







Description of two new genera, three new species, and redescription of two species of Pronematinae (Acari: Iolinidae)

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Original research

ABSTRACT


Duoparus n. gen. with its type species *Duoparus hyeresensis* n. gen. n. sp. from *Rubus* in France are described. *Duoparus* is the first genus within the Pronematinae with two *ag* setae. In the genus *Pseudopronematus*, two new species, *P. duffelensis* n. sp. from sweet pepper leaf litter in Belgium and *Pseudopronematus tocantinsensis* n. sp. from leaf/soil litter from a no-tillage field in Brazil are described. *Pseudopronematus tenuisetosus*, recently transferred from the genus *Pronematus*, from cotton in Mozambique is redescribed. *Pseudopronematus duffelensis* n. sp. and *P. tocantinsensis* n. sp. are the fourth and fifth species in this genus and the first to be described in detail, including nymphal stages for *P. duffelensis* n. sp. *Dasilcoferla* n. gen. is described with *Pseudopronematus nadirae* n. comb. as type species, which is transferred from *Pseudopronematus* to *Dasilcoferla* and redescribed. A taxonomic key is provided for the separation of the species presently placed in *Pseudopronematus* Fan & Li, 1992. Molecular analysis and morphological differences, mostly the chaetotaxy, of *P. duffelensis* n. sp. are compared with those of *Pronematus ubiquitous* (McGregor, 1932) and *Homeopronematus anconai* (Baker, 1943). The molecular results underpin the morphological difference between the species that belong to different genera. Relative distance of the genera are discussed.

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Keywords Tydeoidea; mites; natural enemies; fungivore; aggenital setae

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Introduction

The subfamily Pronematinae André, 1978 of the family Iolinidae Pritchard, 1956, contains 53 confirmed species organised in 14 genera (André 2021, <https://species.wikimedia.org/wiki/Pronematinae>, accessed on 12/2/2024). In a recent review of the genus *Pronematus* (Ueckermann & De Vis *et al.* 2024), two new *Pronematus* species were described, and five species were placed on a list of *species inquirendae*. Additionally, one species, *Pronematus tenuisetosus* Meyer and Rodrigues, 1966, previously considered a *species inquirenda*, was recently transferred to the genus *Pseudopronematus* Fan & Li, 1992 (Ueckermann & De Vis

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et al. 2024). The description of the latter species is complemented in this work, as several morphological features were not specified in its original description. Furthermore, three new species are here described, two in *Pseudopronematus* and one in a new genus, *Duoparus* **n. gen.** Three species have been placed in the genus *Pseudopronematus*, namely *P. acus* Fan and Li, 1992, *P. augrabiensis* Ueckermann and Grout, 2007 and *P. nadirae* Silva, Da-Costa & Ferla, 2017 (André 2021). Observations conducted in this work indicated that the latter does not fit the description of this genus (Fan and Li 1992) and should be transferred to a new genus, according André (1980), here described as *Dasilcoferla* **n. gen.**

The new species were found during different research projects. Since 2016, the tomato russet mite, *Aculops lycopersici* (Tryon, 1917) became a major pest in greenhouse tomato crops in Western Europe (Reybroeck *et al.* 2018; Vervaeet *et al.* 2021). Therefore, a search for potential natural enemies of this pest was initiated in 2017 in Belgium and neighbouring countries in two successive Flemish projects DUCATO and BALTO (Reybroeck *et al.* 2018). The focus was placed on the potential of predatory mites of the family Iolinidae (Vervaeet *et al.* 2022). Three iolinids were found: *Pronematus ubiquitous* (McGregor 1932) (Ueckermann & De Vis *et al.* 2024), *Homeopronematus anconai* (Baker, 1943) and a third one, belonging to a new genus, that is described here. Besides these studies, the first author made a survey for mites in the litter of sweet pepper (*Capsicum annuum* L., Solanaceae) greenhouses in Belgium at the end of the production cycle in November 2021. A new *Pseudopronematus* species was found in two distinct greenhouse facilities, being the second new species described in the present paper. Finally, the examination of specimens recently collected in central Brazil showed that they refer to a third, undescribed species of *Pseudopronematus*, also described here.

Ueckermann & De Vis *et al.* (2024) compared molecularly *P. ubiquitous* and *H. anconai*. That was a first molecular study of iolinids. For this, lab cultures were necessary. As we could not establish a lab culture of the new species found in the sweet pepper leaf litter in Belgium, we studied this species not only morphologically but also molecularly and compared it with those species, all belonging to three different genera.

Thus, the objectives of the present work were: a) to describe a new genus and one species belonging to that genus from France; b) to describe two new species of *Pseudopronematus*, one from Belgium and one from Brazil; to confirm the transfer to *Pseudopronematus* a species originally described from Africa in *Pronematus* and present a complementary description of that species; to prepare a key for the separation of the known species of *Pseudopronematus*; c) to describe a new genus based on a re-evaluation of a species originally described from Brazil as *Pseudopronematus* and transfer that species to that new genus; d) to compare molecularly and morphologically representatives of the genera *Pseudopronematus*, *Pronematus*, *Homeopronematus*.

Material and methods

Sources of the specimens

The holotype of *P. tenuisetosus* was collected in Mozambique on cotton by Meyer and Rodrigues (1966) and deposited at the Mite Collection, ARC-Plant Health Protection, Pretoria South Africa, NCA (Zhang 2018).

The specimen of the new genus described in this work was collected by Lore Vervaeet from *Rubus* sp. at Hyères in France during surveys conducted mostly in Belgium and France (Survey permission UGent nr. NOR TREL1902817S/165) between 2017 and 2019. The specimens of the new Belgian *Pseudopronematus* were collected by Raf De Vis from sweet pepper leaf litter of two different greenhouse sweet pepper growers, at Duffel and Wommelgem in Flanders (Belgium). In both studies, samples were transported to PSKW, examined under stereo microscopes, mounting the predatory mites (including Iolinidae) and associated mites in Hoyer's medium (Walter and Krantz 2009).

The Brazilian specimens of *Pseudopronematus* were collected by Alice Braga from litter/soil samples of a green panic grass crop [*Megathyrsus maximus* (Jacq.) B.K. Simon & S.W.L. Jacobs] cultivated as green manure at Gurupi (11°49'51.7"S, 48°54'15.6"W), Tocantins state (Cerrado biome) in August 2021. Mites were extracted with a modified Berlese-Tullgren equipment (Oliveira *et al.* 2000) and mounted in Hoyer's medium.

Morphological examination and principal component analysis

Specimens were measured using either a Zeiss Axioskop TM research microscope provided with a Zen Soft Imaging System and measuring tools, or a Leica DM750 with an eyepiece micrometer or a Leica Flexacam c3 camera and Leica LAS-X software. Line drawings were either made from photographs taken with the Zeiss system and prepared with a Wacom One 13" pen display and drawn using Adobe Illustrator CS5, or with a Leica DM750 with a phototube or Wacom Cintiq 16 pen display and drawn using Adobe Illustrator 2024.

Nomenclature of body parts and its organotaxy is that of Kaźmierski (1989) except for adoral setae where we use notation *or*, and that of André (1981b) and Khaustov *et al.* (2020) for the legs. In the text, measurements in micrometres are given directly after each structure.

A principal component analysis (PCA) based on setal lengths (Ueckermann & De Vis *et al.* 2024) of the females measured in this work was done with PAST (version 4.03).

Phylogenetic analysis and morphological differences

The methodology of culturing mites, molecular analysis and construction of a phylogenetic tree is described in detail in Ueckermann & De Vis *et al.* (2024). Briefly, it consists first of the culture of progeny of single females to have sufficient homogenous genetic material (although it is possible with one female, three to four females for one DNA extraction increases the success rate). After the DNA extraction, PCR amplification of a 710-bp fragment of the cytochrome c oxidase subunit I gene (COI, mtDNA) was conducted, followed by sequencing. The consensus sequences were aligned online using MAFFT version 7, including COI sequences of *P. ubiquitous* (Ueckermann and De Vis *et al.* 2024), *H. anconai* (samples and COI sequences subject of another paper in preparation) and a set of gradually less related prostigmatid mites from previous studies, available at GenBank NCBI. Finally, a phylogenetic tree was constructed, using the software W-IQ-TREE with 1,000 ultrafast bootstrap combined with automatic model finding through ModelFinder (Trifinopoulos *et al.* 2016; Kalyaanamoorthy *et al.* 2017; Hoang *et al.* 2018). According to the Bayesian information criterion, the best-fit model was determined to be K3Pu+F+G4, based on the likelihood scores for 88 different models. The resulting maximum-likelihood consensus tree was rooted with the sequence of *Varroa destructor* Anderson and Trueman, 2000 and edited with iTOL version 5 (Letunic and Bork 2021).

Deposits of type material

Voucher specimens of COI sequences of *P. duffelensis* are deposited at CBGP, INRAE, Montpellier, France under their accession number, (CBGP-ACARI 2497–2509) (CBGP–Continental Arthropod Collection, <https://doi.org/10.15454/D6XAKL>).

Deposit GenBank. The *P. duffelensis* COI-sequences herein obtained, have been deposited in the Genbank database under their accession numbers (Genbank accession number PQ327667).

Type material see below in each species description section.

Results

Duoparus: description of the genus and a new species

Family Iolinidae Pritchard, 1956

Subfamily Pronematinae André, 1979

***Duoparus* De Vis & Ueckermann n. gen.**

Zoobank: [24BED0D5-7245-4975-A055-0C435A03BD78](https://zoobank.org/24BED0D5-7245-4975-A055-0C435A03BD78)

Type species — *Duoparus hyeresensis* n. gen. n. sp.

Description — Adult female. Aspidosoma procurved, with four pairs of setae *bo*, *ro*, *la* and *ex*; opisthosoma with 11 pairs of setae, *c1*, *c2*, *d1*, *e1*, *f1*, *f2*, *h1*, *h2*, *ps1*, *ps2* and *ps3*. Poroidotaxy: *ia*, *im*, *ip*, *ih*. Eye spots absent. Two pairs of subequal aggenital setae, supposedly *ag1* and *ag3* with *ag2* and *ag4* absent. Empodium and claws absent on leg I, each of other legs with ciliate empodium and two claws, without empodial hooks. Femur IV divided. Leg chaetotaxy: leg I 9 + ω - 3 + φ + κ - 3 - 3 - 1; leg II 7 + ω - 2 - 3 - 3 - 1; leg III 6 - 2 - 2 - 2 - 1; leg IV 6 - 2 - 1 - 1 + 1 - 0. Epimeral formula 3-1-4-2.

Diagnosis — Adult female of the genus is characterised by the presence of two pairs of *ag* setae, one seta on trochanters I to III, seven setae on tarsus II and six on each of tarsi III and IV. The genus is closely related to *Pseudopronematulus* that differs in having four pairs of *ag* setae.

Etymology — The genus name refers to the presence of only two pairs of aggenital setae (*ag*): ‘*duo*’, Latin for two and ‘*par*’, Latin for pair.

Remark — André (1979: 204) considered the description of a new genus based on one specimen to be unadvisable, except when the specimen exhibits very special characteristics. We consider the presence of only two *ag* setae a special characteristic and therefore describe this new genus. More diagnostic features can be found in the differential diagnosis of the type species, some of which might be generic, but we limit the genus description mostly to chaetotaxy of body and legs (André 1980).

***Duoparus hyeresensis* n. gen. n. sp. De Vis & Ueckermann**

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(Figures 1–5)

Adult female

Holotype (Figures 1–5)

Idiosoma — (Figures 1 & 4). Ovaloid, tapering posteriorly. Distance *bo*–*h1* 180, width at level *c1* 130. Completely striate, striae coarser (Figure 4a–d versus 4e–g, Figure 5) than usual in Pronematinae, without tubercles. Aspidosoma with 4 setae (*bo*, *ro*, *la* and *ex*) and opisthosoma with 11 setae (*c1*, *c2*, *d1*, *e1*, *f1*, *f2*, *h1*, *h2*, *ps1*, *ps2* and *ps3*).

Dorsum – (Figures 1 & 4–5). Aspidosoma with divergent striation towards *das* furrow (Każmierski 1989); dorsal part of opisthosoma with median longitudinal striation and lateral convergent striation posteriorly, turning transverse between level of *im* and *f1* and then divergent towards posterior margin.

Most idiosomal setae aciculate (Figure 4a–b, Figure 5h, k), apparently serrate, their surface at least with a rough aspect (interference with striae makes it unclear); trichobothrial setae (*bo*) on aspidosoma about as long as *ex*, both much longer than subequal *la* and *ro*; *la* somewhat thinner than other of subequal thickness (Figure 4a); *bo* finely barbed except for a smooth proximal part (Figure 5e). Dorsal setae *ro*, *la*, *c1*, *d1*, *e1* and *ps3* relatively short, while *ex*, *f1* (Figure 5h), *f2* (Figure 5k), *h1*, *h2*, *ps1* and *ps2* relatively long. Setae *c1*, *d1* and *e1* not reaching bases of *d1*, *e1* and *f1*, respectively. Setal lengths and distances between setae: *bo* 45, *bo*–*bo* 39, *ro* 12, *ro*–*ro* 22, *la* 11, *la*–*la* 42, *ex* 44, *c1* 14, *c1*–*c1* 38, *c2* 21, *c1*–*d2* 78, *d1* 14, *d1*–*d1* 28, *e1* 20, *e1*–*e1* 51, *f1* 26, *f1*–*f1* 25, *f2* 57, *h1* 38, *h2* 49, *ps1* 30, *ps2* 34.

