

New records of phytoseiid mites (Acari: Mesostigmata: Phytoseiidae) in Belgium with an identification key to Belgian species

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Original research

ABSTRACT

This study provides five new records of phytoseiid mites; *Amblyseius herbicolus*, *Neoseiulus reductus*, *Kampimodromus corylosus*, *Paraseiulus triporus* and *Typhlodromus* (*Anthoseius*) *rhenanoides* for the Belgian fauna. In the study, additional morphological information and new illustrations for the new records as well as an identification key for the Belgian species of Phytoseiidae are presented.

Keywords Belgium; biological control; fauna; identification key; new records; predatory mites

Introduction

Predatory mites from the family Phytoseiidae (Acari: Mesostigmata) are important natural enemies of phytophagous mites and small insects, such as whiteflies, thrips and psyllids (McMurtry and Croft 1997; McMurtry *et al.* 2013; Jorge *et al.* 2021). Several phytoseiids are commercially available and are being used as biological control agents in a wide range of crops (Knapp *et al.* 2018). However, the determination of native populations is of great importance due to their adaptations to specific environmental conditions (Gerson 2014).

Despite the relatively large number of phytoseiids reported in its neighbouring countries such as France (more than 80 species), Germany (more than 70 species), The Netherlands (about 30 species), as well as some other countries in north Europe such as Poland (about 40 species) and United Kingdom (about 30 species), only 17 valid species of phytoseiids have been reported from Belgium (Demite *et al.* 2022).

Previous faunistic studies showed no indication of presence of *Amblyseius herbicolus* (Chant), *Neoseiulus reductus* (Wainstein), *Kampimodromus corylosus* Kolodochka, *Paraseiulus triporus* (Chant & Yoshida-Shaul), and *Typhlodromus* (*Anthoseius*) *rhenanoides* Athias-Henriot in Belgium (Nesbitt 1951; Chant 1959; Malevez 1976; Karg 1982; André 1986; Evans and Momen 1988; Fain *et al.* 1993; Döker *et al.* 2014). In this study we reported these five species for the first time in Belgium. Some additional morphological information and new illustrations for the new records as well as an identification key for the Belgian species of Phytoseiidae are presented in the study.

Material and methods

Samples were collected from several locations in Belgium. The samples were examined under a stereobinocular and stored in 70% ethanol. Phytoseiid mites were cleared in 60%

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lactic acid during 24 hours at 50 °C, then mounted on microscope slides in Hoyer's medium. Further examinations and measurements were performed under an Axio Imager A2 (Carl Zeiss, Germany) microscope equipped with differential interference contrast (DIC) optical system. Pictures were taken with AxioCam 506 colour (Carl Zeiss, Germany). Most images were captured in stacks with focal depth controlled manually. Selected images were combined using computer program, Helicon Focus 7.6.4 Pro (Helicon Soft Ltd., 2000). The taxonomic system used follows Chant and McMurtry (2007). The setal nomenclature used follows Lindquist and Evans (1965) as adapted by Rowell *et al.* (1978) for the family Phytoseiidae. The ventral setal pattern notations follow Chant and Yoshida-Shaul (1991). Nomenclature of the dorsal solenostomes (gland pores) follows that of Athias-Henriot (1975). Measurements are given in micrometers (µm) presented as mean followed by the range in parenthesis if more than two specimens were measured. The dorsal shield length was measured from the anterior to posterior margins along the midline.

Results

Subfamily Amblyseinae Muma

Tribe Amblyseiini Wainstein

Genus *Amblyseius* Berlese

Amblyseius herbicolus (Chant)

Typhlodromus (*Amblyseius*) *herbicolus* Chant, 1959: 84.

(Figure 1)

Material examined — Five females from cherry laurel, *Prunus laurocerasus* L. (Rosaceae) in Ghent, Belgium, (51°03'04.4"N, 3°45'16.9"E), 27 September 2021, collector D. Vangansbeke.

Re-description — *Female* ($n = 5$) — *Dorsum* (Figure 1a). Dorsal shield smooth with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8* and *gd9*). Length of dorsal shield 388 (385–390), width (at level of *s4*) 252 (250–255), width (at level of *S2*) 248 (240–260). Dorsal setae smooth except *Z4* and *Z5* slightly serrated; measurements of setae as follows: *j1* 39 (38–40), *j3* 43 (40–45), *j4* 7 (5–8), *j5* 6 (5–8), *j6* 6 (5–8), *J2* 8 (8–10), *J5* 7 (5–8), *z2* 12 (10–13), *z4* 9 (8–10), *z5* 7 (5–8), *Z1* 8 (6–8), *Z4* 103 (98–105), *Z5* 266 (250–270), *s4* 98 (95–105), *S2* 11 (10–13), *S4* 10 (8–13), *S5* 9 (8–10), *r3* 11 (10–13), *R1* 9 (8–10). Peritreme extending between setae *j1*.

Venter (Figure 1b, c). All ventral shields smooth. Distances between (*st1*–*st3*) 71 (69–73), *st2*–*st2* 77 (75–80), *st5*–*st5* 72 (67–75). Ventrianal shield vase-shaped with three pairs of preanal setae (*ZV2* in left side out of shield in one specimen) and one pair of large crescentic pores (*gv3*), distance between pre-anal pores 25 (23–28). Length of ventrianal shield 120 (115–125), width at level of setae *ZV2* 53 (49–56), width at level of paranal setae 72 (69–74). Setae *ZV1*, *ZV3*, *JV4* and *JV5* integument surrounding ventrianal shield (*JV4* absent in right side of a specimen). Setae *JV5* smooth 54 (53–55) in length.

Chelicera (Figure 1d). Fixed digit of chelicera with 12 teeth; movable digit with four teeth.

Spermatheca (Figure 1e, f). Calyx of spermatheca trumpet-shaped, elongated, flaring distally 29 (28–30) in length. Atrium enlarged, wider than base of calyx. Major duct long; minor duct well-developed.

Legs. *GeII*, *GeIII* and *GeIV* each with seven setae. All legs with macrosetae. Measurements of macrosetae as follows: *SgeI* 47 (45–48), *SgeII* 39 (38–40), *SgeIII* 47 (45–48), *StiIII* 39 (38–40), *StiIII* 37 (35–38), *SgeIV* 113 (110–118), *StiIV* 81 (80–83) and *StiIV* 70 (68–73).

Remarks — *Amblyseius herbicolus* is a new record for the Belgian fauna. Morphological characters and measurements of the current specimens are very close to those of the original description and re-descriptions (Chant 1959; Denmark and Muma 1989; Demite *et al.* 2017;

