



## The occurrence of *Paraneognathus wangae* (Fan & Li) (Acari: Caligonellidae) and *Raphignathus gracilis* Rack (Acari: Raphignathidae) of stored products in Turkey

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### ABSTRACT

The occurrence of *Paraneognathus wangae* (Fan & Li) (Acari: Caligonellidae) was reported for the first time in Turkey. This predatory species was found associated with stored wheat and collected from south-eastern part of Anatolia. Measurements of female and male are provided

along with their taxonomic characteristics and illustrations. This is also the first report on the occurrence of the genus *Paraneognathus* (Fan 2000) in Turkey. *Raphignathus gracilis* Rack (Acari: Raphignathidae) was also collected during this study as predatory species and rendered here.

Keywords: Mites, Caligonellidae, *Paraneognathus*, Mardin, Stored product, Turkey

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## 1. Introduction

The Raphignathoidea Grandjean, 1944 (Acari: Prostigmata) includes 11 families: Barbutiidae, Caligonellidae, Camerobiidae, Cryptognathidae, Dasythyreidae, Eupalopsellidae, Homocaligidae, Mecognathidae, Raphignathidae, Stigmaeidae and Xenocaligonellidae, with 62 genera and 900 species (Fan & Zhang 2005, Zhang et al. 2011). In Turkey, this superfamily is represented by 8 families, 25 genera and 192 species (Akyol 2017; Bingül et al. 2017; Doğan et al. 2019).

Caligonellids are small predators, that feed on small invertebrates. They mostly live on cracks of the tree, in litter and also associated with mosses, stored products, bird nests and soil (Summers & Schlinger 1955; Meyer & Ueckermann 1989; Fan 2000). The position of the peritremal plate and shape of stylophore are important for the identification of the genus *Paraneognathus* (Ueckermann & Khanjani 2003). *Paraneognathus wangae* (Fan & Li) (Acari: Caligonellidae) described in firstly in *Sinognathus* Fan & Li (1995) and collected from stored rice and the species later replaced in *Paraneognathus* (Fan 2000).

The genus *Paraneognathus*, can be identified as follows; idiosoma without eyes, with 11 pairs of dorsal setae, stylophore long and elongate, genital and anal opening are close to each other, peritreme confined to the edge of the stylophore.

In this paper, the genus *Paraneognathus* and the species *P. wangae* is reported for the first time from Turkey. *P. wangae* was found associated with stored products in Diyarbakır, Mardin and Muş provinces, which are located in the south-eastern part of Turkey. Besides, *R. gracilis* Rack was also collected in Caligonellidae as predatory species and included here.

## 2. Material and Methods

The mite samples were collected from stored products at Diyarbakır, Mardin and Muş provinces which are situated in the south-eastern part of Turkey (Figure 1). The samples were taken randomly from different wheat storages with monthly intervals during 2013-2014.



**Figure 1- Mite samples collection locations**

Wheat samples were taken with a split probe from the bulk, depending on the size of the stack in 4 kg. All the samples were collected by the second author.

The mites were obtained by Berlese funnel and preserved in ethanol 70% for further studies. Mite samples were kept in lactic acid for clarification and mounted in Hoyer's medium with microscopic slides for identification. using a Leica compound microscope.

Measurements were obtained with a Leica ICC50 HD soft imaging system. Gnathosoma was measured from the base to tip of the chelicerae. Palpi; from palp trochanter to tip of tarsi; the length of the idiosoma, from the base of gnathosoma to posterior end. The width of the body, was measured at the level of (c2). The length of setae were considered from the base to their tips. The legs were measured from the base of the femur to the tip claw. Both setae and solenidia evaluated in the setal counts. All measurements are in micrometres (µm).

The mite samples were deposited at Ankara University and, Diyarbakır Plant Protection Research Institute (Ministry of Agriculture and Forestry).

### 3. Results and Discussion

#### Raphignathoidea

#### Caligonellidae Grandjean 1944

#### *Paraneognathus* (Fan 2000)

#### *Sinognathus* (Fan & Li 1995:326).

#### *Paraneognathus wangae* (Fan & Li 1995)

**Diagnosis:** Idiosoma does not include dorsal shield or eyes. Stylophore conical and elongated, peritremes (W) shapes and lying the edge to stylophore. Genital pore has 3 (*g1-g3*) pairs setae and with 4 pairs of aggenital setae.