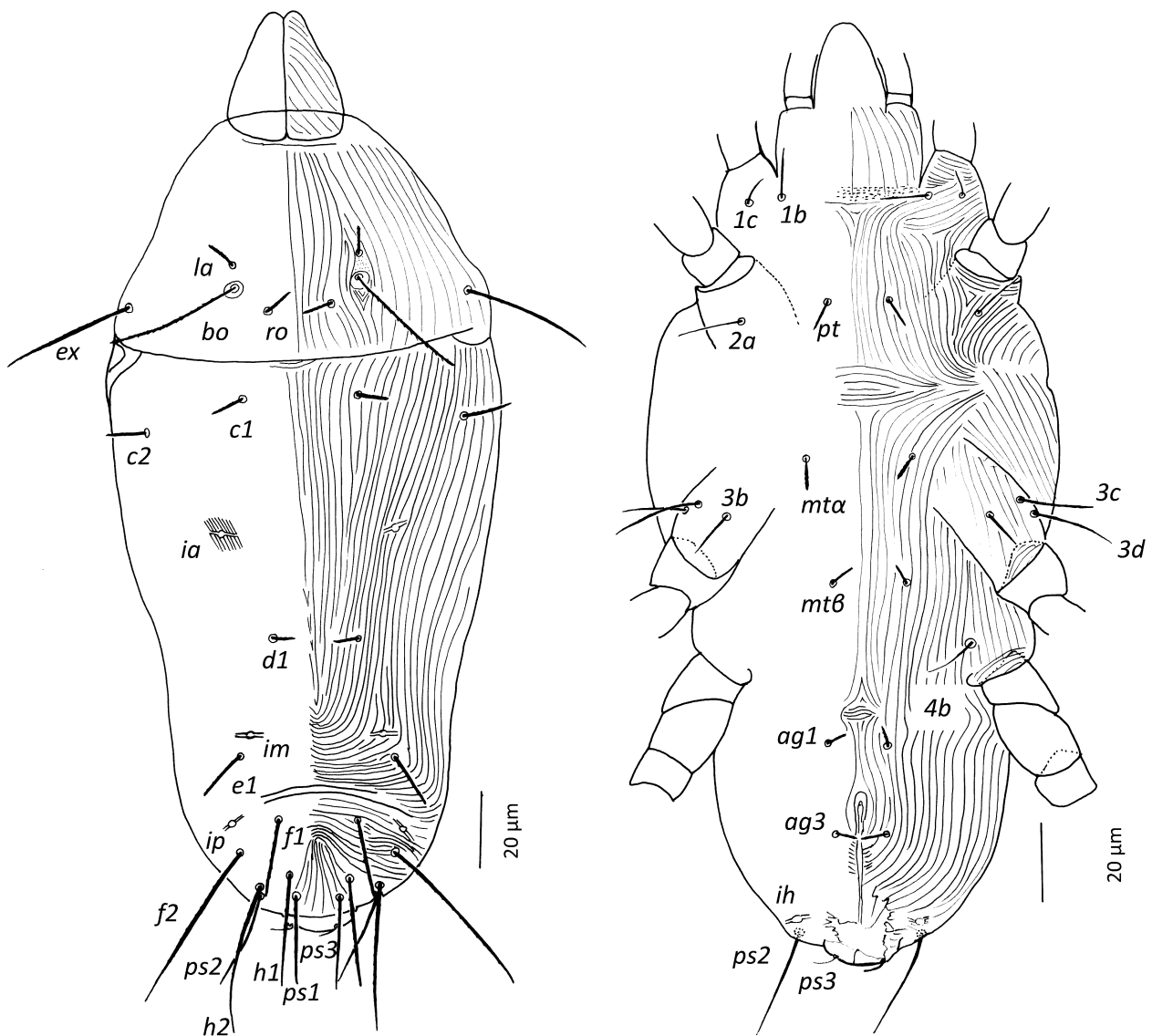


Figure 1 *Duoparus hyeresensis* De Vis & Ueckermann n. gen. n. sp., dorsum (left) and venter (right) of holotype female.

Lyrifissure *ia* located between setae *c1* and *d1*, slightly mesad hypothetical line connecting the bases of these setae; lyrifissure *im* immediately anterior *e1*, on hypothetical line between *d1* and *e1*; lyrifissure *ip* immediately anterior *f2*.

Venter – (Figures 1 & 4 c–d). Transition area between venter and gnathosoma with transverse striation; striation longitudinal between legs I and II and convergent immediately posteriad each of these legs; striation longitudinal between legs III and IV; transverse between setae *pt* and *mta* and for a very short, irregular median section anterior to setae *ag1* (Figure 4c) constituting a pair of spindle-shaped patterns; converging to level of genital opening (Figure 4d).

With only two *ag* setae, interpreted as *ag1* and *ag3* (Figure 4d). Genital papillae not visible. Setae *ps3* anterolaterad anal opening; dome-shaped caudal excrescence dorsal of anal opening distinct, lateral bases connected.

Lyrifissure *ih* laterad genital opening.

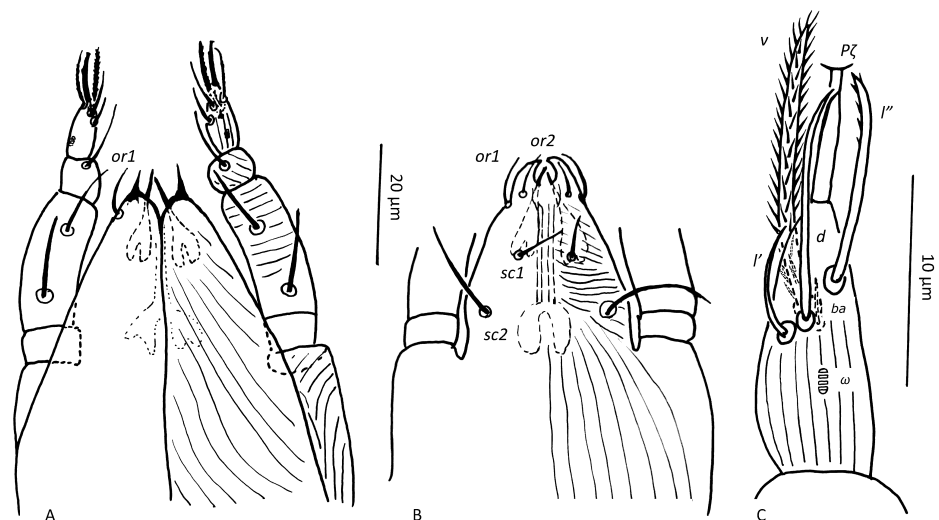


Figure 2 *Duoparus hyeresensis* De Vis & Ueckermann n. gen. n. sp. Female. A – dorsal view of gnathosoma, B – ventral view of gnathosoma, C – palptarsus.

Setal lengths and distances: *1b* 10, *1c* 17, *pt* 11, *pt-pt* 20, *2a* 22, *mta* 10, *mta-mta* 33, *3b* 16, *3c* 22, *3d* 27, *mtβ* 10, *mtβ-mtβ* 24, *4b* 17, *ag1* 7, *ag3* 8, *ps3* 8.4.

Gnathosoma — (Figure 2). Chelicerae with parallel diagonal striae converging anteromedially, with dorsal fixed digit and ventral stylets 14.3. Stylelet tips in oral cavity. Subcapitulum with striae in section anterior *sc2* almost transverse and parallel to each other, converging anteromedially; in section posterior *sc2*, almost longitudinal converging anteromedially; with two pairs of subcapitular setae, *sc1* 13.2, *sc2* 14.4 and two adorals about 6.5. Palp: chaetotaxy (6 + ω -1-2); tarsus 12 with longitudinal striae, terminating with a straight, T-shaped eupathidium *pζ* 7, solenidion and *ba* minute, seta *l''* finely serrate at the tip, ventral seta *v* stout with long barbs over its entire length, setae *l'* and *d* smooth, the former about half as long as *d* and *l''*. Femorogenu length 19.3, width 8.2.

Legs — (Figure 3). Leg lengths (from base of trochanter to base of claws): I 120, II 98, III 95, IV 113; tarsus I 22, tibia I 25. Chaetotaxy: leg I 9 + ω - 3 + φ + κ - 3 - 3 - 1; leg II 7 + ω - 2 - 3 - 3 - 1; leg III 6 - 2 - 2 - 2 - 1; leg IV 6 - 2 - 1 - 1 + 1 - 0. Epimeral formula: 3-1-4-2, right seta *4b* lacking in holotype. Ventral setae on all tibiae apparently serrate, at least with rough surface, slightly stouter than other setae on legs. Leg I with solenidion ωI not reaching tip of tarsus, smooth eupathidia *ft''ζ*, *tc'ζ*, *tc''ζ*, *p'ζ* and *p''ζ*, and a pair of small unguinal setae proximal to prorals on ventral side, seta homologous to *s* (see Ueckermann & De Vis *et al.* 2024) vestigial. Tibia I with bifurcated famulus κ , slightly shorter than solenidion φI . Femur IV divided. Dorsal setae of tarsus III and IV inserted distant from each other, seta *ft'* more distal than *ft''*. Seta *d* on telofemur and external ventral seta *ev'* on basifemur both unforked. Setal lengths **Leg I**: ωI 4, *ft'ζ* 13, *ft''ζ* 24, *tc'ζ* 35, *tc''ζ* 37, *p'ζ* 22, *p''ζ* 21, *u'* 6, *u''* 7, φI 2.2, κ'' 2.2, seta *d* femur I 31. **Leg II**: ω 3, seta *v'* tibia 15, seta *v''* femur 41. **Leg III**: seta *d* tibia 32, seta *v'* tibia 22. **Leg IV**: seta *d* tibia 34, seta *v'* tibia 23, seta *d* telofemur 27, seta *ev'* basifemur 29.

Male and immature stages

Not found.

Differential diagnoses

This is the only species in this genus. It can be distinguished from the closely related *Pseudopronematus* species primarily by the presence of only two subequal (!) *ag* setae

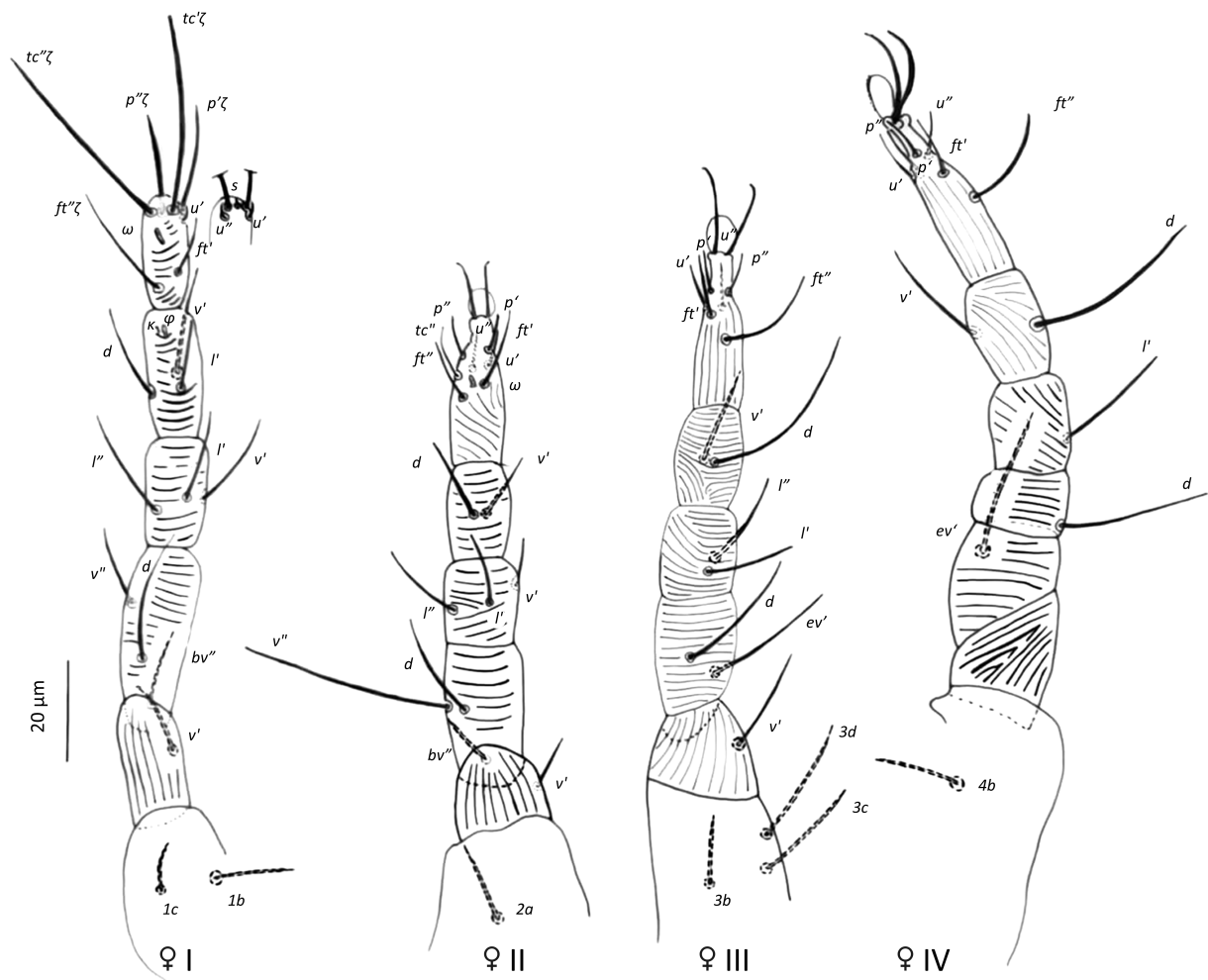


Figure 3 *Duoparus hyeresensis* De Vis & Ueckermann n. gen. n. sp., legs of holotype female (*s* = seta homologous to *s*).

(presumed *ag1* and *ag3* with *ag2* and *ag4* absent), but also by the coarser striae, the narrow, irregular spindle-shaped striae proximal *ag1* setae, the smooth eupathidia on tarsus I, the distant insertion of the two dorsal setae *ft'* and *ft''* of tarsus III and IV, the unforked seta *d* on femur IV, the relatively short seta *l'* and barbed seta *v* on the palptarsus, the long and subequal prodorsal setae *bo* and *ex*, the very long dorsal setae *f2*, the short ventral setae *v'* on tibiae II and III, and the very long seta *v''* on femur II.

Type locality and habitat

Holotype female (slide number 83.10) from a leaf of *Rubus* sp. with few trichomes, collected at 945 Chemin Petit Traversier du Plan, 83400 Hyères, France (43°07'05.2"N 6°09'43.6"E) in August 2018 by Lore Vervaeet. Associated with specimens of the following mite species: *Agistemus* sp. (Stigmaeidae), *H. anconai* and *P. ubiquitous* (Iolinidae), *Triophtydeus triophtthalmus* Oudemans, 1929 (Triophtydeidae), Phytoseiidae, *Czespinskia lordi* Nesbitt, 1946 (Winterschmidtidae), *Tyrophagus* sp. (Acaridae), Tarsonemidae, Tetranychidae, Tenuipalpidae and Tydeidae.