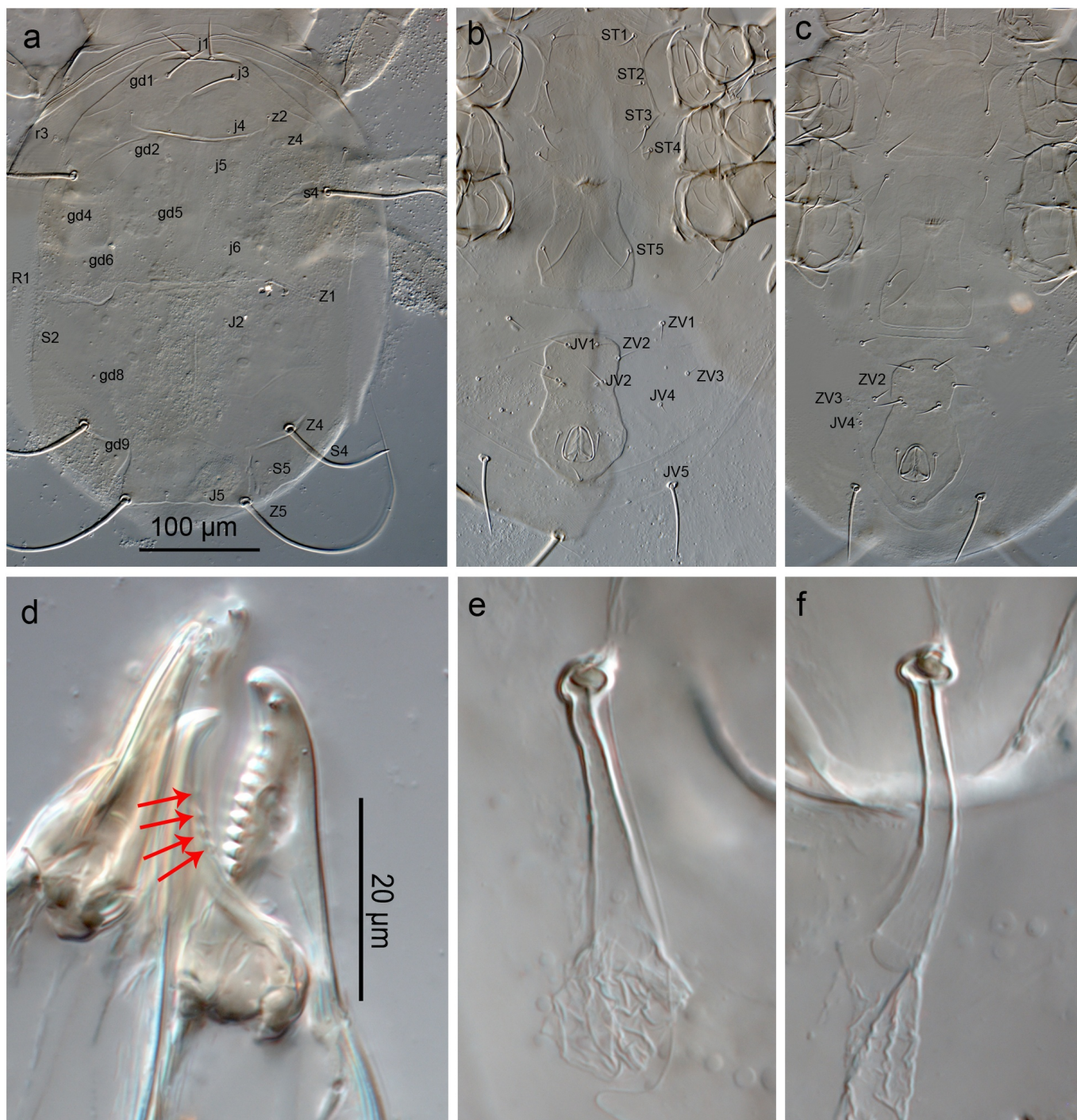


Figure 1 *Amblyseius herbicolus* (Chant) female. a – Dorsal idiosoma, b – Ventral idiosoma of a normal specimen, c – Ventral idiosoma of an abnormal specimen with seta ZV2 out of shield in left side and seta JV4 absent in right side, d – Chelicera, e, f – Spermathecae.

Zannou *et al.* 2007; Guanilo *et al.* 2008a, b; Ferragut *et al.* 2010; Akyazı *et al.* 2016; Kreiter *et al.* 2018; Döker *et al.* 2020; Liao *et al.* 2020). Ventral seta ZV2 in one of the examined specimens in the left side is inserted on integument surrounding ventrianal shield (out of ventrianal shield, see Figure 1c). In addition, setae JV4 is absent in the right side of the same specimen. Based on our best knowledge, these variations are reported for the first time for *A.*

herbicolus.

Tribe Neoseiulini Chant and Mcmurtry

Genus *Neoseiulus* Hughes

Neoseiulus reductus (Wainstein)

Amblyseius reductus Wainstein, 1962: 143.

(Figure 2)

Material examined — One female was collected from blackberry (*Rubus* sp.), in De Haan, Belgium (51°16'51.7"N, 3°02'52.5"E), 9 January 2022, collector D. Vangansbeke. A second female was collected from blackberry (*Rubus* sp.), in Oostende, Belgium, (51°13'28.1"N, 2°55'36.9"E), 2 February 2022, collector D. Vangansbeke.

Re-description — *Female* ($n = 2$) – *Dorsum* (Figure 2a). Dorsal shield smooth with five pairs of solenostomes (*gd1*, *gd2*, *gd6*, *gd8* and *gd9*). Length of dorsal shield 320–331, width (at level of *s4*) 167–174, width (at level of *S2*) 187–190. Dorsal setae smooth except *Z4* and *Z5* slightly serrated; measurements of setae as follows: *j1* 20–22, *j3* 30–34, *j4* 19–21, *j5* 17–19, *j6* 23, *J2* 25–26, *J5* 10–11, *z2* 30–33, *z4* 34–38, *z5* 19–22, *Z1* 26–30, *Z4* 48–51, *Z5* 65, *s4* 45–46, *S2* 43, *S4* 32–34, *S5* 31–32, *r3* 28–30, *R1* 21–23. Peritreme extending between setae *j3*–*z2*.

Venter (Figure 2b). Sternal shield striated with some faint patches of reticulations. Distances between (*st1*–*st3*) 62–64, *st2*–*st2* 62–63. Genital shield faintly reticulated, width at level of setae *st5* 54–59. Ventrianal shield pentagonal, preanal area striated, postanal area reticulated; with three pairs of preanal setae and one pair of large crescentic pores (*gv3*), distance between pre-anal pores 16–18. Length of ventrianal shield 110–112, width at level of setae *ZV2* 80–82, width at level of paranal setae 68–72. Setae *ZV1*, *ZV3*, *JV4* and *JV5* integument surrounding ventrianal shield. Setae *JV5* smooth 35–40 in length.

Chelicera (Figure 2c). Fixed digit of chelicerae with six teeth; movable digit with one tooth.

Spermatheca (Figure 2d). Calyx of spermatheca saccular, elongated, flaring distally 17–18 in length. Atrium nodular attached to the calyx with very short neck. Major duct long; minor duct well-developed.

Legs. *GeII*, *GeIII* and *GeIV* with eight, seven and seven setae, respectively. Leg IV with three macrosetae. Measurements of macrosetae as follows: *SgeIV* 25–26, *StiIV* 24–25 and *StIV* 38–40.

Remarks — *Neoseiulus reductus* is a new record for the Belgian fauna. Morphological characters and measurements of the current specimens are very close to those of the original description and re-descriptions (Wainstein 1962; Kolodochka, 1978; Miedema 1987; Cakar *et al.* 2020; Inak *et al.* 2020). However, as opposed to the aforementioned descriptions, sternal shield striated with some faint patches of reticulations and genital shield reticulated in Belgian specimens.

Tribe Kampimodromini Kolodochka

Subtribe Kampimodromina Chant and McMurtry

Genus *Kampimodromus* Nesbitt

Kampimodromus corylosus Kolodochka

Kampimodromus corylosus Kolodochka, 2003: 51.

(Figure 3)

Material examined — One female (11 January 2022) and four females (30 January 2022) from common hazel *Corylus avellana* L. (Betulaceae) in Gent, Belgium, (51°02'44.5"N, 3°44'47.6"E), collector D. Vangansbeke.