#### *Paraneognathus wangae* (Fan & Li 1995)

#### Female (Figures 2-9)

Oval shaped, body length 520, width 349, Palpus 223; gnathosoma (excluding palp) 153, width of gnathosoma 132.

#### Dorsum (Figures 2-9)

Dorsum soft and without shield and there are no eyes, integument striated simply. Prodorsum with four pairs setae; *vi*, *ve*, *sci* and *sce*. Dorsal setae barbed. Idiosomal setae measurements; *vi* 43; *ve* 44; *sci* 66; *sce* 58; *c1* 44; *c2* 70; *d1* 34; *e1* 38; *f1* 43; *h1* 49; *h2* 66; *ps1* 24; length of between setae: *vi-vi* 37; *vi-ve* 40; *vi-sci* 61; *vi-sce* 43; *sci-sci* 90; *sci-sce* 74; *sce-sce* 222; *sce-c2* 72; *c1-c1* 91; *c1-c2* 120; *c1-d1* 46; *c2-d1* 49; *c1-sce* 105; *d1-d1* 106; *d1-e1* 95; *e1-e1* 104; *e1-f1* 67; *f1-f1* 70; *f1-h1* 80; *h1-h1* 27; *h1-h2* 39; *h2-h2* 95; *h2-ps1* 41; *ps1-ps1* 28.

**Gnathosoma** (Figures 7, 9)

Chelicerae elongated with a very well developed stylophore plate which is conical at the base and surrounded by elongated peritremes ( $\omega$ ) shape including 9-10 septum of each side, at tip 3-4 septum sharply bent down. Subcapitular (*m*, *n*) and adoral setae (*or1*, *or2*); the length of setae: *m* 50, *n* 47; *or1* 15, *or2* 22.

**Palpus:** (from the femur to tip of tarsus) 223; palp tarsus has with a very well developed claw. Palpal chaetotaxy: femur and genua with 2 simple setae; tibia with 2 setae + 1 well developed claw + 1 accessory claw; tarsus with 1 tridentate eupathidium + 1 solenidion + 5 setae (Figures. 9).

**Venter** (Figure 4)

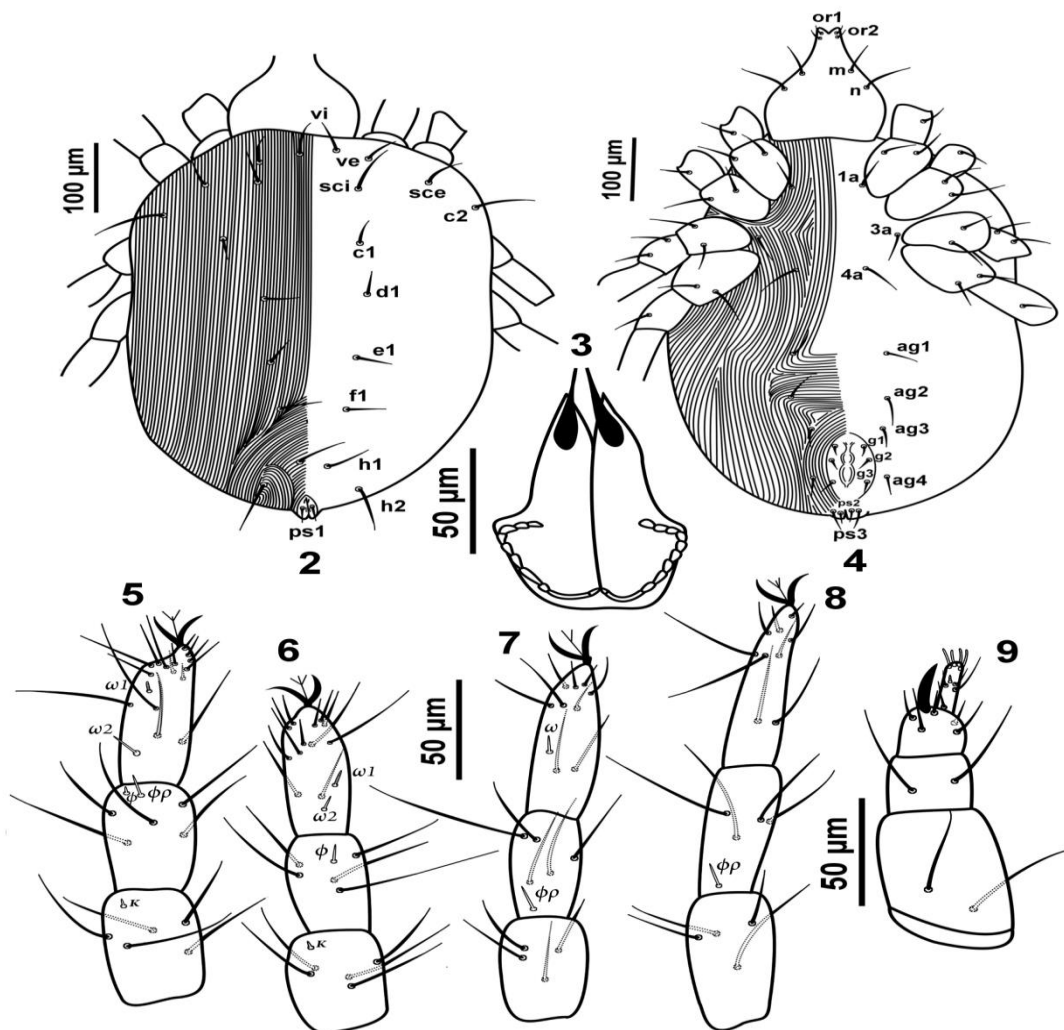
Coxisternal area includes *1a*, *3a* and *4a*; the length of setae: *1a* 53, *3a* 47, *4a* 46; with 4 pairs of agenital setae (*ag1-4*), aggenital shields covered by striae; genital shields with 3 pairs setae (*g1-3*) and pseudanal setae (*ps1-3*); length of setae: *ag1* 37, *ag2* 25, *ag3* 27, *ag4* 23; *g1* 17, *g2* 19; *g3* 17, *ps1* 24, *ps2* 25 and *ps3* 19.