Type repository

Holotype (CBGP-ACARI 2496) deposited at deposited at CBGP, INRAE, Montpellier, France.

Etymology

The species is named after Hyères, France, the place where the holotype was found.

***Pseudopronematus*: description of two species, redescription of one and key to all the species**

***Pseudopronematus* Fan & Li, 1992**

Pseudopronematus Fan and Li 1992: 396.

Type species — *Pseudopronematus acus* Fan & Li, 1992.

Diagnosis – Adult females can be distinguished from those of other genera by the presence of one seta on trochanters I to III, seven setae on tarsus II and six on each of tarsi III and IV, and the presence of four *ag* setae increasing in length from *ag1* to *ag4*. Empodium and claws absent on leg I, each of other legs with ciliate empodium and two claws, without empodial hooks. Both setae (*pζ*) and setae (*tcζ*) on tarsus I subequal, the former two shorter than the latter two. Femur IV divided. Aspidosoma with four pairs of setae (*bo*, *ro*, *la* and *ex*) and opisthosoma with 11 pairs (*c1*, *c2*, *d1*, *e1*, *fl*, *f2*, *h1*, *h2*, *ps1*, *ps2* and *ps3*). Epimeral formula 3-1-4-2. Poroidotaxy: *ia*, *im*, *ip*, *ih*. Leg setal pattern as follows: Leg I – 9 + ω – 3 + φ + κ – 3 – 3 – 1; leg II – 7 + ω – 2 – 3 – 3 – 1; Leg III – 6 – 2 – 2 – 2 – 1; Leg IV – 6 – 2 – 1 – 1 + 1 – 0.

Remark — The presence of the seta homologous to *s* is either absent or vestigial and hard to distinguish. This contrasts with other genera, e.g. *Pronematus* or *Homeopronematus* André, 1980, in which this seta is clearly visible in all stages except the larva (Ueckermann & De Vis *et al.* 2024). The ventral setae on tibiae II–IV are stout compared to the other leg setae, and the dorsal seta on the telofemur IV is forked. These three characteristics might be generic but they are not clear for *P. acus* nor for *P. augrabiensis* Ueckermann & Grout, 2007, so we refrain from citing them as a generic characteristics.

***Pseudopronematus duffelensis* De Vis & Ueckermann n. sp.**

Zoobank: 1E304688-71F7-4708-80D7-6CB74601DBCA

(Figures 4–10)

Measurements

Measurements of different structures are shown in Table 1.

Adult female

Holotype and paratypes 1–7 (Figures 4–8)

Idiosoma — (Figures 4 & 6). Body ovaloid, tapering slightly posteriorly. Eye spots absent. Procurved. Completely striated, striae fine, without tubercles. All setae minutely serrate.

Dorsum – (Figures 4 & 6). Aspidosoma with divergent striation toward *das* furrow; dorsal part of opisthosoma with median longitudinal striation and lateral striation converging posteriorly, turning transverse at level of *im* and *h1* and then divergent toward posterior margin. Idiosomal setae aciculate, finely serrated; *la* somewhat thinner than other of subequal thickness (Figure 5i, l). Trichobothrial setae thinner, longest, finely barbed on about 2/3 of distal part (Figure 5f). Most dorsal setae short to medium sized, except *bo*, *f2*, *h2* and *ps2*, relatively long. Setae *c1*, *d1* and *e1* not reaching bases of *d1*, *e1* and *fl*, respectively; *fl* barely reaching base of *h1*. Lyrifissure *ia* located equidistantly to *c1* and *d1*, slightly laterad line connecting bases of these setae. Lyrifissure *im* situated close to *e1*, anterocentrally. Lyrifissure *ip* located between *e1* and *f2*.

Venter – (Figures 4 & 6). Transition area between venter and gnathosoma with transverse striation; Overall striation longitudinal between legs I-II; converging between leg I and II; between *pt* and *mta* transversal striae in spindle-shaped pattern, spindle wider than distance between *mta* setae; proximal to *ag1* transversal striae forming second, smaller spindle-shaped

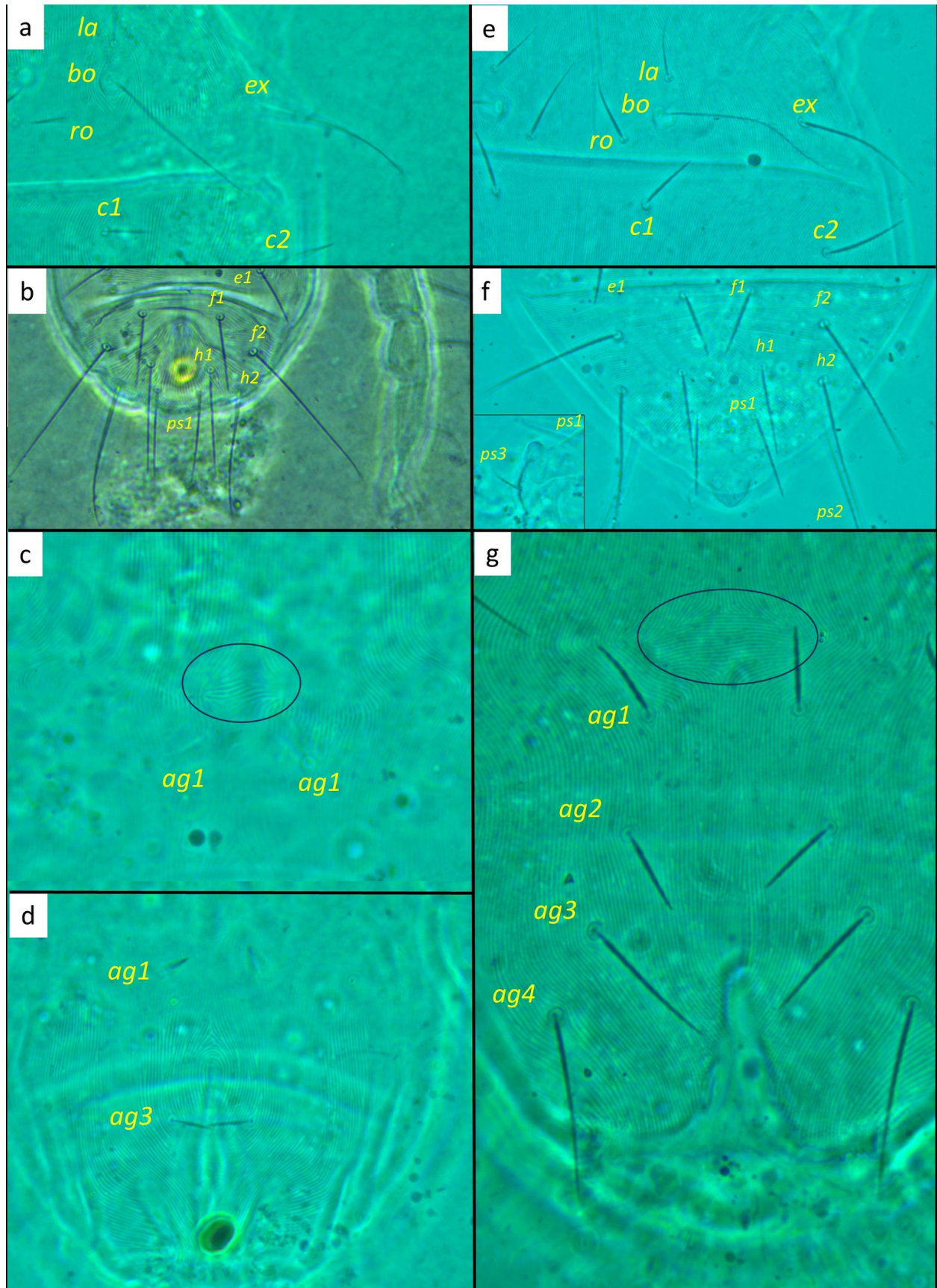


Figure 4 a–d *Duoparus hyeresensis* De Vis & Ueckermann **n. gen. n. sp.** holotype: a – aspidosoma, b – posterior region of dorsum, c – area anterior to *ag1* with transversal spindle-shaped striae (within ellipse), d – genital area with two *ag* setae; e–g *Pseudopronematus duffelensis* De Vis & Ueckermann **n. sp.**: e – aspidosoma, f – posterior region of dorsum (caption = lateral view of dome-shaped excrescence), g – genital area with larger transversal spindle-shaped striae (within ellipse) and four *ag* setae.

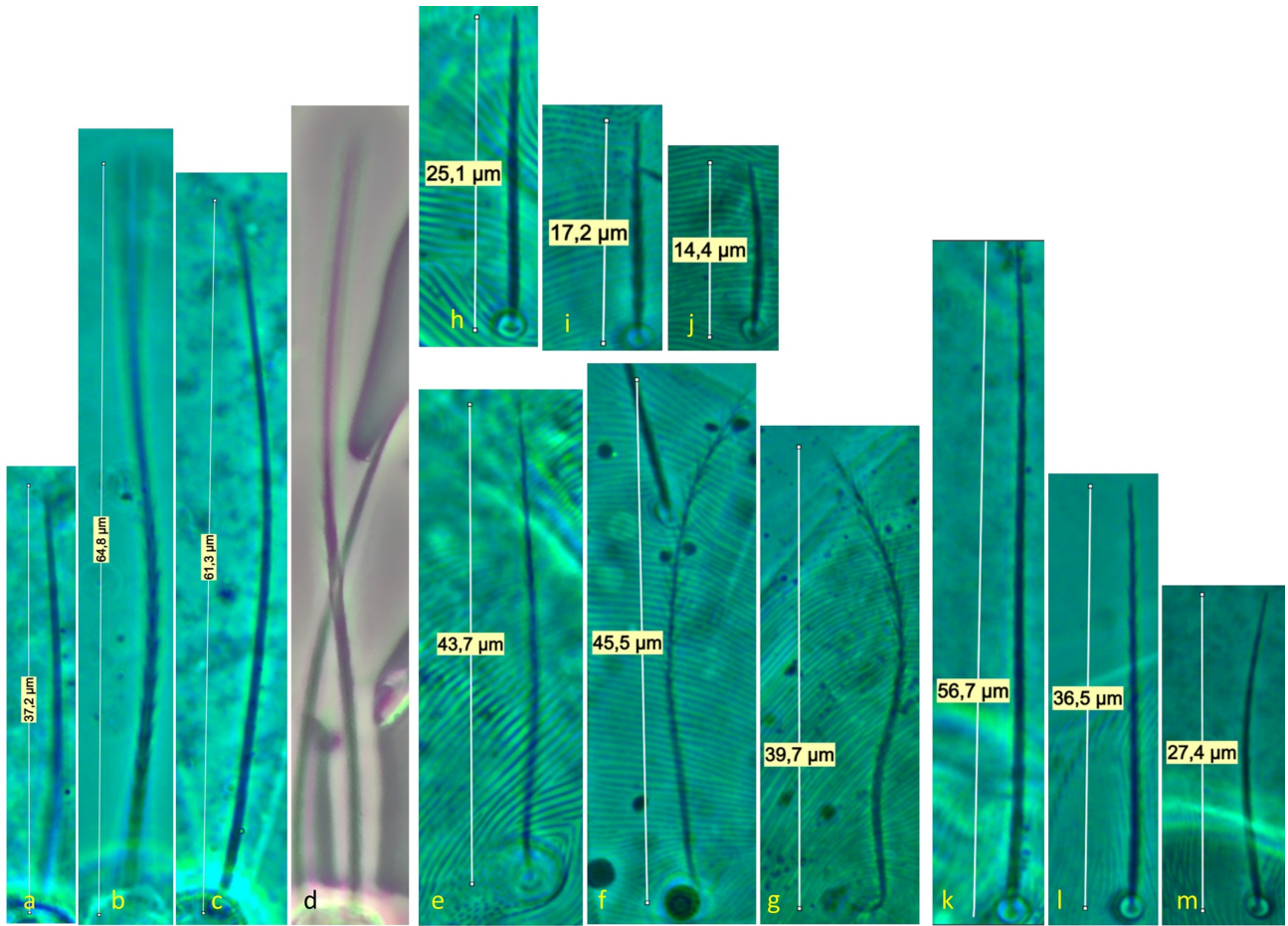


Figure 5 Comparison of setae of different species: a–d *tc*ζ of respectively *Duoparus hyeresensis* De Vis & Ueckermann **gen. n. sp.**, *Pseudopronematus duffelensis* De Vis & Ueckermann **n. sp.**, *Pseudopronematus tocantinsensis* De Vis, Castilho & Ueckermann **n. sp.** and *Pseudopronematus tenuisetosus* (Meyer & Rodrigues, 1966) **n. comb.**; e–g *bo*, h–j *fl* and k–m *f2* of respectively *Duoparus hyeresensis* De Vis & Ueckermann **n. gen. n. sp.**, *Pseudopronematus duffelensis* De Vis & Ueckermann **n. sp.** and *Pseudopronematus tocantinsensis* De Vis, Castilho & Ueckermann **n. sp.**

pattern, spindle wider than distance between *ag1* setae; striation converges towards genital opening and laterally divergent toward posterior margin. Genital opening shaped as inverted “T”, with one pair of small genital papillae at anterior part. Four *ag* setae forming two eccentric lines. Length increasing from *ag1* to *ag4*, the latter about twice as long as the former. Setae *ps3* minute, anterolaterad anal opening, on striated area. Caudal, dome-shaped excrescence dorsally of anal opening, lateral bases connected. Lyrifissure *ih* posterolaterad genital opening.

Gnathosoma — (Figure 7). Chelicera with parallel diagonal striae converging anteromedially, dorsal fixed digit and ventral stylet 14. Subcapitulum with longitudinal striation converging anteromedially, two pairs of subcapitular setae, *sc1* 13 and *sc2* 11.2, and two pairs of adoral setae, dorsal *or1* (not visible) and ventral *or2* 5 (both mostly not discernible). Palp: tarsus 16 with longitudinal striae, terminating with straight eupathidium *pζ* 6.6, slightly broadened and bifurcated distally. Palpal chaetotaxy (6+ω-1-2), solenidion and *ba* minute (on most specimens not discernible), palptarsal dorsal setae smooth and ventral seta (*v*) stouter and smooth; femorogenu length 21.3, width 8.