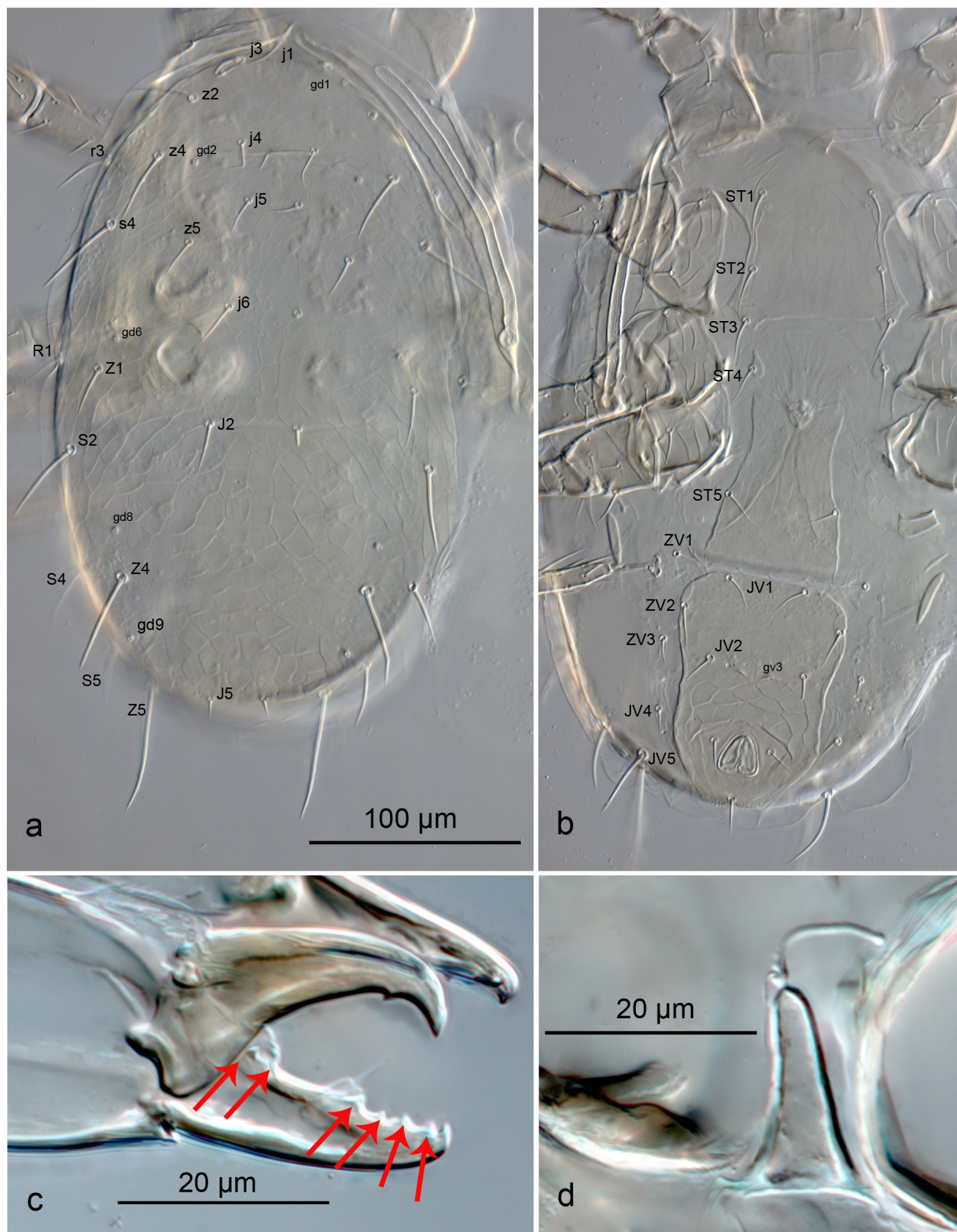


Figure 2 *Neoseiulus reductus* (Wainstein) female. a – Dorsal idiosoma, b – Ventral idiosoma, c – Chelicera, d – Spermatheca.

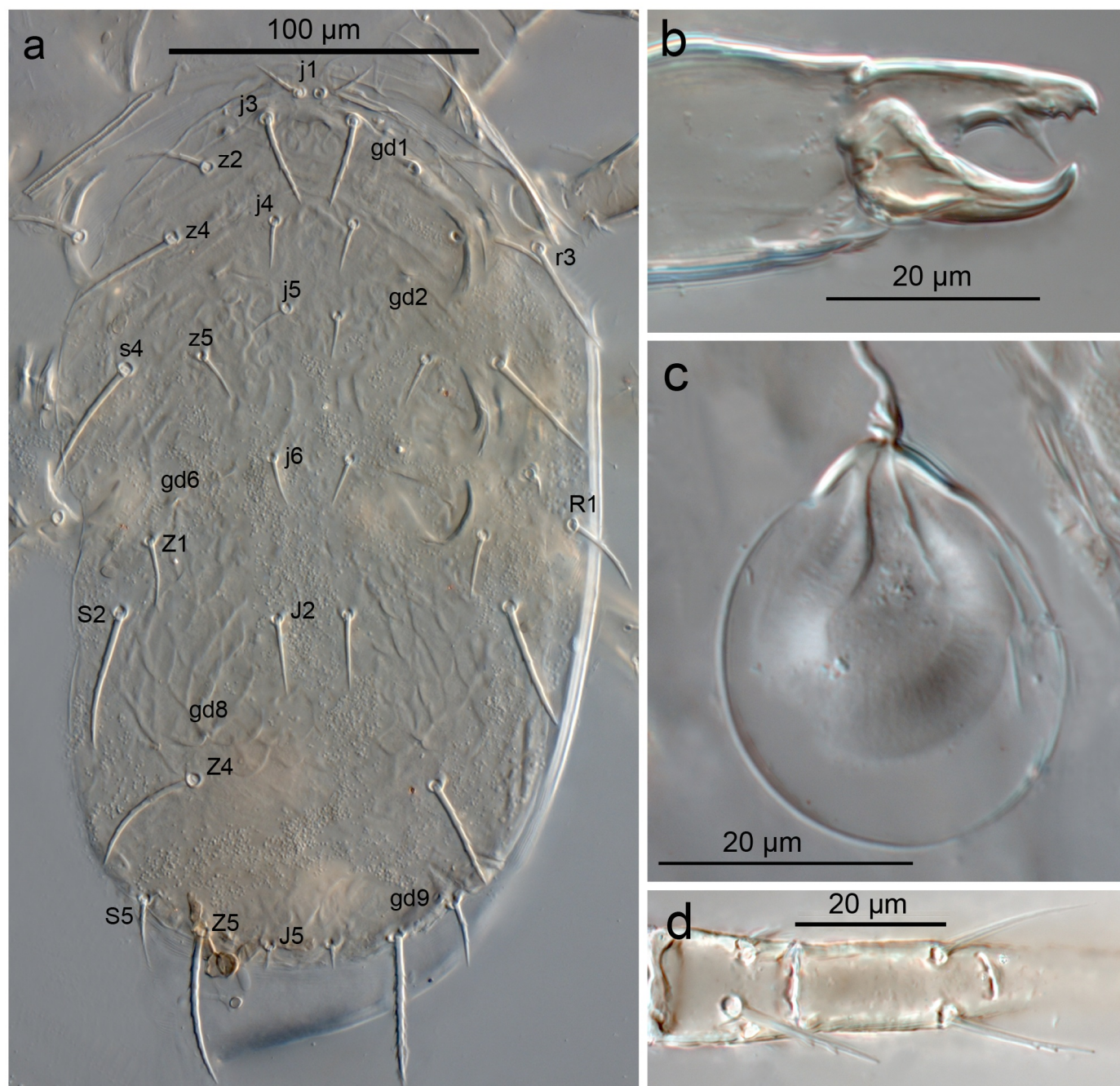


Figure 3 *Kampimodromus corylosus* Kolodochka female. a – Dorsal idiosoma, b – Chelicera, c – Spermatheca, d – Leg IV (basitarsus and telotarsus).