**Legs** (Figures 5-8)

Lengths; leg I 334; leg II 302; Leg III 284; Leg IV 404.

Legs chaetotaxy (setae and solenidia in brackets) (I–V): coxae 2–2–2–2; trochanters 1–1–2–1; femora 6–6–3–2; genua 5(+1 $\kappa$ )–5(+1 $\kappa$ )–4–4; tibiae 5(+2 $\omega$ )–5(+1 $\omega$ )–5(+1 $\omega$ )–4(+1 $\omega$ ); tarsi: 15(+2 $\omega$ )–12(+2 $\omega$ )–9(+1 $\omega$ )–9.

Tal:  $\omega$ I 11;  $\omega$ II 18; Ta II  $\omega$ I 9;  $\omega$ II 14; TalIII  $\omega$  14.



**Figures 2- 9. Paraneognathus wangae (Female), 2. Dorsum, 3. Chelicera and Peritreme, 4. Venter, 5. Leg I, 6. Leg II, 7. Leg III, 8. Leg IV, 9. Palp.**

**Male** (Figures. 10-17)

Body length 433, width 220, Palpus 185; gnathosomal length (excluding palp) 137, width of gnathosoma 131.

**Dorsum** (Figure 10)

Setae measurements; *vi* 37; *ve* 38; *sci* 55; *sce* 46; *c1* 35; *c2* 53; *d1* 29; *e1* 29; *f1* 44; *h1* 22; *h2* 68; *ps1* 24; measurements of distance dorsal setae: *vi-vi* 39; *ve-ve* 108; *vi-ve* 42; *ve-sci* 37; *sci-sci* 91; *sci-sce* 47; *sce-sce* 170; *sce-c2* 63; *c1-c1* 64; *c1-c2* 97; *c2-c2* 222; *c1-d1* 76; *d1-d1* 73; *d1-e1* 57; *e1-e1* 92; *e1-f1* 25; *f1-f1* 92; *f1-h1* 31; *f1-h2* 79; *h1-h2* 89; *h1-h2* 75; *h2-h2* 89.

**Gnathosoma** (Figure 11)

Chelicerae with a conical stylophore and surrounded by elongated peritremes ( $\omega$ ) shapes including 9-10 septum of each side. Subcapitular setae (*m*, *n*) and adoral setae (*or1*, *or2*); subcapitular setae: *m* 33, *n* 43.

**Palpus (from the base of femur to tip of tarsus)** 185; Palp tarsus have with a very well developed claw. Palpal tarsus: 1 tridentate eupathidium + 1 solenidion + 5 simple setae; tibia: 2 setae + 1 developed claw + 1 accessory claw; genua: 2 and femur include 2 tiny setae (Figure 15).