Legs — (Figure 8). Dimensions shown in Table 1. Chaetotaxy: leg I – 9 + ω – 3 + φ + κ – 3 – 3 – 1; leg II – 7 + ω – 2 – 3 – 3 – 1; leg III – 6 – 2 – 2 – 2 – 1; leg IV – 6 – 2 – 1 – 1 + 1 – 0. Epimeral formula: 3-1-4-2. Ventral setae of tibiae serrate and stouter than other setae on the legs. Dorsal setae of tarsus III and IV inserted near each other. **Leg I** with ω surpassing

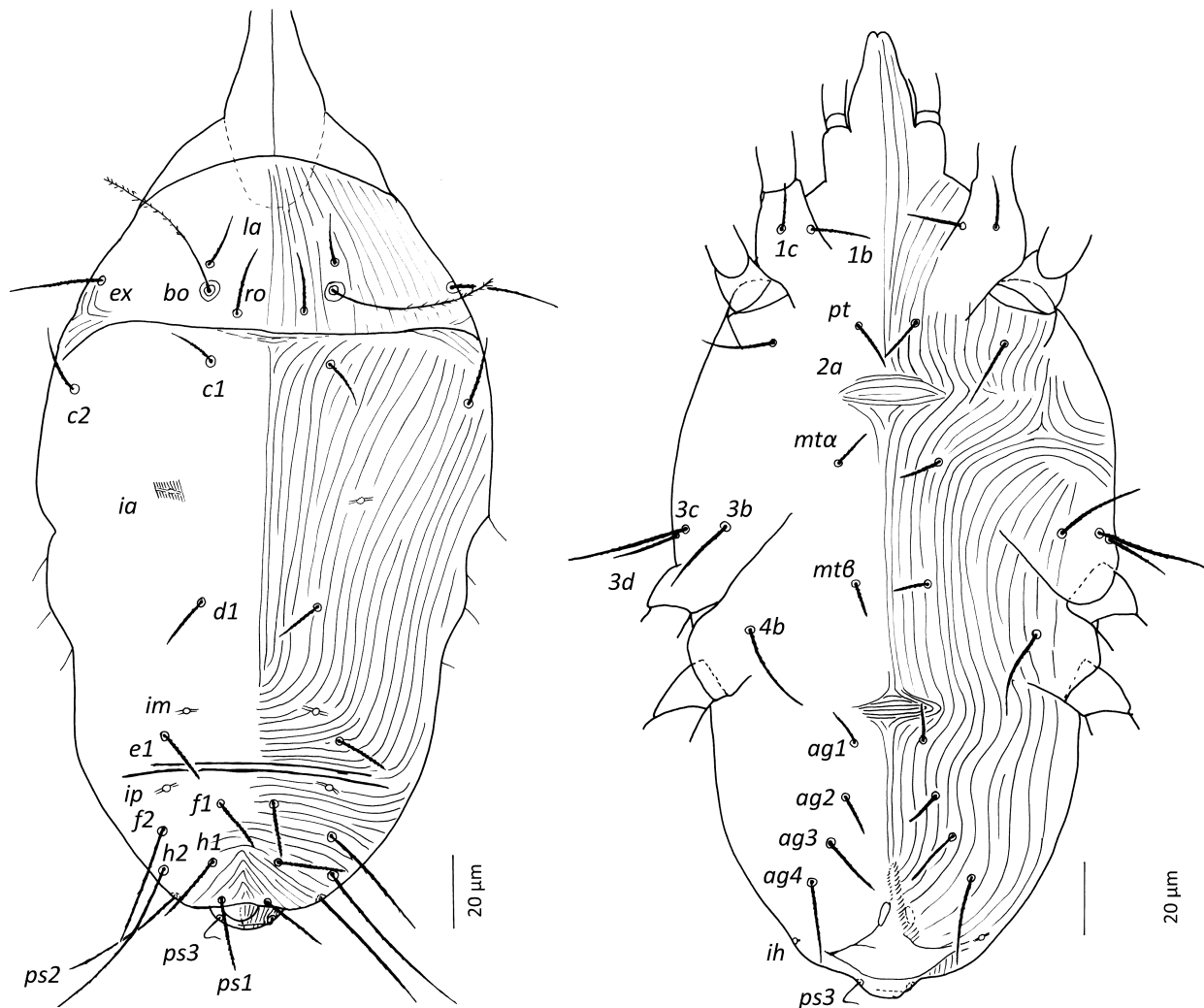


Figure 6 *Pseudopronematus duffelensis* De Vis & Ueckermann n. sp., dorsum (left) and venter (right) of holotype female.

slightly tip of segment; with five long eupathidia (abaxial fastigial and both tectals and prorals) of which subequal prorals shortest and subequal tectals longest; prorals and tectals serrated in proximal half (Figure 5b); fastigial eupathidium $fi\zeta'''$ serrated in proximal third, fi' smooth; with a pair of bifurcate unguinals (bifurcation visible in holotype but not discernible in most specimens), proximal to prorals on ventral side; unpaired, small seta homologous to s between and distally to the proral setae visible in holotype but most often not discernible; tibia famulus with tip thickened and bifurcated (the bifurcation is not always visible, depending on position), somewhat shorter than solenidion ϕ ; seta d femur 25.8. **Leg II** with tarsus bearing three dorsal setae near minute solenidion ω ; seta v' tibia 25, seta d tibia 19.5; seta v'' femur 31. **Leg III** with seta v' tibia 28.0 and subequal dorsal seta d 28.7; seta $3c$ of coxa longer than $3b$ and $3d$ (Table 1). **Leg IV** with tibial setae seta v' 26 and d 29.9; femur divided; seta ev' basifemur 30; dorsal seta d telofemur 28, serrate and distally forked, with one member of fork fine 5 and other stouter 11.

Tritonymph

Paratype eight (Figure 9)

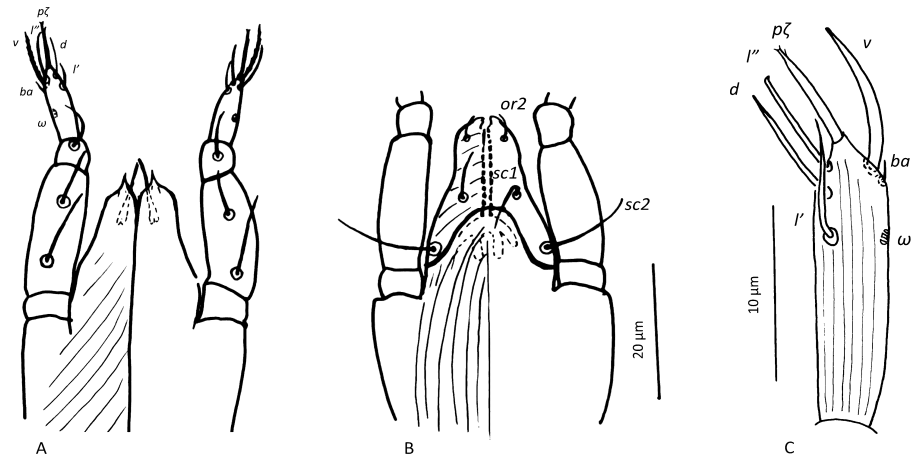


Figure 7 *Pseudopronematus duffelensis* De Vis & Ueckermann n. sp. Female. A – dorsal view of gnathosoma, B – ventral view of gnathosoma, C – palptarsus. Setae *or1* indistinguishable;

Dorsal and ventral chaetotaxy as in adult female. Genital pore between *ag3* and *ag4*. In one specimen *ag3* absent on one side. With posteriorly sharp tipped excrescence projecting from posterior margin of idiosoma over anal opening. Legs lacking a single seta in relation to adult female: tarsus IV with five instead of six setae (we suppose *ft'* missing), hence legs with following chaetotaxy (difference from adult female shown in bold): leg I – 9 + ω – 3 + φ + κ – 3 – 3 – 1; leg II – 7 + ω – 2 – 3 – 3 – 1; leg III – 6 – 2 – 2 – 2 – 1; leg IV – **5** – 2 – 1 – 1 + 1 – 0; epimeral formula: 3-1-4-2. Dorsal seta *d* on telofemur not forked. Femur IV divided.

Deutonymph

Paratype nine (Figures 9–10)

Aspidosoma with dehiscence line arching mesad towards setae *ro* (= species procurved, see André 1981a). Dorsal and ventral chaetotaxy as in adult female, except for the absence of *ag3* and *ag4*. In one specimen only two setae on coxa III at one side. Genital pore posteromesad seta *ag2*. With posteriorly sharp tipped excrescence projecting from posterior margin of idiosoma over anal opening. Legs lacking a few setae in relation to adult female: trochanters I and II nude instead of with one seta each; tarsus II with six instead of seven setae (*tc''* lacking); each of tarsi III and IV with five instead of six setae (we suppose *ft'* lacking), hence legs with the following chaetotaxy (differences from adult female shown in bold): leg I – 9 + ω – 3 + φ + κ – 3 – 3 – 0, leg II – **6** + ω – 2 – 3 – 3 – 0, leg III – **5** – 2 – 2 – 2 – 1, leg IV – **5** – 2 – 1 – 1 + 1 – 0; epimeral formula: 3-1-4-2. Dorsal seta on telofemur not forked. Femur IV not divided.

Protonymph

Paratype 10 (Figure 10)

Dorsal chaetotaxy same as in adult female. Ventral chaetotaxy reduced (lacking one coxal III seta, assumed to be *3d*, and further lacking *mtβ*, *4b* and all *ag* setae). Genital pore anteromedial seta *ps3*. With posteriorly excrescence projecting from posterior margin of idiosoma over anal opening, distally roundish. Leg chaetotaxy as in deutonymph except for leg IV, in which all segments are nude, except for tarsus, with five setae, hence with the following chaetotaxy (differences from adult female shown in bold): leg I – 9 + ω – 3 + φ + κ – 3 – 3 – 0, leg II – **6** + ω – 2 – 3 – 3 – 0, leg III – **5** – 2 – 2 – 2 – 1, leg IV – **5** – 0 – 0 – 0 – 0; epimeral formula: 3-1-3-0. Seta homologous to *s* visible in paratype. Dorsal seta on telofemur not forked. Femur IV not divided.

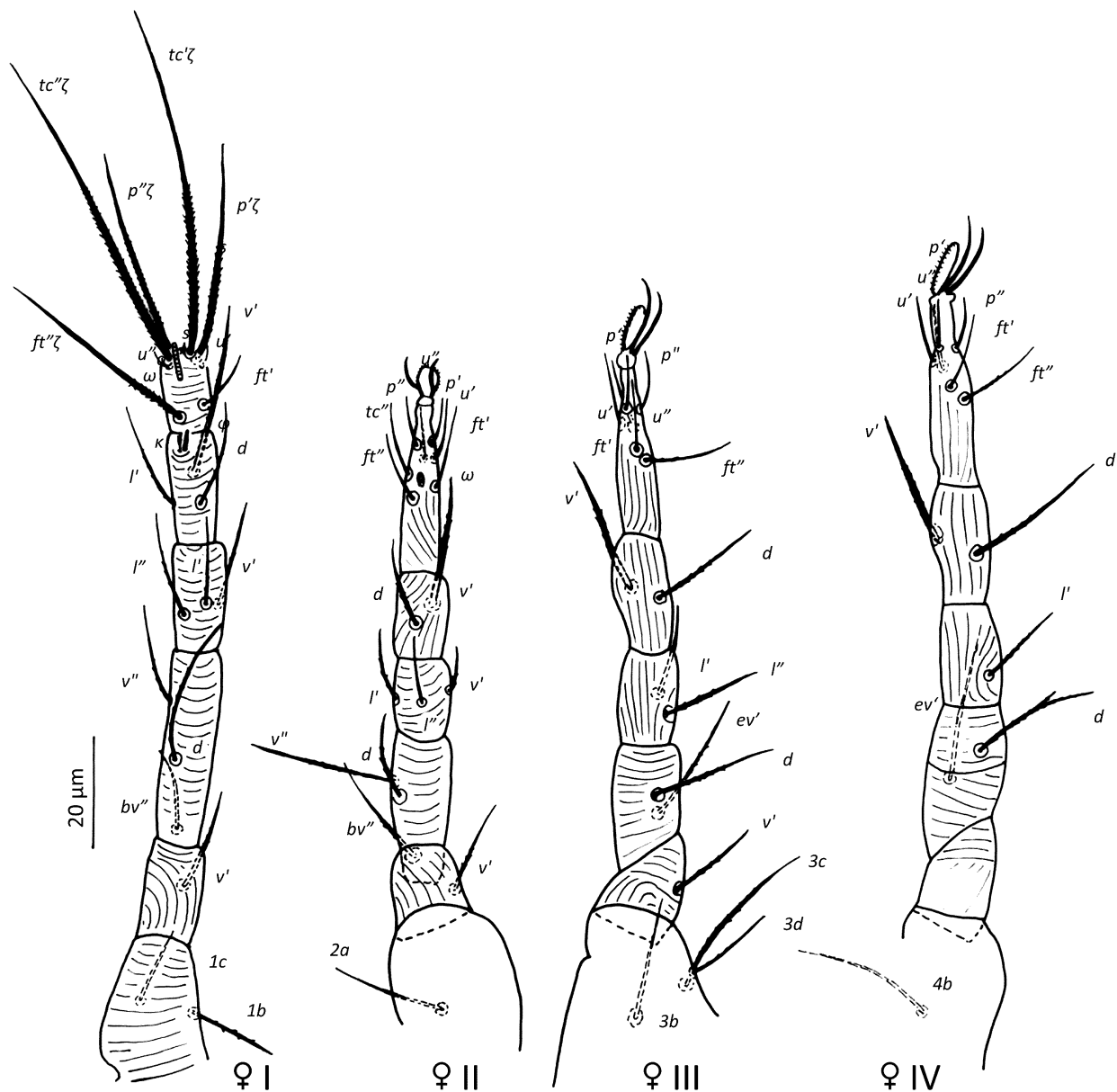


Figure 8 *Pseudopronematus duffelensis* De Vis & Ueckermann n. sp. legs of holotype female.

Larva and male

Not found.