Re-description — *Female* ($n = 5$) – *Dorsum* (Figure 3a). Dorsal shield reticulated with five pairs of solenostomes (*gd1*, *gd2*, *gd6*, *gd8* and *gd9*). Length of dorsal shield 296 (293–298), width (at level of *s4*) 170 (166–172), width (at level of *S2*) 170 (164–174). Dorsal setae serrated except *j4*, *j5*, *j6*, *J2*, *Z1* smooth; measurements of setae as follows: *j1* 17 (16–17), *j3* 21 (21–22), *j4* 16 (16–17), *j5* 14 (13–14), *j6* 17 (16–18), *J2* 21 (17–23), *J5* 8 (7–9), *z2* 25 (24–26), *z4* 32 (31–33), *z5* 18 (17–18), *Z1* 20 (19–21), *Z4* 38 (37–39), *Z5* 48 (46–49), *s4* 39 (35–41), *S2* 42 (40–45), *S5* 18 (18–19), *r3* 38 (36–40), *R1* 25 (24–26). Peritreme extending between setae

j3–z2.

Venter. All ventral shields smooth except ventrianal shield with some faint striations posterior to setae *JV2*. Distances between (*st1–st3*) 63 (61–65), *st2–st2* 57 (56–58), *st5–st5* 48 (46–49). Ventrianal shield elongated with three pairs of preanal setae and one pair of large crescentic solenostomes (*gv3*), distance between pre-anal pores 15 (12–16). Length of ventrianal shield 96 (94–100), width at level of setae *ZV2* 50 (48–52), width at level of paranal setae 48 (48–49). Setae *ZV1*, *ZV3*, *JV4* and *JV5* integument surrounding ventrianal shield. Setae *JV5* serrated 32 (29–34) in length.

Chelicera (Figure 3b). Fixed digit of chelicerae with three teeth; movable digit smooth.

Spermatheca (Figure 3c). Calyx of spermatheca cup-shaped, flaring distally 9 (8–10) in length. Atrium nodular attached to calyx without neck. Major duct long; minor duct developed.

Legs. *GeII*, *GeIII* and *GeIV* eight, seven and eight setae, respectively. Leg IV with two macrosetae both with two barbs and blunt or slightly knobbed tip. Macrosetae basitarsus IV 22 (20–23) and telotarsus IV 21 (20–22) in length.

Remarks — *Kampimodromus corylosus* is a new record for the Belgian fauna. Morphological characters and measurements of the current specimens are very close to those of the original description and re-descriptions (Kolodochka 2003; Tixier *et al.* 2008; Cargnus *et al.* 2012). Similar to the Belgian material, Kolodochka (2003) described macroseta on basitarsus IV with two barbs. We here recognized and illustrated an additional macroseta on telotarsus which have also two barbs, and blunt tip. Therefore, the presence or absence of modified macrosetae on legs, as an additional diagnostic character, should also be investigated in other species in this genus.

Subfamily Typhlodrominae Wainstein

Tribe Paraseiulini Wainstein

Paraseiulus Muma

Paraseiulus triporus (Chant & Yoshida-Shaul)

Typhlodromus triporus Chant & Yoshida-Shaul, 1982: 3029.
(Figure 4)

Material examined — One female from black alder (*Alnus glutinosa* (L.) Gaertn., Betulaceae), 27 November 2021, in Ghent, Belgium (51°02'44.4"N, 3°44'47.4"E). Three females from blackberry (*Rubus* sp., Rosaceae), 22 January 2022, in Ghent, Belgium, (51°02'43.7"N, 3°44'59.7"E). One female from blackberry plant (*Rubus* sp., Rosaceae), 19 February 2022, in Merelbeke, Belgium, (51°00'54.9"N, 3°44'34.4"E), collector D. Vangansbeke.

Re-description — *Female* (*n* = 5) – **Dorsum** (Figure 4a, b, c). Dorsal shield strongly reticulated with three pairs of solenostomes (*gd2*, *gd6* and *gd9*). Length of dorsal shield 372 (370–375), width (at level of *s4*) 179 (172–184), width (at level of *S2*) 206 (200–214). Dorsal setae smooth except *Z5* slightly serrated; measurements of setae as follows: *j1* 19 (17–21), *j3* 27 (24–31), *j4* 20 (19–21), *j5* 20 (19–21), *j6* 27 (23–30), *J2* 29 (28–30), *J5* 12 (11–13), *z2* 32 (31–32), *z4* 36 (35–36), *z5* 21 (18–26), *z6* 25 (22–27), *Z4* 31 (28–34), *Z5* 46 (45–48), *s4* 37 (32–42), *s6* 38 (35–41), *S2* 40 (38–41), *S4* 32 (30–33), *S5* 34 (33–34), *r3* 33 (32–33), *R1* 29 (27–32). Peritreme extending between setae *j1–j3*.

Venter. Sternal and genital shields smooth, ventrianal shield striated. Distances between (*st1–st2*) 48 (46–52), *st2–st2* 61 (58–63), *st5–st5* 64 (61–66). Ventrianal shield elongated two pairs of preanal setae without preanal pores. Length of ventrianal shield 121 (119–123), width at level of setae *ZV2* 51 (47–56), width at level of paranal setae 62 (57–69). Setae *ZV1*, *ZV3*, *JV4* and *JV5* integument surrounding ventrianal shield. Setae *JV5* smooth 39 (36–41) in length.

Chelicera (Figure 4d). Fixed digit of chelicera with four teeth and pilus dentilis; movable digit with one tooth.

Spermatheca (Figure 4e). Calyx of spermatheca bell-shaped, progressively narrowing where it joins c-shaped atrium, base weakly sclerotized.

