First record of the genus *Paragigagnathus* Amitai and Grinberg, 1971 (Mesostigmata: Phytoseiidae) from Saudi Arabia with description of a new species

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ABSTRACT

The genus *Paragigagnathus* Amitai and Grinberg (Acari: Phytoseiidae) is reported for the first time from Saudi Arabia. *Paragigagnathus desertorum* (Amitai and Swirski) and *P. insuetus* (Livshitz and Kuznetsov) were collected from *Acacia* sp. (Fabaceae) and *Tamarix* sp. (Tamaricaceae), respectively. *Paragigagnathus madinaensis* n. sp. is described and illustrated. The new species was found on *Tamarix* sp. in association with *Obdulia daadi* Al-Gboory (Prostigmata: Tenuipalpidae) from Al-Riyadh and Al-Madina regions of Saudi Arabia.

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Introduction

The genus *Paragigagnathus* Amitai and Grinberg, 1971 (Acari: Phytoseiidae) comprises eight valid species (Chant and McMurtry 2007; Hajizadeh et al. 2010). Moraes et al. (2004) listed 10 species in this genus. But, *Paragigagnathus tawfiki* (Yousef, 1974) is a synonym of *P. tamaricis* Amitai and Grinberg (Hajizadeh et al. 2010), while *P. amantis* (Chaudhri et al., 1979) is declared as uncertain species because of inadequate description and illustrations (Chant and McMurtry 2007). The species of this genus are known from Egypt, Namibia, Madagascar, South Africa (Africa), Greece, Ukraine (Southeast Europe), Iran, Israel, Jordan, Pakistan, Russia, Turkmenistan, Tadjikistan, Yemen (Middle East, Central and South Asia) (Amitai and Grinberg 1971; Livshitz and Kuznetsov 1972; Wainstein 1973; Yousef 1974; Amitai and Swirski 1978; Chaudhri et al. 1979; Ueckermann and Loots 1988; Kolodochka 1989; Papadoulis and Emmanouel 1991; Kuznetsov 1994; Ueckermann 1996; Moraes et al. 2004; Hajizadeh et al. 2010). Most of the species have been reported from *Tamarix* sp. (Tamaricaceae), suggesting that the species of this genus are confined in arid to semi-arid regions.

The genus *Paragigagnathus* was first placed in the subfamily Gigagnathinae Wainstein. Kolodochka (1994) transferred it to subfamily Amblyseinae and tribe Amblyseiini Muma on the basis of dorsal setal pattern. After that, it was placed in the tribe Neoseiulini Chant and McMurtry because of cheliceral morphology, dorsal setal pattern and shape of female ventrianal shield (Chant and McMurtry 2003). Chant and

McMurtry (2007) divided the genus *Paragigagnathus* in two species groups, *desertorum* and *strunkovae*, based on the position of sternal shield setae ST_3 (on or off the sternal shield). However, in some species this character is not distinctive (Chant and McMurtry 2007; Hajizadeh et al. 2010). A key to the eight valid species of this genus was created by Hajizadeh et al. (2010). They separated the species based on the following morphological characters: length and shape of dorsal setae, most of dorsal setae either with or without tubercles, sternal setae ST_4 on the soft cuticle or on metasternal shields and number of teeth on moveable digit.

Phytoseiid mites are poorly investigated in Saudi Arabia, and to date only 19 species are known (Dabbour and Abdel-Aziz 1982; Fouly and Al-Rehiyani 2011; Al-Atawi 2011a, 2011b; Negm et al. 2012a, 2012b). This paper presents the first record of the genus *Paragigagnathus* from Saudi Arabia, with description of a new species *P. madinaensis* n. sp. and two new records, *P. desertorum* (Amitai and Swirski) and *P. insuetus* (Livshitz and Kuznetsov).