Differential diagnoses

This new species is most similar to *P. acus*, type species of the genus, but females of the latter have several setae considerably shorter (*la* 13, *ex* 21, *el* 19, *h1* 17, *h2* 36, *ps1* 17, *ps2* 25 and *ag4* 22) than the new species. It is also similar to *P. augrabiensis*, described based on one specimen, but female of the latter is much larger, have seven setae longer (*ro* 25, *ex* 38, *cl* 25, *c2* 25, *d1* 22 and *el* 22), and ωI is also longer, than the new species described here.

Type locality and habitat

Holotype female collected from leaf litter of a sweet pepper crop at Wommelgem, Belgium in November 2020 by Raf De Vis. Paratypes (12 adult females, four tritonymphs, three deutonymphs and one protonymph) collected in November 2020 at Duffel, Belgium, from leaf litter of sweet pepper crop, and rearing thereof. The species was not found on the leaves of sweet pepper plants. In the leaf litter it was associated with several mite groups,

Table 1 Dimensions of structures in μm of different stages of *Pseudopronematus duffelensis* De Vis & Ueckermann n. sp., and females of *Pseudopronematus tenuisetosus* (Meyer & Rodrigues, 1966) and *Pseudopronematus tocantinsensis* De Vis, Castilho & Ueckermann n. sp.

Structure	<i>P. duffelensis</i>				<i>P. tenuisetosus</i>	<i>P. tocantinsensis</i>		
	Adult female (12)**	Tritonymph (4)	Deutonymph (3)	Protonymph (1)	Female (1)	Female (9)	Tritonymph (2)	
<i>bo-hl</i>	156.7 ± 2.5 (145 - 170) 10**	150.6 ± 2.6 (148 - 156) 3	115.1 ± 5 (105 - 120.5) 3	105	189.7	154.9 ± 6.1 (129.4 - 189) 9	134.1 ± 7.1 (127 - 141.25) 2	
Body width	128 ± 3.8 (115 - 150) 8	102 ± 5 (92 - 108) 3	96.3 ± 6.1 (84 - 103) 3	84	-	120.2 ± 4.4 (107.6 - 148.2) 9	116.6 ± 9.8 (106.75 - 126.5) 2	
<i>bo</i>	48.1 ± 0.4 (46 - 50.3) 11	43.8 ± 0.6 (42.4 - 45) 4	37.6 ± 0.8 (36 - 38.9) 3	38.1	36.9	42.8 ± 0.6 (39.3 - 45.6) 9	40.2 ± 0.7 (39.5 - 41) 2	
<i>bo-bo</i>	34.8 ± 0.4 (33 - 38) 11	33.2 ± 1 (31.4 - 36) 4	29 ± 1.3 (27.2 - 31.6) 3	31.6	27.9	43.4 ± 0.9 (40.4 - 49.9) 9	38.8 ± 3.2 (35.6 - 42) 2	
<i>ro</i>	19 ± 0.3 (16.5 - 20) 10	13.4 ± 0.3 (12.8 - 14.2) 4	10.7 ± 0.5 (9.9 - 11.8) 3	9.9	17.8	17.9 ± 0.2 (16.5 - 18.6) 9	13.9 ± 0.5 (13.4 - 14.5) 2	
<i>ro-ro</i>	19.2 ± 0.4 (16.8 - 22) 11	16.9 ± 0.7 (15.3 - 18.8) 4	14.7 ± 0.1 (14.5 - 15.1) 3	14.5	20.8	21.9 ± 0.3 (20.2 - 24.1) 9	20.1 ± 0.7 (19.4 - 20.9) 2	
<i>la</i>	14.5 ± 0.4 (12 - 16) 10	11.2 ± 0.3 (10.4 - 11.9) 4	8.5 ± 0.5 (7.5 - 9.4) 3	7.5	11.8	11.8 ± 0.3 (10.9 - 13.9) 9	10.8 ± 0 (10.8 - 10.8) 2	
<i>la-la</i>	37.3 ± 0.4 (36 - 40) 9	34.9 ± 0.8 (33 - 37.1) 4	31.2 ± 0.1 (31 - 31.6) 3	31.6	33.4	42.2 ± 0.3 (40.9 - 44.3) 9	41.7 ± 3.2 (38.5 - 45) 2	
<i>ex</i>	30.8 ± 0.4 (29 - 33) 12	24.9 ± 1.3 (21.8 - 28.3) 4	19.2 ± 0.6 (17.5 - 20.2) 3	17.5	21.4	28.2 ± 0.6 (25.5 - 30.8) 9	24.2 ± 0.6 (23.6 - 24.8) 2	
<i>c1</i>	14.3 ± 0.2 (13 - 15) 12	11.6 ± 0.2 (11 - 12) 4	9.5 ± 0.4 (9.1 - 10.4) 3	9.1	16.9	13 ± 0.2 (11.7 - 14) 9	11.5 ± 0.7 (10.8 - 12.3) 2	
<i>c2</i>	19.6 ± 0.2 (18 - 21) 11	16.3 ± 0.7 (14.9 - 18.3) 4	12.7 ± 0.7 (11.8 - 14.3) 3	11.8	21.3	17.7 ± 0.2 (16.2 - 19.3) 9	14.6 ± 0.2 (14.4 - 14.8) 2	
<i>c1-c1</i>	32.8 ± 0.4 (30 - 35) 11	29.4 ± 1.5 (26.8 - 33.8) 4	27.1 ± 0.6 (26.1 - 28.2) 3	27.1	36.5	31.6 ± 0.7 (28.2 - 35.9) 9	30.8 ± 0.4 (30.4 - 31.3) 2	
<i>d1</i>	14.4 ± 0.1 (13.6 - 15) 11	12 ± 0.1 (11.6 - 12.5) 4	9.6 ± 0.2 (9.3 - 10.2) 3	9.3	-	14.1 ± 0.2 (12.6 - 14.9) 9	10.7 ± 0.7 (10 - 11.4) 2	
<i>d1-d1</i>	32.7 ± 0.6 (30.1 - 37) 9	28 ± 2.1 (25.2 - 34.3) 4	23.9 ± 0.5 (23.2 - 25) 3	23.7	32.8	29.2 ± 0.9 (26.5 - 35.9) 9	28.2 ± 1 (27.2 - 29.2) 2	
<i>e1</i>	16.2 ± 0.2 (15 - 18) 12	13.9 ± 0.4 (13.3 - 15.4) 4	12.1 ± 0.5 (11.1 - 12.7) 3	11.1	18.5	15.7 ± 0.2 (14.5 - 16.7) 9	15.4 ± 0.9 (14.5 - 16.3) 2	
<i>e1-e1</i>	50.4 ± 0.8 (47 - 55) 9	37.7 ± 1 (36 - 40.9) 4	31.5 ± 0.3 (30.9 - 31.9) 3	31.9	54.3	50.7 ± 0.7 (48 - 55.2) 9	38.7 ± 1.6 (37.1 - 40.3) 2	
<i>f1</i>	15.9 ± 0.2 (14.7 - 17.1) 12	14.4 ± 0.2 (13.7 - 15) 4	12 ± 0.7 (10.6 - 12.8) 3	10.6	39.2	13.9 ± 0.2 (13 - 15.9) 9	13.2 ± 0 (13.2 - 13.3) 2	
<i>f1-f1</i>	15.6 ± 0.1 (15 - 17) 11	13.3 ± 0.5 (11.8 - 14.6) 4	11.7 ± 0.2 (11.4 - 12.1) 3	12.1	47	15.6 ± 0.1 (14.9 - 17) 9	11.9 ± 0.8 (11.1 - 12.7) 2	
<i>f2</i>	36.2 ± 0.4 (33 - 39.1) 12	33.1 ± 1 (31.6 - 36) 4	27.2 ± 0.5 (26.1 - 27.9) 3	26.1	51.9	28 ± 0.5 (26.2 - 31.2) 9	30.3 ± 1 (29.3 - 31.3) 2	
<i>h1</i>	21.9 ± 0.4 (19.3 - 25) 11	17.5 ± 0.5 (16.1 - 18.9) 4	14 ± 0.6 (12.7 - 14.8) 3	12.7	22.8	16.7 ± 0.2 (15.2 - 18.1) 9	14.4 ± 0.4 (14 - 14.9) 2	
<i>h2</i>	54 ± 0.4 (50.6 - 56) 12	39.4 ± 1 (36.6 - 41.4) 4	28.5 ± 1.0 (26.1 - 30.8) 3	24.7	39.4	44.1 ± 0.4 (41.5 - 46) 9	30.8 ± 0.6 (30.2 - 31.5) 2	
<i>ps1</i>	20.2 ± 0.2 (19 - 22) 12	15.8 ± 0.7 (13.6 - 16.9) 4	12.2 ± 1.6 (9.3 - 14.8) 3	9.3	21.1	16.2 ± 0.3 (13.6 - 17.8) 9	12.6 ± 0.4 (12.2 - 13) 2	
<i>ps2</i>	38.5 ± 0.4 (37 - 41) 12	30.6 ± 0.7 (28.8 - 32.5) 4	19.8 ± 2.7 (14.3 - 22.9) 3	14.3	15	33.3 ± 0.6 (29.6 - 35.8) 9	23.8 ± 0 (23.8 - 23.9) 2	
<i>ps3</i>	11.8 ± 0.2 (10 - 13) 12	9.3 ± 0.4 (8.1 - 10.3) 4	6 ± 0.3 (5.4 - 6.5) 3	5.4	-	12.8 ± 0.3 (11.3 - 14.4) 9	8.1	
<i>lb</i>	16 ± 0.3 (14.4 - 18) 11	13.9 ± 0.4 (13.1 - 15.1) 4	11.4 ± 0.2 (10.9 - 11.8) 3	10.9	15.7	19.4 ± 0.3 (17.5 - 21.4) 9	17.6 ± 0.6 (17 - 18.3) 2	
<i>lc</i>	15 ± 0.2 (13.9 - 16.5) 11	12.5 ± 0.3 (11.8 - 13.3) 4	10.1 ± 0.2 (9.7 - 10.5) 3	9.7	13.6	18.2 ± 0.4 (15.7 - 19.8) 9	14.1	
<i>pt</i>	12.5 ± 0.3 (11 - 14) 12	9.9 ± 0.2 (9.3 - 10.4) 4	8.2 ± 0.3 (7.6 - 8.5) 3	8.5	12.6	16 ± 0.7 (10.9 - 18.9) 9	13.9 ± 0.2 (13.7 - 14.2) 2	
<i>pt-pt</i>	14.9 ± 0.5 (12.2 - 18) 9	17.3 ± 1.6 (14 - 22) 4	14.9 ± 0.5 (14 - 16) 3	14.7	21.8	20 ± 0.6 (16.6 - 22.5) 9	23.5 ± 1 (22.5 - 24.5) 2	
<i>2a</i>	20.4 ± 0.2 (19 - 22) 12	17.1 ± 0.6 (15.4 - 18.5) 4	14.4 ± 0.6 (13.4 - 15.6) 3	13.4	17.6	22.5 ± 0.5 (19.8 - 24.8) 9	18.5 ± 0.3 (18.2 - 18.9) 2	
<i>mta</i>	11.7 ± 0.2 (10.8 - 13) 12	10.2 ± 0.5 (9.6 - 11.8) 4	7.7 ± 0.3 (7 - 8.2) 3	8	12.6	15.6 ± 0.3 (14.1 - 17.2) 9	14.5 ± 0 (14.5 - 14.5) 2	
<i>mta-mta</i>	29.8 ± 0.8 (25.6 - 32.4) 7	29.4 ± 2.7 (23.3 - 36.4) 4	27.2 ± 1.5 (24.8 - 30.1) 3	26.8	35.5	27.6 ± 1.3 (23.2 - 34.8) 9	35.6 ± 5.2 (30.4 - 40.8) 2	
<i>3b</i>	23.3 ± 0.2 (21.9 - 24) 11	18.5 ± 0.8 (17 - 21) 4	15.9 ± 0.4 (15 - 16.7) 3	16	20.1	21.8 ± 0.5 (20.2 - 25.4) 9	16.9 ± 0.4 (16.5 - 17.3) 2	
<i>3c</i>	35.1 ± 0.3 (34 - 37.6) 12	27.6 ± 1.3 (24.5 - 30.8) 4	21.3 ± 0.3 (20.8 - 22) 3	20.8	26.9	29.3 ± 0.4 (27.1 - 31.9) 9	24.7 ± 1.1 (23.6 - 25.8) 2	
<i>3d</i>	21.1 ± 0.4 (18.3 - 23) 12	18.5 ± 0.4 (17.3 - 19.6) 4	14.3 ± 0.1 (14.2 - 14.4) 2	-	17.5	20.7 ± 0.4 (18.6 - 23.2) 9	16.9 ± 0.4 (16.9 - 17) 2	
<i>mtβ</i>	10.8 ± 0.2 (9 - 12) 11	8.4 ± 0.3 (7.6 - 9.3) 4	6 ± 0.6 (5.4 - 6.7) 2	-	9.8	14 ± 0.3 (12.6 - 16.1) 9	10.7 ± 0.1 (10.6 - 10.9) 2	
<i>mtβ-mtβ</i>	22.1 ± 1.7 (15.8 - 31) 7	18.4 ± 1.9 (14.8 - 24) 4	17.5 ± 0.2 (17.3 - 17.8) 2	-	23.2	22.7 ± 1.8 (14.7 - 33.3) 9	19.5 ± 7.7 (11.8 - 27.2) 2	
<i>4b</i>	26.8 ± 0.3 (25 - 29) 12	19.6 ± 0.5 (18.5 - 20.8) 4	15.6 ± 1.3 (14.3 - 17) 2	-	20.4	26.9 ± 0.5 (24.8 - 29) 8	20.4 ± 0 (20.4 - 20.5) 2	
<i>ag1</i>	10.5 ± 0.1 (9.7 - 11) 12	8.6 ± 0.2 (8.2 - 9.2) 4	6.6 ± 0.1 (6.5 - 6.8) 2	-	8.9	12.4 ± 0.3 (10.8 - 13.9) 9	9.0	
<i>ag2</i>	11 ± 0.1 (9.9 - 12) 12	9.3 ± 0.5 (8.3 - 10.7) 4	7.2 ± 0.2 (7 - 7.5) 2	-	9.9	14.6 ± 0.3 (12.6 - 16.5) 9	9.1	
<i>ag3</i>	17.7 ± 0.3 (15.8 - 20) 12	11.7 ± 0.1 (11.3 - 12.1) 4	-	-	13.5	17.8 ± 0.4 (16 - 19.3) 9	10.4	
<i>ag4</i>	24.3 ± 0.4 (21.6 - 27) 12	15.6 ± 0.3 (14.6 - 16.5) 4	-	-	22.2	22 ± 0.4 (20.1 - 24.8) 9	11.9	
<i>palptarsus</i>	14.8 ± 0.1 (13.6 - 16) 11 **	12.5 ± 0.2 (11.8 - 13) 4	10.8 ± 0.2 (10.4 - 11.3) 3	10.4	14.4	15.6 ± 0.5 (13.4 - 18.3) 8	11.1 ± 1.7 (9.3 - 12.9) 2	
<i>palp p'ζ</i>	6.7 ± 0.1 (5.8 - 7.6) 11	5.6 ± 0.1 (5.3 - 6.1) 4	5.6 ± 0.2 (5.1 - 5.9) 3	5.1	8.4	6.6 ± 0.1 (6.1 - 7.2) 8	6.5 ± 0.7 (5.8 - 7.2) 2	
<i>stylet</i>	11.7 ± 1.5 (1 - 14) 8	11.3 ± 0 (11.2 - 11.5) 3	10.5 ± 0.2 (10.3 - 11) 3	10.3	12.4	13.4 ± 0.4 (12 - 15.7) 8	11 ± 0.3 (10.7 - 11.4) 2	
<i>leg I</i>	108.8 ± 0.7 (105.7 - 112) 10	94 ± 2.6 (88 - 101) 4	75.3 ± 2.6 (70 - 78) 3	70	83.1	127.5 ± 1.6 (121 - 137) 9	103.5 ± 0.8 (102.75 - 104.4) 2	
<i>leg II</i>	99.3 ± 0.8 (95 - 104) 10	83 ± 2.5 (78 - 89) 4	69 ± 2.5 (64 - 72) 3	64	105.2	106.1 ± 1.9 (97.6 - 113.1) 9	85.5 ± 3.5 (82 - 89) 2	
<i>leg III</i>	107.1 ± 0.7 (103.8 - 110) 10	90 ± 2.6 (83 - 96) 4	73 ± 2 (69 - 75) 3	69	106	109.2 ± 2.5 (99.1 - 120.4) 9	85.7 ± 0.7 (85 - 86.4) 2	
<i>leg IV</i>	115.8 ± 0.9 (112.5 - 120) 10	95 ± 2.5 (88 - 100) 4	74.6 ± 2.4 (70 - 78) 3	70	105.2	121 ± 2.3 (107.1 - 131.4) 9	93.8 ± 2.5 (91.25 - 96.4) 2	
<i>tarsus I length</i>	15.4 ± 0.3 (14.8 - 19.5) 12	14.9 ± 0 (14.9 - 15) 4	14.1 ± 0.1 (14 - 14.3) 3	14.3	13.9	20.9 ± 0.1 (20 - 21.7) 9	19.1 ± 0.2 (18.9 - 19.3) 2	
<i>tibia I length</i>	20.2 ± 0.4 (16.1 - 21) 12	17.4 ± 0.6 (16 - 19) 4	13.7 ± 0.4 (13.2 - 14.6) 3	13.2	17	23.6 ± 0.3 (21.8 - 25.2) 9	17.8 ± 0.5 (17.3 - 18.3) 2	
<i>ol</i>	6.4 ± 0.1 (5.8 - 7.1) 12	5.2 ± 0.1 (4.9 - 5.7) 4	3.9 ± 0.2 (3.4 - 4.3) 3	3.4	5.3	12.4 ± 0.2 (11.3 - 13.9) 9	8.2 ± 1.5 (6.7 - 9.8) 2	
<i>fi'</i>	14.1 ± 0.5 (12 - 18) 11	10.2 ± 0.5 (8.9 - 11.7) 4	8.3 ± 0.6 (8.3 - 8.5) 3	8.5	11.6	23 ± 0.8 (19.6 - 26.4) 9	17.4 ± 2.6 (14.8 - 20.1) 2	
<i>fi'ζ</i>	42.3 ± 0.8 (38 - 46.2) 10	30.1 ± 1.4 (26.4 - 33.5) 4	18.4 ± 3.7 (11 - 22.4) 3	11	36.5	43.9 ± 0.8 (40.1 - 47.6) 9	31.5 ± 1.8 (29.7 - 33.4) 2	
<i>tc'ζ</i>	64 ± 0.5 (62 - 67) 10	48.8 ± 1.6 (45.9 - 53.4) 4	35.3 ± 3.1 (29.1 - 38.7) 3	29.1	-	63.8 ± 0.5 (61 - 66.3) 9	46.4 ± 1.8 (44.6 - 48.2) 2	
<i>tc'ζ</i>	63.3 ± 0.5 (60 - 66) 12	47.2 ± 1.6 (44.2 - 51.8) 4	33.6 ± 2.7 (28.5 - 38.1) 3	28.5	65.1	63.2 ± 0.5 (60.5 - 64.9) 7	46.2 ± 1.4 (44.8 - 47.6) 2	
<i>p'ζ</i>	41.3 ± 0.4 (38 - 43) 12	30.6 ± 1.4 (27.3 - 34.5) 4	23.4 ± 0.5 (22.3 - 24.2) 3	22.3	39.5	41.4 ± 0.5 (38.8 - 43.6) 9	28.5 ± 0.9 (27.6 - 29.5) 2	
<i>p'ζ</i>	41.4 ± 0.5 (37 - 44) 11	30.8 ± 1 (28.4 - 33.5) 4	22.8 ± 0.9 (21.5 - 24.7) 3	21.5	39.9	41.9 ± 0.4 (39.5 - 43.8) 8	27.5 ± 0 (27.5 - 27.6) 2	
<i>u'</i>	2.8 ± 0.1 (2 - 4) 12	2.8 ± 0.1 (2.4 - 3.1) 4	2.4 ± 0.3 (2 - 3.2) 3	3.2	3.5	3.2 ± 0.4 (1.7 - 5.8) 9	3.4 ± 0.2 (3.2 - 3.7) 2	
<i>u''</i>	2.9 ± 0.2 (2 - 4.2) 12	2.5 ± 0.2 (2 - 3.1) 4	2.5 ± 0.5 (2 - 3.6) 3	3.6	-	3.3 ± 0.3 (2 - 5.4) 9	2.9 ± 0.1 (2.8 - 3.1) 2	
<i>ϕI</i>	3.7 ± 0.1 (3 - 4.5) 12	2.8 ± 0.1 (2.5 - 3.3) 4	2.4 ± 0.2 (1.9 - 2.7) 3	1.9	2.7	4.8 ± 0.1 (4.3 - 5.5) 9	3.6 ± 0.1 (3.5 - 3.7) 2	
<i>κ''</i>	2.8 ± 0 (2.1 - 3.1) 12	2.3 ± 0.1 (1.9 - 2.6) 4	2.3 ± 0 (2.3 - 2.4) 3	2.4	3.2	1.8 ± 0.1 (1.5 - 2.8) 9	2.4 ± 0.4 (2 - 2.8) 2	
<i>oll</i>	2.7 ± 0.1 (2 - 3) 12	2.5 ± 0.1 (2.2 - 3) 4	1.8 ± 0 (1.8 - 1.9) 3	1.9	-	4.4 ± 0.3 (3.5 - 6.3) 8	3.6	