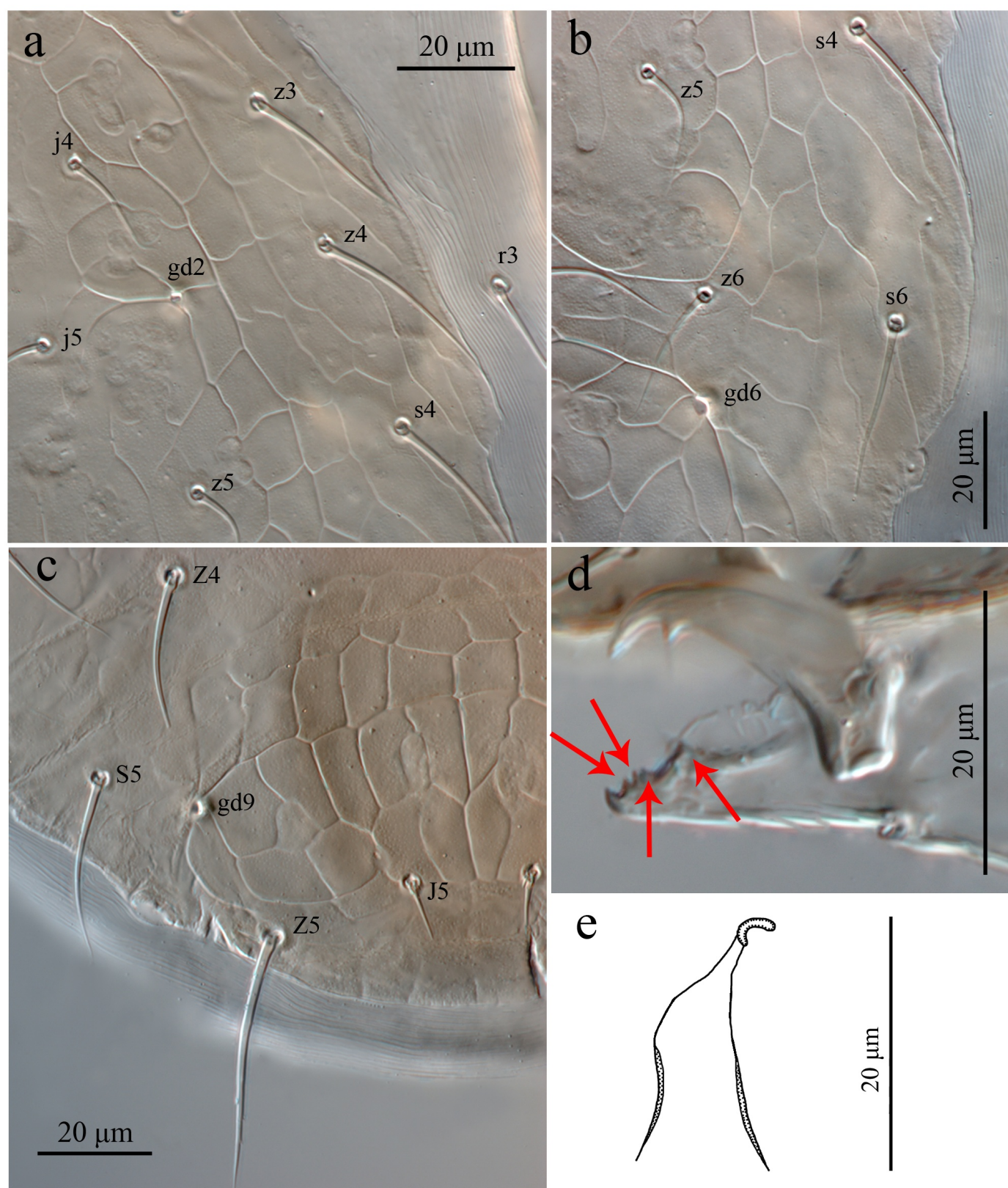


Figure 4 *Paraseiulus triporus* (Chant & Yoshida-Shaul) female. a – Anterolateral area of dorsal shield with solenostome *gd2*, b – Lateral area of dorsal shield with solenostome *gd6*, c – Posterolateral area of dorsal shield with solenostome *gd9*, d – Chelicera, e – Spermatheca.

Legs. GeII, GeIII and GeIV with eight, seven and seven setae, respectively. Leg IV with one macroseta, *StIV* 30 (28–34).

Remarks — *Paraseiulus triporus* is a new record for the Belgian fauna. Morphological characters and measurements of the current specimens are very close to those of the original description and re-descriptions (Chant and Yoshida-Shaul 1982; Miedema 1987; Faraji *et al.* 2007; Ferragut *et al.* 2010; Papadoulis *et al.* 2009).

Tribe Typhlodromini Wainstein

Genus Typhlodromus

Subgenus Anthoseius De Leon

Typhlodromus (Anthoseius) rhenanoides Athias-Henriot

Typhlodromus rhenanoides Athias-Henriot, 1960: 85.

(Figure 5)

Material examined — Ten females and two males from cherry laurel, *Prunus laurocerasus* L. (Rosaceae) in Ghent, Belgium, (51°03'04.4"N, 3°45'16.9"E), 27 September 2021, collector D. Vangansbeke.

Re-description — *Female* ($n = 10$) – *Dorsum* (Figure 5a, b, c). Dorsal shield reticulated with five pairs of solenostomes (*gd2*, *gd4*, *gd6*, *gd8* and *gd9*). Length of dorsal shield 348 (340–355), width (at level of *s4*) 185 (180–188), width (at level of *S2*) 192 (190–195). Dorsal setae smooth except *Z4* and *Z5* slightly serrated; measurements of setae as follows: *j1* 28 (26–31), *j3* 31 (27–35), *j4* 16 (15–18), *j5* 18 (15–19), *j6* 21 (20–24), *J2* 25 (22–27), *J5* 10 (9–11), *z2* 18 (17–21), *z3* 26 (25–30), *z4* 25 (23–28), *z5* 17 (15–19), *Z4* 46 (44–49), *Z5* 69 (63–76), *s4* 30 (29–33), *s6* 33 (30–37), *S2* 38 (35–41), *S4* 40 (37–44), *S5* 22 (18–27), *r3* 28 (25–30), *R1* 29 (27–30). Peritreme extending to almost base of setae *j1*.

Venter (Figure 5d). All ventral shields smooth. Distances between (*st1*–*st2*) 37 (35–38), *st2*–*st5* 58 (58–60), *st5*–*st5* 63 (60–65). Ventrianal shield pentagonal with three pairs of preanal setae and one pair of rounded solenostomes (*gv3*), distance between pre-anal pores 37 (35–38). Length of ventrianal shield 109 (108–110), width at level of setae *ZV2* 103 (103–105). Setae *ZV1*, *ZV3*, *JV4* and *JV5* integument surrounding ventrianal shield. Setae *JV5* smooth 60 (55–66) in length.

Chelicera (Figure 5e). Fixed digit with four teeth and pilus dentilis; movable digit with two teeth.

Spermatheca (Figure 5f). Calyx saccular or tubular, flaring distally, 22 (20–23) in length; atrium nodular attached to calyx without neck. Major duct as wide as atrium, minor duct visible.

Legs. GeII, GeIII and GeIV each with seven setae. Leg IV with three macrosetae, all knobbed apically. Measurements of macrosetae as follows; *SgeIV* 26 (24–28), *StIV* 33 (32–34) and *StIV* 64 (62–65).

Male ($n = 2$) – Similar to female in many aspects. *Dorsum*. Setae *r3* and *R1* on shield. Dorsal shield reticulated, with five pairs of solenostomes (*gd2*, *gd4*, *gd6*, *gd8* and *gd9*). Length of dorsal shield 270–288, width (at level of *s4*) 145–160, width (at level of *S2*) 150–155. Dorsal setae smooth, except *Z5* slightly serrated. Measurements of dorsal setae as follows: *j1* 20–23, *j3* 25–28, *j4* 13–15, *j5* 13–15, *j6* 15–18, *J2* 18, *J5* 8, *z2* 15–18, *z3* 18–20, *z4* 18–20, *z5* 13, *Z4* 38–40, *Z5* 48–50, *s4* 20–25, *s6* 23–25, *S2* 25–28, *S4* 25–28, *S5* 15–18, *r3* 18–20 and *R1* 18. Peritreme extending to level of setae between setae *j3*–*z2*.

Venter. Sternogenital shield smooth. Ventrianal shield triangular, reticulated, with four pairs of pre-anal setae (*JV1*, *JV2*, *JV3*, and *ZV2*); with one pair of small rounded solenostomes (*gv3*) between setae *JV3*. Length of ventrianal shield 105–108, width (at anterior corners, widest point) 153–155. Setae *JV5* smooth, much longer than other ventral setae (25–28).

Chelicera. Fixed digit with four teeth and pilus dentilis; movable digit with one tooth, spermatophoral process L-shaped, foot 25–28 in length, with toe slightly developed.