Materials and methods

Three regions of Saudi Arabia, Al-Riyadh, Al-Madina and Al-Baha, were surveyed for the collection of Phytoseiid mites during the years 2012–2014. Two collection methods were used: (1) different plant parts were shaken over a white paper and the mites were transferred using a camel hair brush into 70% alcohol; (2) Tullgren funnels were used to extract mites from plant materials. The collected mite specimens were cleared in Nesbitt's fluid for 10–12 h. Subsequently, the specimens were mounted on slides in Hoyer's medium, and dried in oven at 40°C for 1 week. The mounted specimens were examined under a phase-contrast microscope (DM2500, Leica®, Germany). Template illustrations were either drawn with pencil by using a drawing tube (Olympus®, Japan) attached to the microscope, or different body parts of mites were pictured with an Auto-montage Software System (SYNCROSCOPY®, Cambridge, UK) attached to the microscope. Final processing of drawings was done in Adobe Illustrator (Adobe Systems Incorporated, USA). The terminology used in this study follows that of Chant and McMurtry (2003, 2007). All measurements are given in micrometers. Holotype and eight paratypes of new species are deposited at the King Saud University Museum of Arthropods (KSMA) and Acarology Laboratory, Department of Plant Protection, College of Food and Agriculture Sciences, King Saud University. One paratype (P1-accession no. Acy: 15/04) is deposited at the Agriculture Research Council, Plant Protection Research Institute, Pretoria, South Africa (ARC-PPRI).

Results and discussion

Paragigagnathus Amitai and Grinberg

Paragigagnathus Amitai and Grinberg 1971: 327; Karg 1983: 300; Kolodochka 1994: 3; Chant and McMurtry 2003: 39; Chant and McMurtry 2007: 31–32; Hajizadeh et al. 2010: 222–226.

Afrogigagnathus Yousef 1974: 381; Chant and McMurtry 2003: 39.

Ansaria Chaudhri, Akbar and Rasool 1979: 63; Chant and McMurtry 2003: 39.

Amblyseius (*Pamiroseius*) Karg 1983: 13.

Amblyseius (*Amblyseius*) Ueckermann and Loots 1988: 118.

Pamiroseius Wainstein 1973: 954; Kolodochka 1989: 221; Chant and McMurtry 2003: 39.

Phytocerus Amitai and Swirski 1978: 124; Chant and McMurtry 2003: 39.

Phytodromus Muma, Denmark 1993: 107.

***Paragigagnathus madinaensis* n. sp.**

(Figures 1, 2)

Female (Figures 1, 2). $n = 16$, the measurements of holotype followed by those of 15 paratypes (female) in parenthesis.

Dorsal Idiosoma (Figure 1): Dorsal shield 339 (337–324) long and 196 (185–210) wide, elongate, slightly concave near seta S_2 , strongly sclerotized, ornamented and with rugose lines/ patches; with 19 pairs of setae including setae r_3 and R_1 and 11 pairs of pores. Dorsal setae vary in length, only posteriorly set on prominent tubercles. Dorsal shield setal length: j_1 17 (16–18), j_3 27 (25–29), $j_4 = j_5$ 26 (22–30), j_6 32 (31–32), J_2 34 (32–38), J_5 20 (18–25), z_2 34 (32–36), z_4 35 (34–37), z_5 25 (21–29), Z_1 41 (39–46), Z_4 43 (40–46), Z_5 38 (35–41), s_4 37 (35–38), S_2 46 (41–50), S_4 48 (41–50), S_5 44 (39–48) and lateral setae r_3 18 (15–21), R_1 19 (16–22). Peritreme extending up to setae j_1 .

Ventral idiosoma (Figure 2A): Sternal shield smooth, convex anteriorly, slightly concave posteriorly, 70 (67–75) long, 52 (50–56) wide at the level of setae ST_2 ; with two pairs of setae and one pair of pores. ST_3 and ST_4 present on soft cuticle. $ST_1 = ST_2$ 15 (14–16), $ST_3 = ST_4$ 14 (13–15). Genital shield truncate posteriorly, 69 wide, wider than ventrianal shield, with one pair of setae. One pair of pores present lateral to genital shield on soft cuticle. Ventrianal shield and genital shield 7 apart, with a membranous fold in between. Ventrianal shield sole shaped, with marked waist, 28 wide at preanals, 57 wide (at anal setae), 106 long. L/W ratio at narrowest point 3.78, with three pairs of preanal setae, three circumanal setae and one pair of pores. Four pairs of setae, six pairs of pores and two pairs of metapodal platelets present on the membrane surrounding the ventrianal shield. $ZV_1 = ZV_3 = 13$, JV_4 13 (13–14), JV_5 22 (22–24), primary metapodal platelet 50 (47–52), secondary 18 (17–19).