* Number of specimens. ** Mean ± standard error (min-max) n.

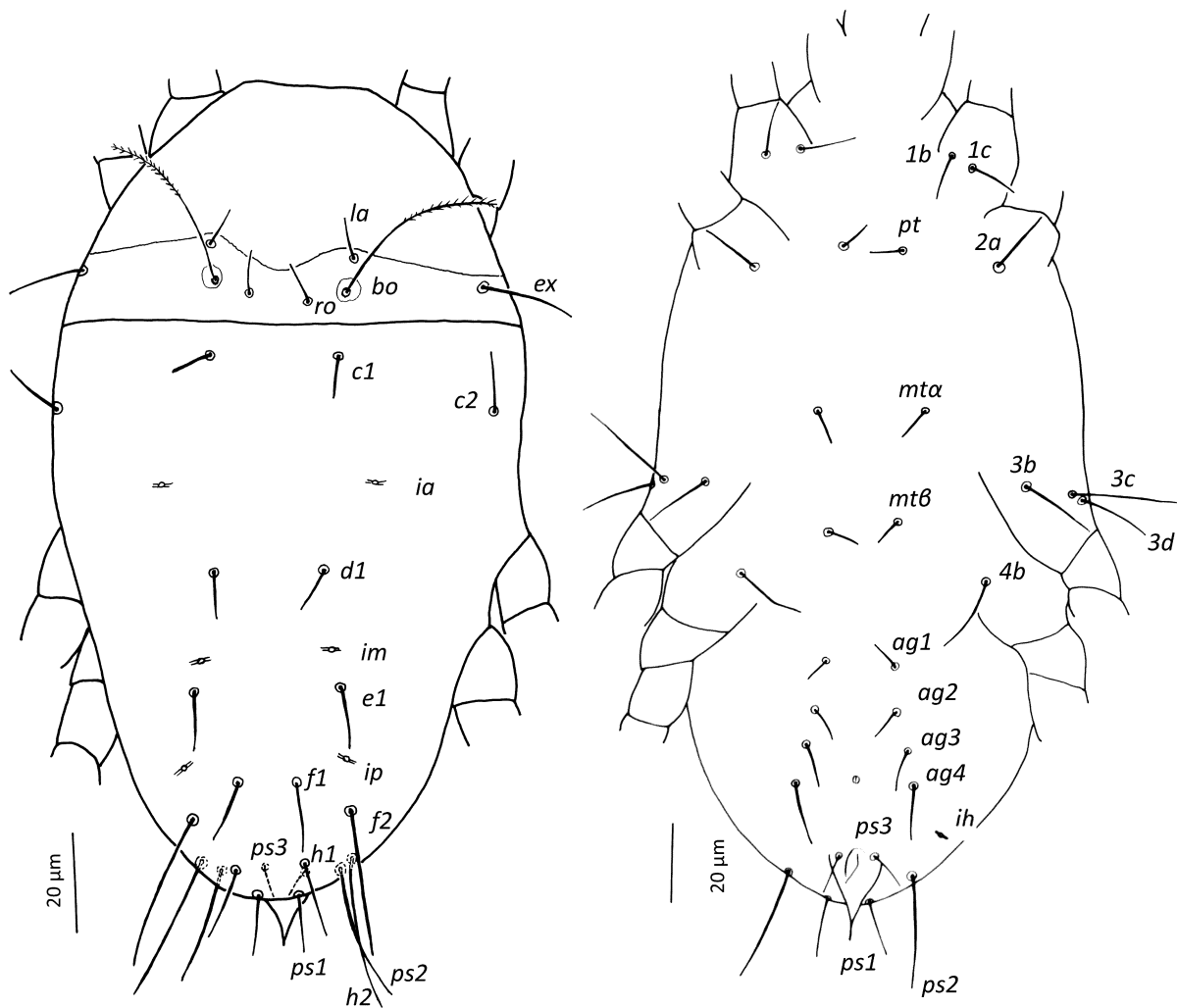


Figure 9 *Pseudopronematus duffelensis* De Vis & Ueckermann n. sp. deutonymph dorsum with dehiscence line on aspidosoma (left) and tritonymph venter (right)

namely *Protogamasellus* sp. (Ascidae), *Blattisocius* sp. (Blattisociidae), Bdellidae, Laelapidae [including *Stratiolaelaps miles* (Berlese, 1892)], Oribatida, Phytoseiidae, Stigmaeidae and Tarsonemidae, as well as the insect *Myzus persicae* (Sulzer) (Hemiptera: Aphididae) (from the crop above) and *Forficula auricularia* L. (Dermaptera: Forficulidae). Specimens maintained in leaf litter in almost totally closed plastic bags survived for at least one month, supposedly feeding on fungi.

Type repository

Holotype (CBGP-ACARI 2497), seven paratype females (CBGP-ACARI 2498–2504), one paratype tritonymph (CBGP-ACARI 2505), one paratype deutonymph (CBGP-ACARI 2506) and one paratype protonymph (CBGP-ACARI 2507) deposited at CBGP, INRAE, Montpellier, France. Other specimens will be deposited at the collection at PSKW (address of the first author). The paratypes collected in Duffel, Belgium and their progeny obtained by Lore Vervaeet in the laboratory served as voucher specimens of the COI sequences.