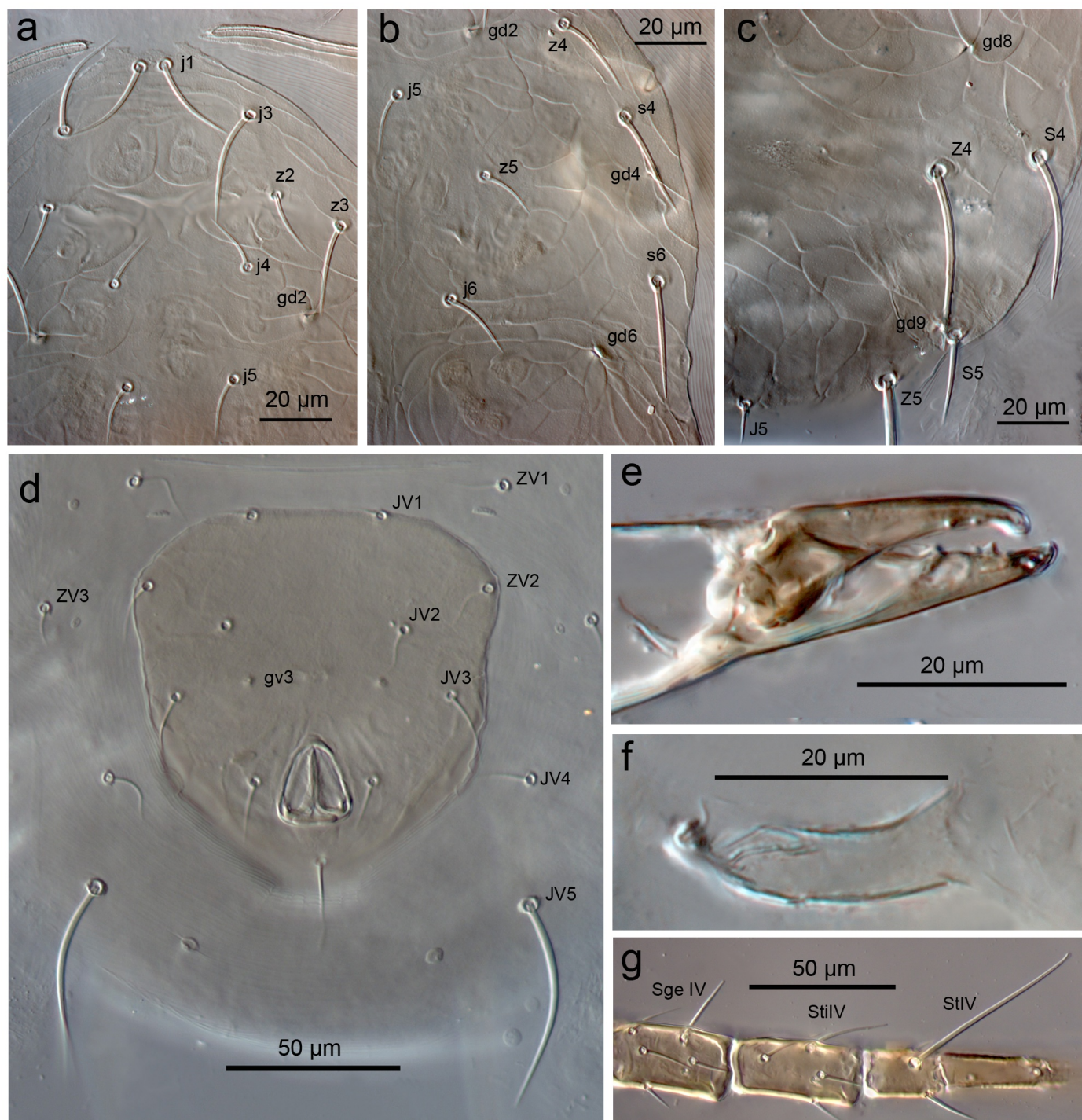


Figure 5 *Typhlodromus (Anthoseius) rhenanoides* Athias-Henriot female. a – Podonotal area of dorsal shield with solenostomes *gd2*, b – Lateral area of dorsal shield with solenostomes *gd2*, *gd4* and *gd6*, c – Posterolateral area of dorsal shield with solenostomes *gd8* and *gd9*, d – Ventrianal shield with solenostome *gv3*, e – Chelicera, f – Spermatheca g – Leg IV (Genu, tibia and basitarsus).

Legs. Genua II, III, and IV each with seven setae. Leg IV with three knobbed macrosetae, *SgeIV* 18, *StilIV* 18–20 and *StlIV* 45–48.

Remarks — *Typhlodromus (Anthoseius) rhenanoides* is a new record for the Belgian fauna. Morphological characters including the presence of preanal pores and measurements

of the current specimens are very close to those of the original description and re-descriptions (Athias-Henriot 1960; Schuster and Pritchard 1963; Papadoulis *et al.* 2009; Ferragut *et al.* 2010). However, as oppose to the all previous descriptions, three knobbed macrosetae on leg IV are present in the Belgian material, as previously mentioned by Faraji *et al.* (2011b) based on the specimens collected from France.

Key to Belgian Species of Phytoseiidae

1. Setae *z3* and *s6* absent 2
— Either or both setae *z3* and *s6* present 12
2. Sternal shield with median posterior projection; deutosternal groove wider ($>5\ \mu\text{m}$ in width); with forward migration of preanal setae *JV2* and *ZV2*; preanal setae of male usually arranged in tangential row rather than triangular pattern *Euseius* Wainstein 3
— Sternal shield without posterior projection; deutosternal groove narrower ($<5\ \mu\text{m}$ in width); without forward migration of preanal setae *JV2* and *ZV2*; preanal setae of male usually arranged in a triangular pattern rather than tangential row 4
3. Calyx of spermatheca short and bulged *E. finlandicus* (Oudemans)
— Calyx of spermatheca tubular *E. gallicus* Kreiter & Tixier
4. Seta *S4* absent *Kampimodromus* Nesbit – *K. corylosus* Kolodochka
— Seta *S4* present 5
5. Ratio seta *s4*:*Z1* $<3.0:1.0$; setae *s4*, *Z4*, and usually *Z5* not greatly longer than other dorsal setae 6
— Ratio seta *s4*:*Z1* $>3.1:1.0$; setae *s4*, *Z5*, and usually *Z4* markedly longer than other dorsal setae 9
6. Macrosetae present on leg II and III in addition to leg IV
..... *Aristadromips* Chant & McMurtry – *A. masseei* (Nesbitt)
— Macroseta present only on leg IV *Neoseiulus* Hughes 7
7. Genu II with seven setae *N. alpinus* (Schweizer)
— Genu II with eight setae 8
8. Peritreme long extending level of seta *j1*; ventrianal shield with small rounded solenostomes *N. cucumeris* (Oudemans)
— Peritreme short extending between setae *j3*–*z2*; ventrianal shield with large elliptical solenostomes *N. reductus* (Wainstein)
9. Ratio seta *s4*:*S2* $>3.0:1.0$ *Amblyseius* Berlese 10
— Ratio seta *s4*:*S2* $<2.7:1.0$ *Transeius* Chant and McMurtry 11
10. Female ventrianal shield vase-shaped *A. herbicolus* (Chant)
— Female ventrianal shield pentagonal *A. andersoni* (Chant)
11. Calyx of spermatheca short, length and width subequal *T. wainsteini* (Gomelaui)
— Calyx of spermatheca elongated, saccular ... *T. namurensis* (Fain, Vangeluwe, Degreef and Wauthy)
12. Setae *J2*, *S2*, and *S4* absent *Phytoseius* Ribaga *P. macropilis* (Banks)
— Setae *J2*, *S2*, and *S4* present 13

13. Seta *z6* present *Paraseiulus* Muma *Paraseiulus triporus* (Chant and Yoshida-Shaul)
— Seta *z6* absent 14
14. Seta *Z1* present *Neoseiulella* Muma – *N. aceri* (Collyer)
— Seta *Z1* absent *Typhlodromus* Scheuten 15
15. Seta *S5* present 16
— Seta *S5* absent 19
16. Preanal pores present 17
— Preanal pores absent 18
17. Leg IV with three macrosetae, knobbed apically; macrosetae *StIV* longer than the distance between its base and dorsal slit organ; genu II with eight setae; movable digit of chelicera with two teeth *T. (A.) rhenanoides* Athias-Henriot
— Leg IV with only one macroseta, sharp pointed and shorter than the distance between its base and dorsal slit organ; genu II with eight setae; movable digit of chelicera with one tooth *T. (A.) rhenanus* (Oudemans)
18. Calyx of spermatheca short, bell-shaped *T. (A.) foenilis* Oudemans
— Calyx of spermatheca elongate *T. (A.) richteri* Karg
19. Dorsal shield with three pairs of solenostomes 20
— Dorsal shield with four pairs of solenostomes 21
20. Seta *Z4* as long as distance between its insertion and that of *Z5*; calyx of spermatheca elongate, with short neck *T. (T.) pyri* Scheuten
— Seta *Z4* shorter than distance between its insertion and that of *Z5*; calyx of spermatheca cup-shaped with long neck between atrium and calyx *T. (T.) tubifer* Wainstein
21. Preanal pores present *T. (T.) andrei* Karg
— Preanal pores absent *T. (T.) tiliae* Oudemans