**Venter** (Figure 12)

Coxisternal area includes (*1a*, *3a* and *4a*); the length of these setae: 34, 29 and 30.

Aggenital setae 4 pairs (*ag1-4*), anogenital shields with 6 pair I setae (*gl-6*) and pseudanal setae (*ps1-3*); lengths: *ag1* 37, *ag2* 40, *ag3* 60, *ag4* 31; *ps1-3* 26; *ps3* 26

**Legs** (Figures.13-17)

Lengths; leg I 334, leg II 302; Leg III 332; Leg IV 404;

Male leg segments setal formula (setae and solenidia in parantheses) (I–V):

Femur one has sensory setae of tarsi I and II which are subequal in length.

The setal formula of leg segments as (I–V): coxae 2–2–2–2; trochanters 1–1–2–1; femora 6–6–3–2; Femora III with a flange-like apophyse; genua 5(+1 $\kappa$ )–5(+1 $\kappa$ )–4–4; tibiae 5(+2 $\omega$ )–5(+1 $\omega$ )–5(+1 $\omega$ )–4(+1 $\omega$ ); tarsi: 15(+2 $\omega$ ) – 12(+2 $\omega$ ) – 9 (+1 $\omega$ ) – 9. Ge: I. ( $\kappa$ ) 7; II ( $\kappa$ ) 7; Ti: II ( $\phi$ ) 11; III ( $\phi$ ) 11; IV ( $\phi$ ) 13; Ta I: ( $\omega$ I) 8; ( $\omega$ II) 12; Ta II ( $\omega$ I) 7; ( $\omega$ II) 13; TaIII ( $\omega$ ) 13.

**Material Examined:** 7♀♀ and 6♂♂ from whole wheat Mardin (37120950N:40362365E), 06-06-2014, and 1 ♀ from stored wheat, Muş (Kayapınar) (38425333N:41373057E), 13-06-2014.

**Distribution:** China, Iran, Brazil and Turkey (with this study) (Ardeshir et al. 2014; Fan & Li 1995; Silva et al. 2015).

**Remarks.** The Turkish specimens resemble the original description of *P. wangae* in all aspects. *P. wangae* is very close to *Paraneognathus summersi*, which has tarsi I with 16 setae and genu I with 7 setae while *P. wangae* has tarsi I 17 and genu I with 6 setae respectively. This species is also very close to *Paraneognathus oblongus*, which has a very strong spine-like sensory setae of tarsus I which is longer than tarsus II while it has subequal length in *P. wangae*. For coxal chaetotaxy, it was mentioned that 2–2–2–2 in Iranian specimen (Fan & Li 1995; Ardeshir et al. 2014). Our specimens have the same coxal chaetotaxy as Iranian specimen have.

**Raphignathidae**

*Raphignathus* Dugés

*Raphignathus gracilis* (Rack 1962)

*Acheles gracilis* Rack 1962: 281.