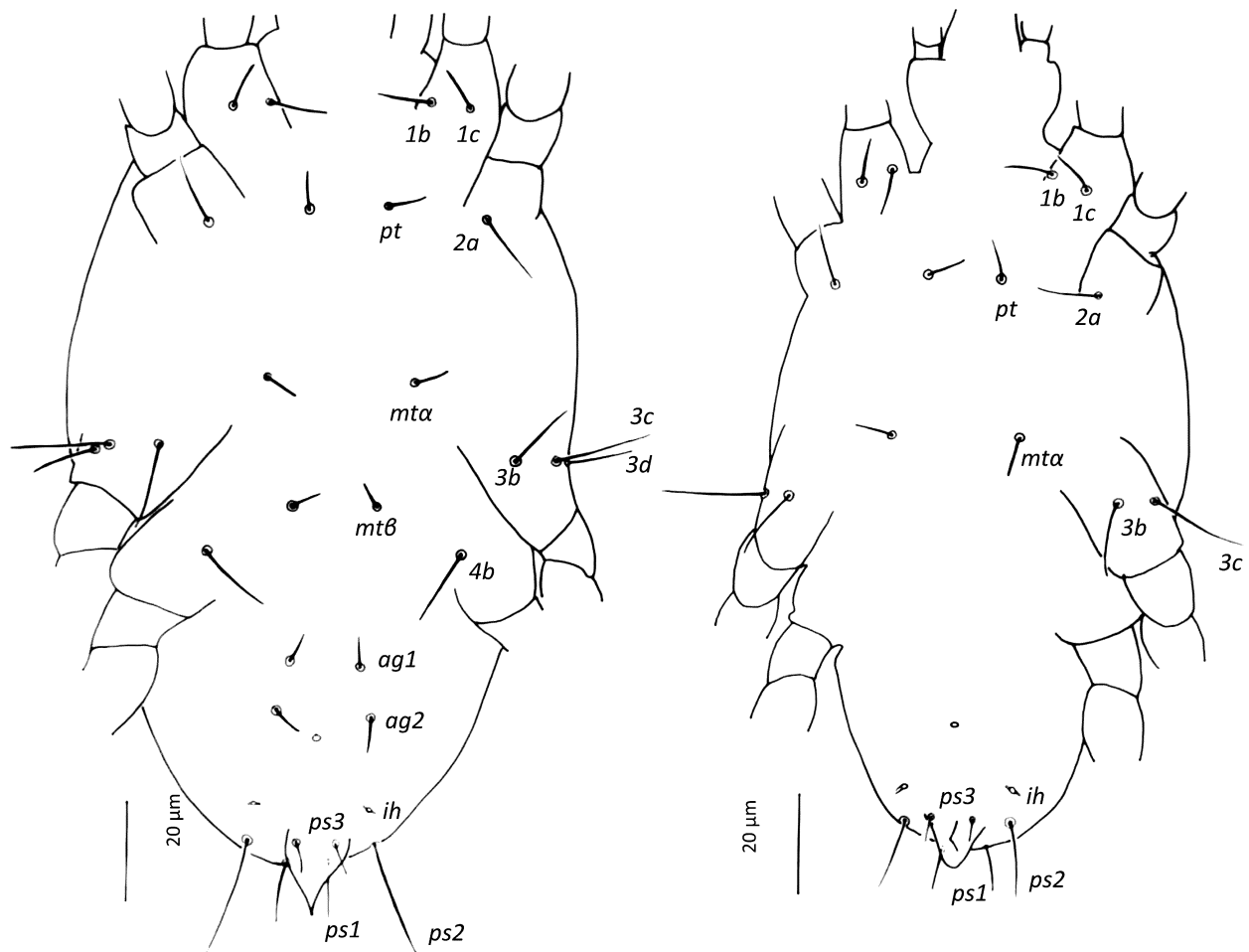


Figure 10 *Pseudopronematus duffelensis* De Vis & Ueckermann n. sp. deutonymph venter (left) and protonymph venter (right).

Deposit GenBank

Genbank accession number PQ327667.

Etymology

The species is named after Duffel, Belgium, the municipality where it was found for the first time and part of the paratypes were collected.

***Pseudopronematus tocantinsensis* De Vis, Castilho & Ueckermann n. sp.**

Zoobank: [1255D79C-4234-4D61-8446-658F1738B4BD](https://zoobank.org/1255D79C-4234-4D61-8446-658F1738B4BD)

(Figures 5 & 11–13)

Measurements — Measurements of different structures are shown in Table 1.

Adult females

Holotype + paratypes 1–2

Idiosoma — (Figure 11). Ovaloid, tapering posteriorly; procurved. Eye spots absent. Completely striated; striae in general continuous, fine and not lobed. Most setae apparently smooth.

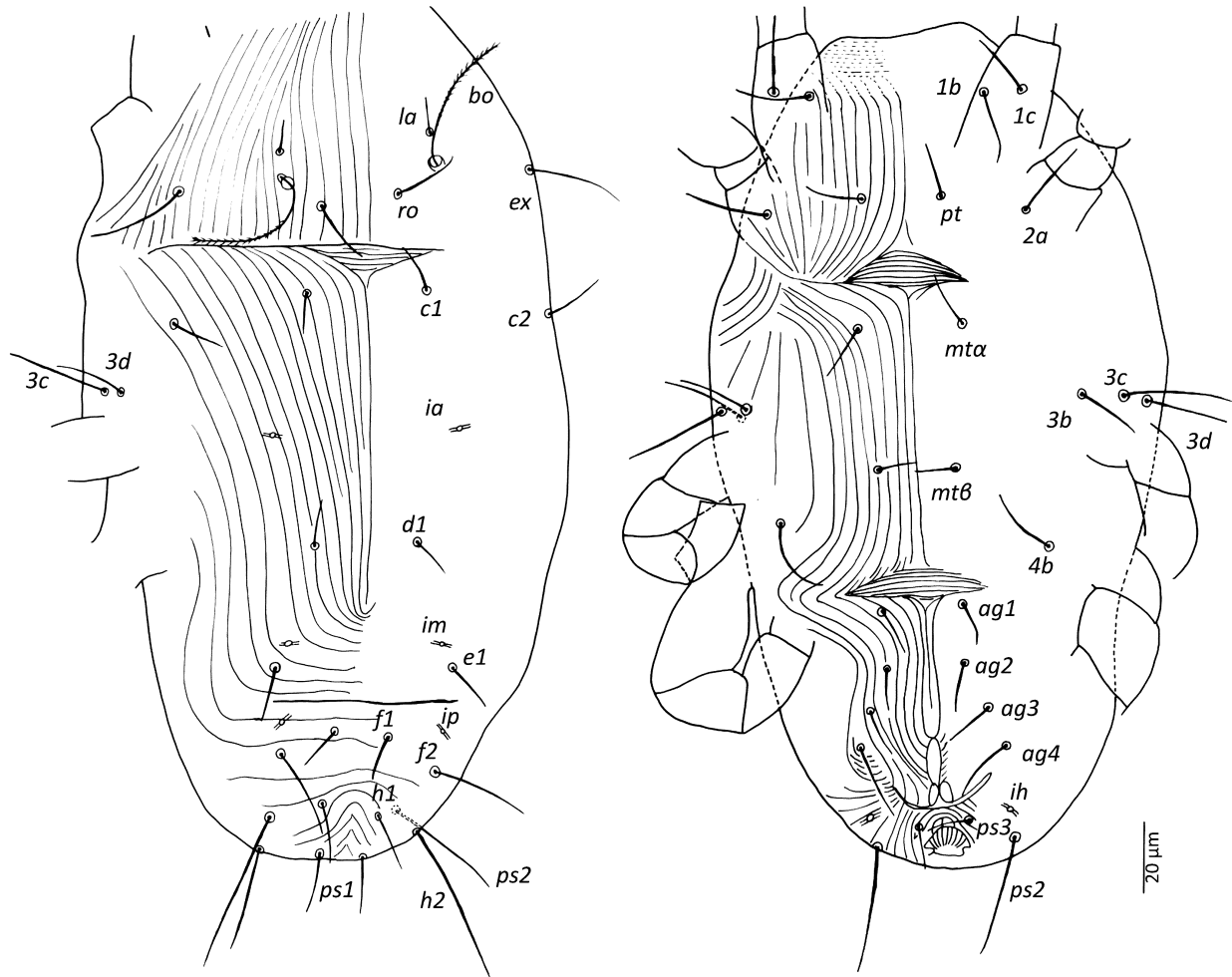


Figure 11 *Pseudopronematus tocantinsensis* De Vis, Castilho & Ueckermann n. sp. Dorsum of holotype (left) and venter (right) of paratype female.

Dorsum – (Figure 11). Aspidosoma with subparallel striae, converging anteriorly; dorsal part of opisthosoma with striae converging slightly posteriorly *d1*, becoming transverse posteriorly to level *e1* and then divergent toward posterior margin. Idiosomal setae aciculate, smooth; *la* somewhat thinner than other of subequal thickness (Figure 5j, m); trichobothrial setae *bo* on prodorsum barbed, with barbs distinctly longer in distal half (Figure 5g). Trichobothrial setae *bo* the longest, followed by *ex*, *ro* and *la*, all of similar thickness. Most dorsal setae short to medium sized, except *bo*, *f2*, *h2* and *ps2* clearly longer. Setae *c1*, *d1*, *e1* and *f1* not reaching base of *d1*, *e1*, *f1* and *h1*, respectively. Lyrifissure *ia* situated equidistantly to setae *c1* and *d1* and slightly apart from imaginary line *c1*–*d1*. Lyrifissures *im* anterior to and closely associated with setae *e1*, on imaginary line *d1*–*e1*. Lyrifissures *ip* situated equidistantly to *e1* and *f2*, far apart from imaginary line *e1*–*f2*. Setae *ps2* dorsolaterally but due to mounting one appears ventrally.

Venter – (Figure 11). Transition area between venter and gnathosoma with transverse striation, elsewhere longitudinal; constricted between legs I–III and posterior to leg IV, transverse for short median sections anterior to setae *mta* and anterior to setae *ag1*, constituting two spindle-shaped patterns, both wider than the distance between setae *mta* and setae *ag1*, respectively; striae convergent to genital opening. Setae *ps3*, anterior to anal opening in area of striae that circumventing anal opening. With four pairs of *ag* setae distributed in two eccentric

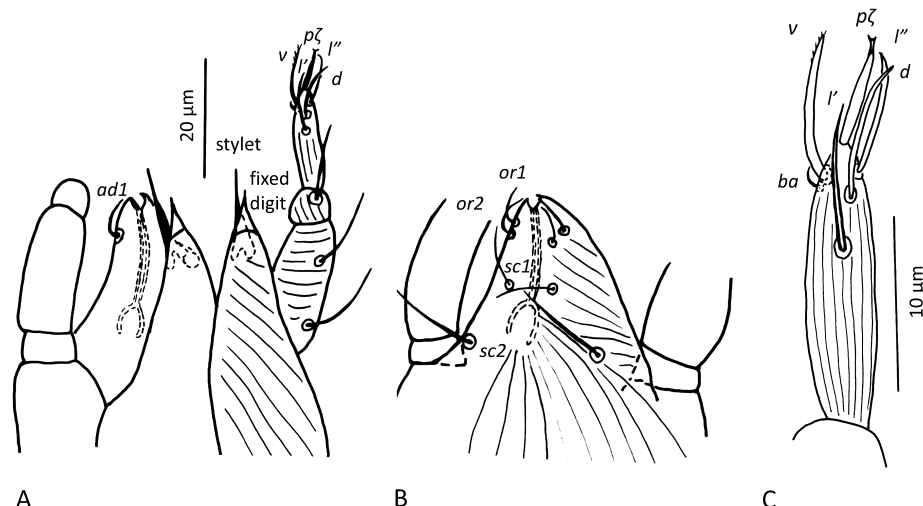


Figure 12 *Pseudopronematus tocantinsensis* De Vis, Castilho & Ueckermann **n. sp.** A – dorsal view of gnathosoma, B – ventral view of gnathosoma, C – palptarsus.

lines; length of these setae increasing from *ag1* to *ag4*, the former about half as long as the latter. Genital opening in form of inverted “T”. With one pair of genital papillae. Lyrifissure *ih* laterad genital opening. Dome-shaped caudal excrescence dorsal of anal opening, lateral bases apparently not connected.

Gnathosoma — (Figure 12). Dorsal view: chelicera with parallel diagonal striation; dorsal fixed digit with sclerotised tip and ventral stylet. Ventral view: subcapitulum with longitudinal striation, two pairs of subcapitular setae, *sc1* 12 and *sc2* 14.5, and two pairs of adoral setae, *or1* 5.6 (dorsolateral) and *or2* 5.8 (ventrolateral). Palpal tarsus terminating with distally bifurcate eupathidium. Palpal chaetotaxy (5-1-2). Solenidion ω and seta *ba* not visible; dorsal setae apparently smooth, ventral seta *v* stouter and smooth; femorogenu 24 long and 10 wide.

Legs — (Figure 13). Ventral setae *v'* of each tibia I to IV stouter, apparently serrate and longer than their respective dorsals. Setae *ft'* and *ft''* of tarsus III and IV inserted near each other. **Leg I** with ω surpassing tip of the segment, five long eupathidia (abaxial fastigial and a pair of tectals and prorals) of which subequal prorals are shortest and subequal tectals are longest, all apparently smooth for all their length (Figure 5c), including *ft'*; with two bifurcated unguinals (bifurcation mostly not visible) adjacent and proximal to prorals; seta homologous to *s* vestigial between and slightly distal to the prorals; seta *v'* on tibia 36, famulus bifurcated at tip, shorter than solenidion ϕ ; seta *d* on femur 29.5. **Leg II** with solenidion ω slender 4.2; tibial setae *v'* 32.5 and *d* 17; femoral setae *d* 21.8 and *v''* 22.5, both smooth. **Leg III** with tibial seta *v'* 31.5 and *d* 22.9; seta *3c* of coxae longer than *3b* and *3d*. **Leg IV** with tibial seta *v'* 32.8 and *d* 24.7; with femur divided; femoral setae *ev''* 27.7 on basifemur and *d* 27.9 on telofemur, the latter apparently smooth but distally serrate in some specimens and distally forked, with one member of fork thinner 5-5.7 and the other stouter 12.5-13.4. Bifurcation not always visible because members of the fork stick together.

Differential diagnosis

This new species is distinguished from all other species of the genus by the short seta *f2*. It is most similar to *P. duffelensis* De Vis & Ueckermann **n. sp.**, but females of the latter have seta *f2* and *h2* longer, tarsus I and tibia I shorter, tarsus I with solenidion ωI shorter and four distal eupathidia with proximal half serrate. The new species is also similar to *P. augrabiensis*, but females of the latter have dorsum of idiosoma with longer setae *ro*, *ex* and *f2*.