Notes on the identification key

Amblyseius potentillae (Garman) reported by Malevez (1976), *Typhlodromus (Anthoseius) picea* (Karg & Edland) reported by Karg & Edland (1987) are considered junior synonyms of *A. andersoni* and *T. (A.) foenilis* Oudemans as suggested by Chant & Yoshida-Shaul (1990) and Evans & Edland (1998), respectively. The previous report of *Transeius similis* (Koch) by Chant (1959) in Belgium is considered as *T. wainsteini* due to status of the former as *nomen dubium*, as suggested by Chant and McMurtry (2004), Faraji *et al.* (2011a) and Khaustov *et al.* (2021). Moreover, *Transeius namurensis* (Fain, Vangeluwe, Degreef and Wauthy) is suspected as a junior synonym of *Graminaseius graminis* (Chant), due to insufficient diagnostic characters used to separate these two species in its original description and the descriptions of the latter (Chant 1956; Kolodochka 1978; Döker *et al.* 2019). We included this species to the identification key on a provisional basis, as we are unable to examine its type materials. The list of recorded species was obtained online database created by Demite *et al.* (2022).

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References

- Akyazi R., Ueckermann E.A., Soysal M. 2016. The new distribution of *Amblyseius herbicolus* in Turkey (Parasitiformes, Phytoseiidae) with a key of *Amblyseius* species found in Turkey. *Acarologia*, 56: 237-244. <https://doi.org/10.1051/acarologia/20162241>
- André H.M. 1986. Notes on the ecology of corticolous epiphyte dwellers. 4. Actinedida (especially Tydeidae) and Gamasida (especially Phytoseiidae). *Acarologia*, 27: 107-115.
- Athias-Henriot C. 1960. Phytoseiidae et Aceoseiidae (Acarina: Gamasina) d'Algérie. IV. Genre *Typhlodromus* Scheuten, 1857. *Bull. Soc. Hist. Nat. Afr. N.*, 51: 62-107.
- Athias-Henriot C. 1975. Nouvelles notes sur les Amblyseini. II. Le relevé organotaxique de la face dorsale adulte (Gamasides, protoadéniques, Phytoseiidae). *Acarologia*, 17:20-29.
- Cakar T., Yanar D., Döker I. 2020. Re-descriptions of *Neoseiulus reductus* (Wainstein) and *Typhlodromus (Anthoseius) caucasicus* (Abbasova) (Acari: Phytoseiidae) from Turkey. *Turkish J. Biol. Cont.* 11: 208-216. <https://doi.org/10.31019/tbmd.774853>
- Cargnus E., Girolami V., Zandigiacomo P. 2012. Re-examination of specimens of three species of *Kampimodromus* Nesbitt (Acari: Phytoseiidae) from north-eastern Italy. *Int. J. Acarol.*, 38: 583-594. <https://doi.org/10.1080/01647954.2012.710247>
- Chant D.A. 1956. Some mites of the subfamily Phytoseiinae (Acarina: Laelaptidae) from southeastern England, with descriptions of new species. *Can. Entomol.*, 88: 26-37. <https://doi.org/10.4039/Ent8826-1>
- Chant D.A. 1959. Phytoseiid mites (Acarina: Phytoseiidae). Part I. Bionomics of seven species in southeastern England. Part II. A taxonomic review of the family Phytoseiidae, with descriptions of thirty-eight new species. *Can. Entomol.* 61: 1-166. <https://doi.org/10.4039/entm9112fv>
- Chant D.A., McMurtry J.A. 2004. A review of the subfamily Amblyseini Muma (Acari: Phytoseiidae): Part IV. Tribe Amblyseini Wainstein, subtribe Arrenoseiina Chant & McMurtry. *Int. J. Acarol.*, 30: 291-312. <https://doi.org/10.1080/01647950408684399>
- Chant D.A., McMurtry J.A. 2007. *Illustrated keys and diagnoses for the genera and subgenera of the Phytoseiidae of the world (Acari: Mesostigmata)*. West Bloomfield: Indira Publishing House. pp. 219.
- Chant D.A., Yoshida-Shaul E. 1991. Adult ventral setal patterns in the family Phytoseiidae (Acari: Gamasina). *Int. J. Acarol.*, 17: 187-199. <https://doi.org/10.1080/01647959108683906>
- Chant D.A., Yoshida-Shaul E. 1982. A world review of the *soleiger* species group in the genus *Typhlodromus* Scheuten (Acarina: Phytoseiidae). *Can. J. Zool.*, 60: 3021-3032. <https://doi.org/10.1139/z82-385>
- Chant D.A., Yoshida-Shaul E. 1990. The identities of *Amblyseius andersoni* (Chant) and *A. potentillae* (Garman) in the family Phytoseiidae (Acari: Gamasina). *Int. J. Acarol.*, 16: 5-12. <https://doi.org/10.1080/01647959008683857>
- Demite P.R., Dias M.A., Cavalcante A.C.C., Ramos M.V.V., Lofego A.C. 2017. Phytoseiid mites (Acari: Mesostigmata: Phytoseiidae) associated with Cerrado biome plantas in Brazil, with description of a new species. *Syst. Appl. Acarol.*, 22: 2141-2177. <https://doi.org/10.11158/saa.22.12.9>
- Demite P.R., de Moraes G.J., McMurtry J.A., Denmark H.A., Castilho R.C. 2022. Phytoseiidae Database. Available from: www.lea.esalq.usp.br/phytoseiidae (accessed 20 May 2022).
- Denmark H.A., Muma M.H. 1989. A revision of the genus *Amblyseius* Berlese, 1914 (Acari: Phytoseiidae). Occasional Papers of the Florida State Collection of Arthropods, 4: 149 pp.
- Döker I., Kazak C., Karut K. 2019. The genus *Graminaseius* Chant & McMurtry (Acari: Phytoseiidae) in Turkey with descriptions of two new species and re-description of *Graminaseius graminis* (Chant). *Syst. Appl. Acarol.*, 24: 731-741. <https://doi.org/10.11158/saa.24.5.2>
- Döker I., Kazak C., Karut K. 2020. The genus *Amblyseius* Berlese (Acari: Phytoseiidae) in Turkey with discussion on the identity of *Amblyseius meridionalis*. *Syst. Appl. Acarol.*, 25: 1395-1420. <https://doi.org/10.11158/saa.25.8.4>
- Döker I., Witters J., Pijnakker J., Kazak C., Tixier M.-S., Kreiter S. 2014. *Euseius gallicus* Kreiter & Tixier (Acari: Phytoseiidae) is present in four more countries in Europe: Belgium, Germany, The Netherlands and Turkey. *Acarologia*, 54: 245-248. <https://doi.org/10.1051/acarologia/20142132>
- Evans G.O., Edland T. 1998. The genus *Anthoseius* De Leon (Acari: Mesostigmata) in Norway. *Fauna Norv.*, Ser. B., 45: 41-62.
- Evans G.O., Momen F. 1988. The identity of *Seiulus rhenanus* Oudemans. and *Typhlodromus foenilis* Oudemans. (Acari: Phytoseiidae). *J. Nat. Hist.*, 22: 209-216. <https://doi.org/10.1080/00222938800770151>
- Fain A., Vangeluwe D., Degreef M., Wauthy G. 1993. Observations on mites inhabiting nests of *Bubo bubo* (L.) (Strigiformes, Strigidae) in Belgium. *Belg. J. Zool.*, 123: 3-26.
- Faraji F., Cobanoglu S., Cakmak I. 2011a. A checklist and a key for the Phytoseiidae species of Turkey with two new species records (Acari: Mesostigmata). *Int. J. Acarol.*, 37(Supl. 1): 221-243. <https://doi.org/10.1080/01647954.2011.558851>

