak forest on the Kurupelit campus Ondokuz Mayis University in Samsun Province, 41°21′58.9″N, 36°11′18.5″E: two females, 6 May 2021; one female, 27 May 2021; two males, 29 July 2021; two females, 18 August 2021; four females and six males, 28 August 2021; one female and one male, 18 September 2021.

**World Distribution**

Armenia (Wainstein and Arutunjan 1973), Russia (Meshkov 1999), Norway (Denmark and Edland 2002), Moldova (Kulikova 2011), Croatia, Italy (Cargnus \textit{et al.} 2012), The Netherlands (Faraji and Hoekstra 2021) and Turkey (this study).

**Remarks**

\textit{Kampimodromus langei} was described by Wainstein and Arutunjan (1973) based on the material collected from \textit{Quercus} sp. (Fagaceae) in Stepanavan, Armenia. Our collection of this species in Turkey represents a new record for the country as previous studies of the genus \textit{Kampimodromus} did not include \textit{K. langei} (Ozman and Cobanoglu 2001; Cobanoglu and Saglam D. \textit{et al.} (2022), \textit{Acarologia} 62(2): 446-453. \url{https://doi.org/10.24349/d6cm-8rly} 450
and Ozman 2002; Kasap and Cobanoglu 2009; Yesilayer and Cobanoglu 2011; Doker et al. 2017, 2018). In addition, the male K. langei is described for the first time in this study. Morphological characters and measurements of the current specimens are similar to those of the original description and subsequent re-descriptions (Wainstein and Arutunjan 1973; Ragusa di Chiara and Tsolakis 1994; Tixier et al. 2008; Cargnus et al. 2012; Faraji and Hoekstra 2021). However, a single female specimen showed an abnormality in having an additional dorsal seta on both sides, with all other morphological characters and measurements of the specimen being almost identical to the other specimens examined in this study, as well as the earlier descriptions. To the best of our knowledge, the extra seta inserted at the location of S1 has previously been reported by Kolodochka (2006) for Typhlodromus (Typhlodromus) laurae Arutunjan, but is not known in any other Phytoseiidae species to date (Rowell et al. 1978; Chant and Yoshida-Shaul 1989; Chant and McMurtry 2007; Ferragut et al. 2010). However, it is not known whether the extra seta reported for T. (T.) laurae was paired or unpaired because Kolodochka (2006) illustrated only the right side of the specimen.

This extra seta could be considered seta z6 or s6 because both are already known for some members of the family Phytoseiidae (Chant and McMurtry 2007; Papadoulis et al. 2009). However, when those setae are present on other phytoseiid species their insertion is clearly anterior to seta R1 (Kreiter et al. 2002; Faraji et al. 2008; Ferragut et al. 2010; Demite et al. 2020). However, the extra setae described in this study were located posterior to R1. In addition, when the podosomal setae z6 and s6 are present in phytoseiids their insertion is clearly anterior to solenostome gd6 (Chant and McMurtry 2007; Papadoulis et al. 2009) which is not the case in the abnormal specimens reported by Kolodochka (2006) and in this study. Kolodochka (2006) named this seta, SS. Therefore, we have used the same notation and have described this seta as SS.

Instead of being called an abnormality, the presence of extra seta/e can also be considered to be a kind of variation that has been reported for some phytoseiid species such as Amblyseius palustris (Chant), Euseius finlandicus (Oudemans), Neoseiulus agreris (Karg), N. longispinosus (Evans), Phytoseius echinus Wainstein & Arutunjan, Typhlodromus (Anthoseius) caudiglans Schuster, T. (A.) commenticus Livshitz & Kuznetsov, T. (T.) pyri Scheuten (Chant and Yoshida-Shaul 1989; Kolodochka 2006; Silva et al. 2020). In addition, Kolodochka (1985) reported a type specimen of T. (T.) rarus Wainstein without setae j3 and one each of S5 and Z4 but with an unpaired seta in the region of seta Z4. However, unpaired and unknown setae on the dorsal shield of phytoseiid mites can also represent a new taxonomic status as Demite et al. (2017) recently described a new genus and a new species, Amazoniaseius imparisetosus Demite, Cruz & McMurtry, with two unpaired setae.

In addition, an unpaired seta (JV3) was also observed on the ventrianal shield of a male specimen examined in this study. We consider the presence of this unpaired seta to be a variation because it has been already reported for A. nemorivagus Athias-Henriot and N. bicaudus (Wainstein) by Papadoulis et al. (2009).

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