Spermatheca

Vesicle is saccular, calyx thick, dish shaped, with annulated neck, atrium not adjacent to the calyx, major duct thick and long, minor duct not visible (Figure 2C).

Chelicerae

Fixed digit with three small apical teeth and a pilis dentilis; movable digit with one subapical blunt tooth (Figure 2D).

Leg IV

One macroseta on basitarsus 27 (26–27) (Figure 2B).

Etymology

The specific epithet '*madinaensis*' refers to the city name 'Madina' where some paratypes of the new species were collected.

Figure 1. *Paragigagnathus madinaensis* n. sp. Female, Dorsal Shield.

Figure 2. *Paragigagnathus madinaensis* n. sp. Female, (A) Idiosoma venter; (B) Spermatheca, (C) Chelicera; (D) Genu, tibia and basitarsus of Leg IV.

Type material

Holotype and 10 paratype females, on aerial part of *Tamarix* sp. (Tamaricaceae), near Arqa over bridge, Wadi-e-Hanifa, Al-Riyadh, Saudi Arabia, 24. 4135°N, 46.3704°E, 18, Oct., 2012; five paratype females, *Tamarix* sp., 'Uhad' mountain, Al-Madina, Saudi Arabia, 24.3008°N, 39.364°E, 23 Feb., 2013; all collected by M. Kamran.

Remarks

Paragigagnathus madinaensis n. sp. closely resembles *Paragigagnathus namibiaensis* (Ueckermann and Loots, 1988) because both share the following characters: sternal setae ST_4 on soft cuticle, movable digit with one tooth, ventrianal shield with three pairs of preanal setae, dorsal setae smooth and only posterior setae set on prominent tubercles. The new species can be distinguished from *P. namibiaensis* by much longer dorsal setae (15–48), sternal shield without posterolateral lobes, a dish shaped calyx of spermatheca, instead of comparatively short dorsal setae (13–35), sternal shield with posterolateral lobes and funnel shaped spermatheca in later species. The new species differs from *P. strunkovae* (Wainstein, 1973) by dish-shaped calyx of spermatheca and 3 pairs of preanal setae, while calyx of spermatheca is funnel shaped and preanal setae 2 pairs in later species.

Paragigagnathus desertorum (Amitai and Swirski)

Phytocerus desertorum Amitai and Swirski 1978: 123–127; Swirski and Amitai 1985: 185; 1997: 31.

Amblyseius desertorum Ueckermann 1996: 28.

Paragigagnathus desertorum (Amitai and Swirski), Chant and McMurtry 2003: 39–44; Moraes et al. 2004: 159; Chant and McMurtry 2007: 33; Hajizadeh et al. 2010: 22–227. Female. ($n = 8$), the measurements of Saudi Arabian specimens in range.

Dorsal idiosoma

Dorsal shield 288–302 long and 204–212 wide at the level of setae R_1 , strongly sclerotized, ornamented and with wax plates, rugose lines/ patches; with 19 pairs of setae including setae r_3 and R_1 . All dorsal setae thick and set on prominent tubercles. Dorsal shield setal length: j_1 16–18, j_3 26–31, j_4 24–27, j_5 29–30, j_6 32–35, J_2 38–40, J_5 13–14, z_2 35–37, z_4 36–38, z_5 24–26, Z_1 36–39, Z_4 46–49, Z_5 45–47, s_4 39–42, S_2 45–47, S_4 45–48, S_5 46–49 and lateral setae r_3 23–24, R_1 18–19. Peritreme extending up to setae j_1 .

Ventral idiosoma

Sternal shield smooth, convex anteriorly and posteriorly, 76–79 long, 57–59 wide at the level of setae ST_2 ; with two pairs of setae and one pair of pores. ST_3 present on metasternal platelets, ST_4 present on soft cuticle. Genital shield truncate posteriorly, 55–58 wide, wider than ventrianal shield, with one pair of setae. One pair of pores present lateral to genital shield on soft cuticle. Ventrianal and genital shields with a membranous fold in between. Ventrianal shield smooth, elongate, sole shaped, with marked waist, 36–37 wide at preanals, 60–61 wide (at anal setae), 99–105 long. L/W ratio at narrowest point 3.43, with three pairs of preanal setae, three circumanal setae and one pair of pores. Four pairs of setae, six pairs of pores and two pairs of metapodal platelets present on the membrane

surrounding the ventrianal shield. $ZV_1 = ZV_3 = 11-12$, JV_4 14–15, JV_5 17–18, primary metapodal platelet 36–39, secondary 16–18.