- Faraji F., Roig J., Bakker F. 2011b. Some new records of Phytoseiidae from southwest Europe with description of a new species from Spain (Acari: Mesostigmata). *Int. J. Acarol.*, 37: 331-346. <https://doi.org/10.1080/01647954.2010.519722>
- Faraji F., Shiroodbakhshi M., Ostovan H., McMurtry J.A. 2007. Redescription of the female of *Paraseiulus triporus* and *Proprioseiopsis dacus* (Acari: Phytoseiidae) based on material collected from citrus in northern Iran. *Syst. Appl. Acarol.*, 12: 199-204. <https://doi.org/10.11158/saa.12.3.4>
- Ferragut F., Pérez Moreno I., Iraola V., Escudero A. 2010. *Ácaros depredadores en las plantas cultivadas. Familia Phytoseiidae*. Madrid, Spain: Ediciones Agrotécnicas. pp. 202.
- Gerson U. 2014. Pest control by mites (Acari): Present and future. *Acarologia*, 54: 371-394. <https://doi.org/10.1051/acarologia/20142144>
- Guanilo A.D., de Moraes G.J., Knapp M. 2008a. Phytoseiid mites (Acari: Phytoseiidae) of the subfamily Amblyseinae Muma from Peru, with description of four new species. *Zootaxa*, 1880: 1-47. <https://doi.org/10.11646/zootaxa.1880.1.1>
- Guanilo A.D., de Moraes G.J., Toledo S., Knapp M. 2008b. Phytoseiid mites (Acari: Phytoseiidae) from Argentina, with description of a new species. *Zootaxa*, 1884: 1-35. <https://doi.org/10.11646/zootaxa.1884.1.1>
- Inak E., Cobanoglu S., Sade E., Tixier M.S. 2020. Molecular characterization of phytoseiid mites in Turkey based on the internal transcribed spacer (ITS) region, with a new record for the country. *Exp. Appl. Acarol.* 81: 201-213. <https://doi.org/10.1007/s10493-020-00504-3>
- Jorge S.J., Rueda-Ramírez D., de Moraes G.J. 2021. Predation capacity of phytoseiid mites (Mesostigmata: Phytoseiidae) from Brazil on eggs of *Diaphorina citri* (Hemiptera: Liviidae). *Phytoparasitica*, 49: 603-611. <https://doi.org/10.1007/s12600-021-00898-9>
- Karg W. 1982. Diagnostic and systematics of predatory mites of the family Phytoseiidae Berlese in orchards. *Zool. Jahrb. Syst.*, 109: 188-210.
- Karg W., Edland T. 1987. Neue Raubmilbenarten der Phytoseiidae Berlese, 1916. *Deut. Entomol. Z.* 34: 387-395.
- Khaustov V.A., Joharchi O., Döker I. 2021. Review of the genus *Transeius* Chant & McMurtry (Acari: Phytoseiidae) of Russia. *Syst. Appl. Acarol.* 26: 1952-1973. <https://doi.org/10.11158/saa.26.10.9>
- Knapp M., van Houten Y., van Baala E., Groot T. 2018. Use of predatory mites in commercial biocontrol: current status and future prospects. *Acarologia*, 58: 72-82. <https://doi.org/10.24349/acarologia/20184275>
- Kolodochka L.A. 1978. *Manual for the identification of plant-inhabiting phytoseiid mites*. Kiev, Ukraine: Akademii Nauk Ukrainian SSR, Instituta Zoologii, Naukova Dumka. pp. 79 pp. [in Russian].
- Kolodochka L.A. 2003. A new species of the genus *Kampimodromus* (Parasitiformes, Phytoseiidae) from Ukraine and Moldova. *Acarina*, 11: 51-55.
- Kreiter S., Payet R.M., Fillâtre J., Azali H.A. 2018. First records of Phytoseiidae (Acari: Mesostigmata) from one island of the Comoros Archipelago. *Acarologia*, 58: 529-545. <https://doi.org/10.24349/acarologia/20184256>
- Liao L.R., Ho C.C., Lee H.C., Ko C.C. 2020. *Phytoseiidae of Taiwan (Acari: Mesostigmata)*. Taipei, Taiwan: National Taiwan University Press; p. 538.
- Lindquist E.E., Evans G.O. 1965. Taxonomic concepts in the Ascidae, with a modified setal nomenclature for the idiosoma of the Gamasina Acarina: Mesostigmata. *Mem. Ent. Soc. Can.*, 47: 1-64. <https://doi.org/10.4039/entm9747fv>
- Malevez N. 1976. Observations sur l'entomofaune d'un verger de pommiers dans une perspective de lutte intégrée. *Parasitica*, 32: 109-140.
- McMurtry J.A., Croft B.A. 1997. Life-Styles of Phytoseiid Mites and Their Roles in Biological Control. *Annu. Rev. Entomol.*, 42: 291-321. <https://doi.org/10.1146/annurev.ento.42.1.291>
- McMurtry J.A., de Moraes G.J., Sourassou N.F. 2013. Revision of the lifestyles of phytoseiid mites (Acari: Phytoseiidae) and implications for biological control strategies. *Syst. Appl. Acarol.*, 18: 297-320. <https://doi.org/10.11158/saa.18.4.1>
- Miedema E. 1987. Survey of phytoseiid mites (Acari: Phytoseiidae) in orchards and surrounding vegetation of northwestern Europe, especially in the Netherlands. Keys, descriptions and figures. *Neth. J. Plant Pathol.*, 93(Supl.2): 1-64. <https://doi.org/10.1007/BF01984462>
- Nesbitt H.H.J. 1951. A taxonomic study of the Phytoseiidae (Family Laelaptidae) predaceous upon Tetranychidae of economic importance. *Zool. Verh.*, 12, 64 pp.+ 32 plates.
- Papadoulis G.Th., Emmanouel N.G., Kapaxidi, E.V. 2009. *Phytoseiidae of Greece and Cyprus (Acari: Mesostigmata)*. West Bloomfield: Indira Publishing House. pp. 200.
- Rowell H.L., Chant D.A., Hansell R.I.C. 1978. The determination of setal homologies and setal patterns on the dorsal shield in the family Phytoseiidae (Acarina: Mesostigmata). *Can. Entomol.*, 110: 859-876. <https://doi.org/10.4039/Ent110859-8>
- Schuster R.O., Pritchard A.E. 1963. Phytoseiid mites of California. *Hilgardia*, 34: 191-285. <https://doi.org/10.3733/hilg.v34n07p191>
- Tixier M.-S., Kreiter S., Croft B.A., Cheval B. 2008. *Kampimodromus aberrans* (Acari: Phytoseiidae) from the USA: morphological and molecular assessment of its density. *Bull. Entomol. Res.*, 98: 125-134. <https://doi.org/10.1017/S0007485307005457>
- Wainstein B.A. 1962. Some new predatory mites of the family Phytoseiidae (Parasitiformes) of the USSR fauna. *Entomologicheskoe Obozrenie*, Russia, 41, 230-240; *Entomol. Rev.*, 41: 139-146 [English translation].
- Zannou I.D., de Moraes G.J., Ueckermann E.A., Oliveira A.R., Yaninek J.S., Hanna R. 2007. Phytoseiid mites of the subtribe Amblyseina (Acari: Phytoseiidae: Amblyseini) from sub-Saharan Africa. *Zootaxa*, 1550: 1-47. <https://doi.org/10.11646/zootaxa.1550.1.1>