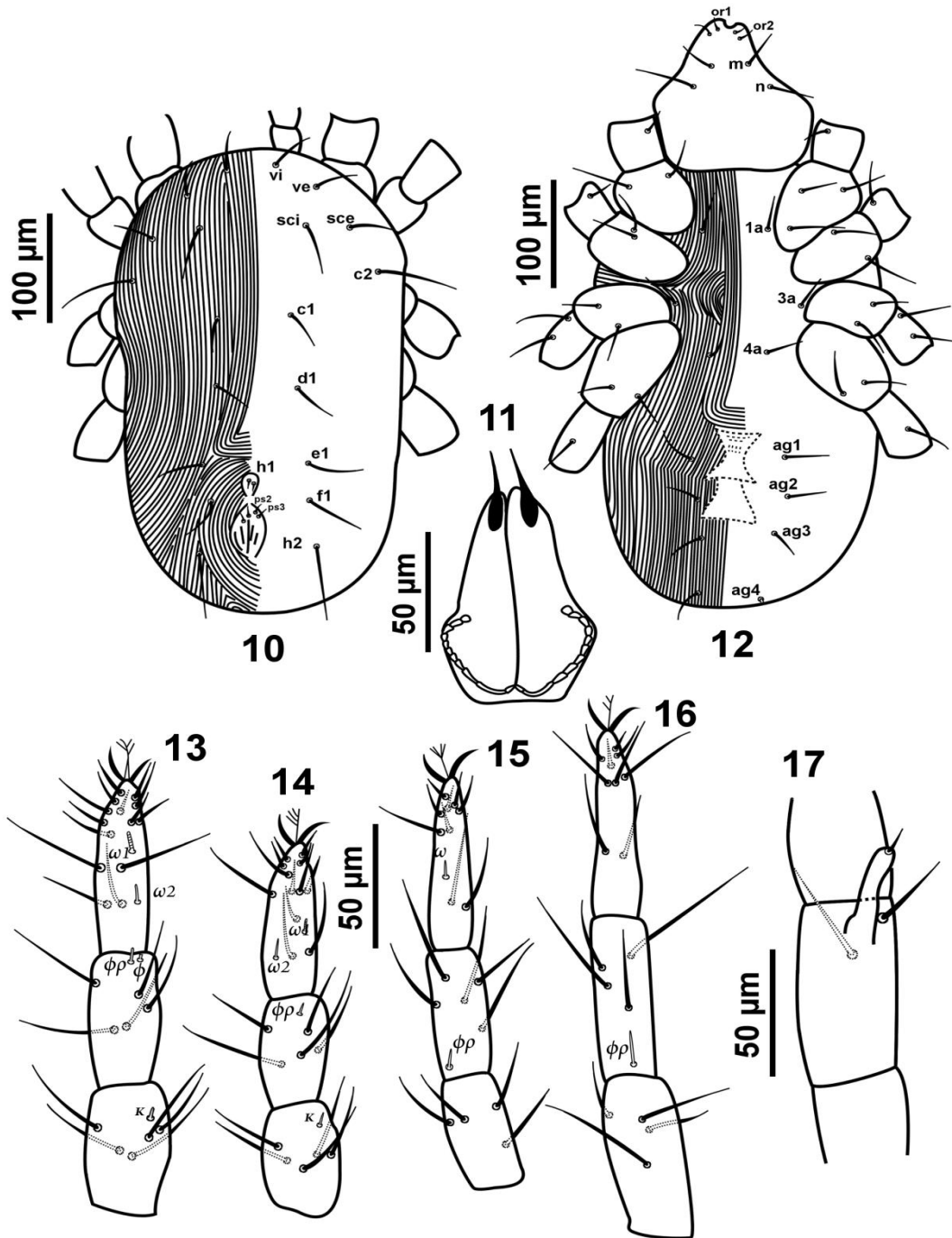
*Raphignathus gracilis* (Rack), (Koç & Ayyıldız 1996: 210; Doğan 2003: 145. Doğan 2007)

**Material Examined.** 2 ♀♀, 1 ♂; 11-06-2014, from litter of mill (animal feed) Muş (38425333N:41373057E); 4 ♀♀; 06-06-2014, Diyarbakır (Mill) wheat (37565066N:40140041E); 2 ♀♀, 13-06-2014 from stored wheat, Diyarbakır (Kayapınar) (37544774N:40051301E), Turkey

**Distribution:** Algeria, China, Egypt; former U.S.S.R., Germany, Israel, Japan, New Zealand; Turkey; U.S.A., (Meyer & Ueckermann 1989; Li et al. 1992; Hu et al 1995; Fan & Yin 2000; Zaher & Gomaa 1979; Wainstein & Kuznetsov 1978; Rack

1962; Gerson 1968; Ehara 1980; Fan & Zhang 2005; Charlet & McMurtry 1977; Koç & Ayyıldız 1996; Doğan 2007; Yeşilayer & Çobanoğlu 2013).

**Remarks;** This species was collected previously in Artvin, Denizli, Erzurum, Erzincan and Istanbul. Its habitats are; litter and soil under *Alnus* sp. (Betulaceae), *Castanea* sp. (Fagaceae), *Euonymus fortunei* (Turcz.) (Apocynaceae); *Pistacia* sp. (Anacardiaceae), *Quercus* sp. (Quercaceae), *Rhododendron* sp. (Ericaceae), *Tamarix* sp. (Tamaricaceae), *Ulmus* sp. (Ulmaceae) and *Vitis* sp. (Vitaceae); grassy soil from olive grove; moss on soil and stone (Doğan 2007; Yeşilayer & Çobanoğlu 2013).



Figures 10-17. *Paraneognathus wangae* (Male), 10. Dorsum, 11. Chelicera and Peritreme, 12. Venter, 13. Leg I, 14. Leg II, 15. Leg III, 16. Leg IV, 17. Femur III

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