Spermatheca

Vesicle is saccular, calyx, dish shaped, not very thick, atrium not adjacent to the calyx, major duct long, thick, minor duct not prominent.

Chelicerae

Fixed digit with one bifid tooth and a pilis dentilis; the movable digit smooth.

Leg IV

One macroseta on basitarsus 23–25.

Material examined

Eight females, 130 km Al-Madinah road, Makkah, *Acacia raddiana* L. (Fabaceae), 7 Feb., 2014, coll. M. Kamran.

Distribution and hosts

Israel, ex. *Acacia raddiana* L. (Fabaceae), association with *Thrips* sp. (Thripidae) (Amitai and Swirski 1978; Swirski and Amitai 1985, 1997); Yemen ex unidentified plants (Ueckermann 1996). It was found on *Acacia raddiana* in association with *Sonotetranychus* sp. (Acari: Tetranychidae) in Saudi Arabia.

Paragigagnathus insuetus (Livshitz and Kuznetsov)

Amblyseius insuetus Livshitz and Kuznetsov 1972: 27.

Pamoroseius insuetus Kolodochka 1989: 227.

Paragigagnathus insuetus (Livshitz and Kuznetsov), Kolodochka 1994: 3; Chant and McMurtry 2007: 31–33.

Female. ($n = 3$), the measurements of Saudi Arabian specimens in range.

Dorsal idiosoma

Dorsal shield 338–345 long and 228–235 wide at the level of setae R_1 , strongly sclerotized, ornamented with rugose lines/ patches; with 19 pairs of setae including setae r_3 and R_1 . All dorsal setae thick, only posterior setae set on prominent tubercles. Dorsal shield setal length: j_1 14–15, j_3 15–16, j_4 14–15, j_5 14, j_6 16–17, J_2 16–17, J_5 10–11, z_2 16–17, z_4 17–18, z_5 14–15, Z_1 16–18, Z_4 17–19, Z_5 25–27, s_4 16–18, S_2 18–19, S_4 22–23, S_5 25–26 and lateral setae r_3 16–17, R_1 14–15. Peritreme extending up to setae j_1 .

Ventral idiosoma

Sternal shield smooth, 76–78 long, 65–67 wide at the level of setae ST_2 ; with two pairs of setae and one pair of pores. ST_3 present on soft cuticle, ST_4 present on metasternal platelets. Genital shield truncate posteriorly, wider than ventrianal shield, with one pair of setae. One pair of pores present lateral to genital shield on soft cuticle. Ventrianal shield smooth, elongate, sole shaped, with marked waist, 45–48 wide at preanals, 65–67 wide (at anal setae), 106–109 long. L/W ratio at narrowest point 2.78, with three pairs of

preanal setae, three circumanal setae and one pair of pores. Four pairs of setae, six pairs of pores and two pairs of metapodal platelets present on the membrane surrounding the ventrianal shield. $ZV_1 = ZV_3 = 10\text{--}11$, JV_4 12, JV_5 17–18, primary metapodal platelet 45–46, secondary 15–16.

Spermatheca

Vesicle is saccular, calyx, dish shaped, thick, atrium not adjacent to the calyx, major duct long, thick, minor duct not prominent.

Chelicerae

Fixed digit with one tooth and a pilis dentilis; the movable digit with tooth.

Leg IV

One macroseta on basitarsus 20–21.

Material examined

Three females, *Tamarix* sp. (Tamaricaceae), Wadi-e-Turba, Al-baha, Saudi Arabia, 19.4957 °N, 041.4734°E, alt. 1798 m, 24 Feb., 2013, coll. M. Kamran.

Distribution and hosts

Ukraine, Crimea ex (Livshitz and Kuznetsov 1972); Greece and Turkmanestan (Kolodochka 1989; Papadoulis and Emmanouel 1991); Iran (Hajizadeh et al. 2010); ex *Tamarix* sp., *Thuja occidentalis* L. (Cuspressaceae); *Populus* sp. (Saliaceae).

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Disclosure statement

No potential conflict of interest was reported by the authors.

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