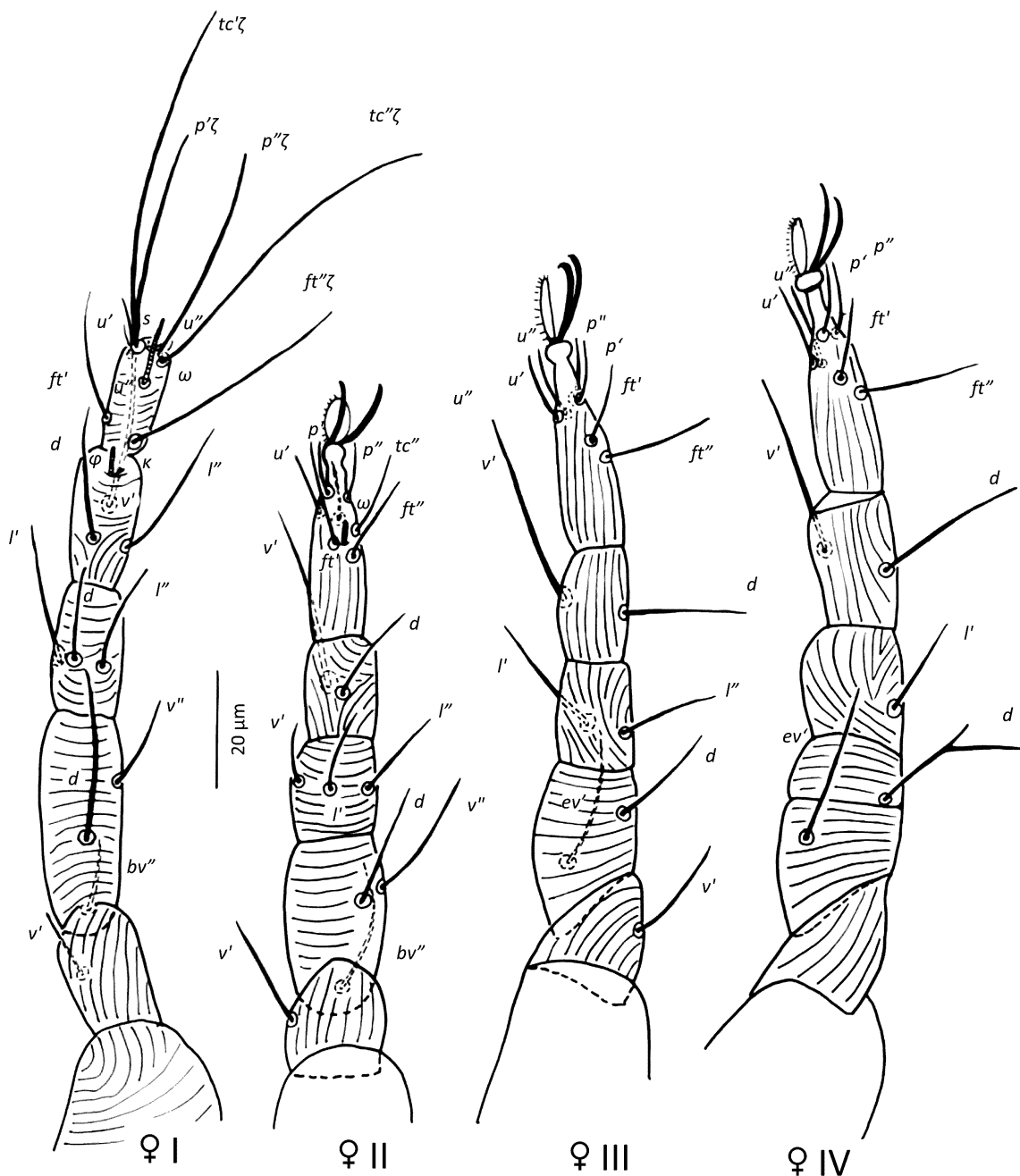


Figure 13 *Pseudopronematus tocantinsensis* De Vis, Castilho & Ueckermann n. sp. legs of paratype female.

Type locality and habitat

Collected from decomposing litter/soil samples coming from a field under no-tillage farming at Gurupi (11°49'51.7"S. 48°54'15.6"W), Tocantins state (Cerrado biome), Brazil by Alice de Freitas Braga. At the moment of the collection in August 2021, the soil was covered by a green panic grass crop [*Megathyrsus maximus* (Jacq.) B.K. Simon & S.W.L. Jacobs (Poaceae)], cultivated as a green manure, following a corn crop that was harvested in May. It was associated with many other arthropods including gamasine predatory mites and free-living nematodes. One specimen was recovered in 2001 from Rubber tree cv. RRIM 600 in Pontes e Lacerda,

Mato Grosso, Brazil, by Noeli Juarez Ferla.

Type repository

All types deposited at Mite Reference Collection of Departamento de Entomologia e Acarologia, Escola Superior de Agricultura “Luiz de Queiroz” (ESALQ), Universidade de São Paulo (USP), Piracicaba, São Paulo state, Brazil, USPB (Zhang 2018).

Etymology

The species name refers to Tocantins, the Brazilian state where the type series was found.

Pseudopronematus tenuisetosus (Meyer & Rodrigues 1966)

(Figures 5d & 14–16)

Pronematus tenuisetosus Meyer and Rodrigues, 1966: 20.

Remarks — Kaźmierski (1998) considered the generic status of this species unclear, whereas André (2021) considered it as a *species inquirendae*, based on Kaźmierski (1998). The holotype female of this species was recently found in the mite collection of ARC-Plant Health Protection, Pretoria, South Africa. It was examined and concluded to belong to *Pseudopronematus* (Ueckermann & De Vis *et al.* 2024). The original description, based on the holotype, was incomplete. It is redescribed here.

Measurements — Measurements of different structures in Table 1.

Adult female

Holotype (Figures 14–16)

Idiosoma — (Figure 14). Body ovaloid, tapering slightly caudally. Eye spots absent. Procurved. Body completely striated, striae fine, without tubercles. All setae minutely serrate.

Dorsum — (Figure 14). Striation on aspidosoma longitudinal; on dorsal part of opisthosoma, longitudinal between *c1* and area between *d1* and *e1*, where it becomes transverse. Not clearly discernible between *e1* and *fl*; apparently dome-shaped posteriad *fl*. Idiosomal setae aciculate, the surface of most of them finally barbed; trichobothrial setae (*bo*) on aspidosoma distinctly longer than *ex*, which in turn is slightly longer than *la*, which is slightly longer than *ro*; setae of similar thickness but *la* somewhat thinner; trichobothria *bo* totally serrate (Figure 5d). Most dorsal setae short to medium sized, except *bo*, *fl*, *f2* and *h2*, relatively long. Setae *c1*, *d1* and *e1* not reaching bases of *d1*, *e1* and *fl*, respectively. Lyrifissures not distinguishable.

Venter — (Figure 14). Striation at base of gnathosoma not visible in holotype. Overall striation longitudinal, between legs I–II constricted, and between legs III–IV transverse for short section, constituting spindle-shaped pattern, wider than distance between *ag1* setae; convergent to genital opening. A spindle may be present between *pt* and *mta* but apparently lies in a fold/suture running transversely between these setae.

With four pairs of *ag* setae distributed in two eccentric lines; length of these setae increasing from *ag1* to *ag4*, the latter about 2.5 times as long as the former. Genital opening in form of inverted “T”, genital papillae indistinct. Lyrifissures *ih* not visible. Setae *ps3* anterolaterad anal opening; dome-shaped caudal excrescence dorsal of anal opening distinct, lateral bases connected.

Gnathosoma — (Figure 15). Dorsal view (chelicera): chelicerae partly covered by aspidosoma, fixed digit not visible, stylet 12.4. Palpal tarsus 14.4. Striae longitudinal. Ventral view (subcapitulum) with longitudinal striation and two subcapitular setae, *sc1* 7.7 and *sc2* 8.2, and adoral setae *or2* (*or1* undistinguishable).

Palps terminate with eupathidium *pζ* 8.4, apparently bifurcated distally. Only five setae clearly visible on palptarsus; dorsal setae apparently smooth, ventral seta (*v*) stouter and smooth; femorogenu length 20.1, width 7.6. Palpal chaetotaxy (5-1-2); solenidion and *ba* not visible.

Legs — (Figure 16). Dimensions shown in Table 1. Ventral setae of tibiae serrate and stouter than other setae on the legs. Dorsal setae of tarsus III and IV inserted near each other.

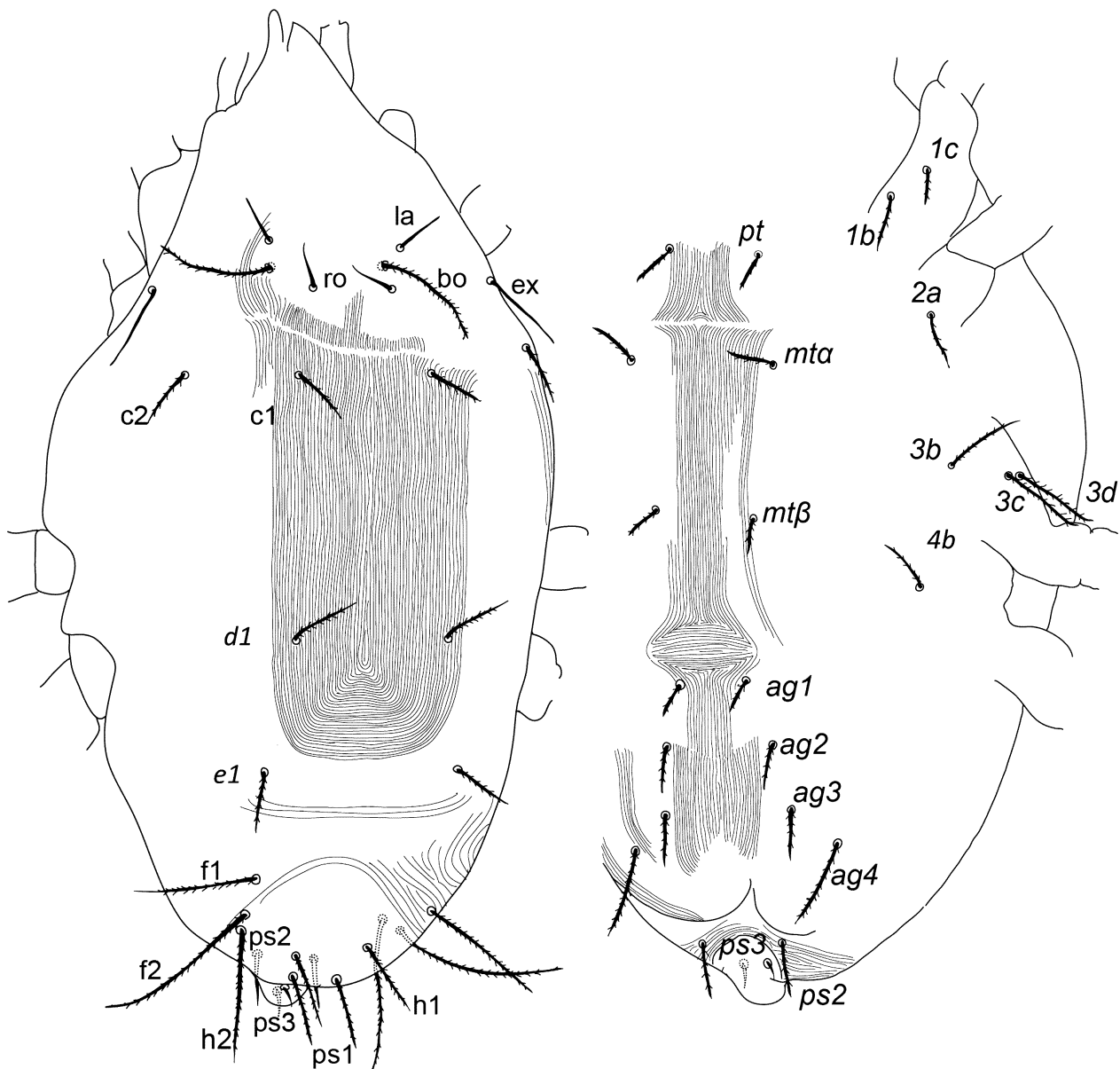


Figure 14 *Pseudopronematus tenuisetosus* (Meyer & Rodrigues, 1966) n. comb. Dorsum (left) and venter (right) of holotype female.

Leg I with ω surpassing slightly tip of the segment; with five long eupathidia (abaxial fastigial and both tectals and prorals) of which subequal prorals are shortest and subequal tectals are longest; prorals and tectals slightly serrate throughout; both fastigials could be slightly serrate, but seem smooth; u' is clearly visible on tarsus I but not clear if it is forked, unguinal setae proximal to prorals on ventral side; unpaired, small seta homologous to s not visible; famulus κ with undistinguishable bifurcation, subequal in length to solenidion ϕ ; seta d femur 29.2. **Leg II** with solenidion ω minute, tibial seta v' 22.8 and femoral seta v'' 32.5. **Leg III** with tibial seta v' 25.8 serrate and d 30.7; seta $3c$ of coxa longer than $3b$ and $3d$. **Leg IV** with tibial seta v' 24.8, stout and not clearly serrate, and d 32.3, thinner; femur divided; femoral setae v' on basifemur 27 and d 26.7 on telofemur, the latter serrate, distally forked, with one member of the fork very short, 1.7, and the other member 4.3 and serrate. Seta on telofemur of other leg not forked.

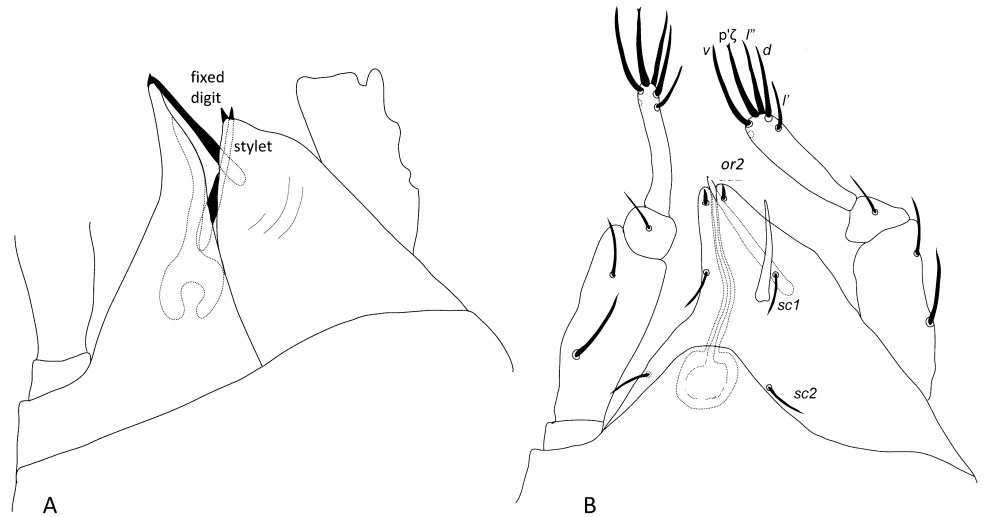


Figure 15 *Pseudopronematus tenuisetosus* (Meyer & Rodrigues, 1966) **n. comb.** Holotype female. A – chelicerae, B – ventral view of gnathosoma with palps.

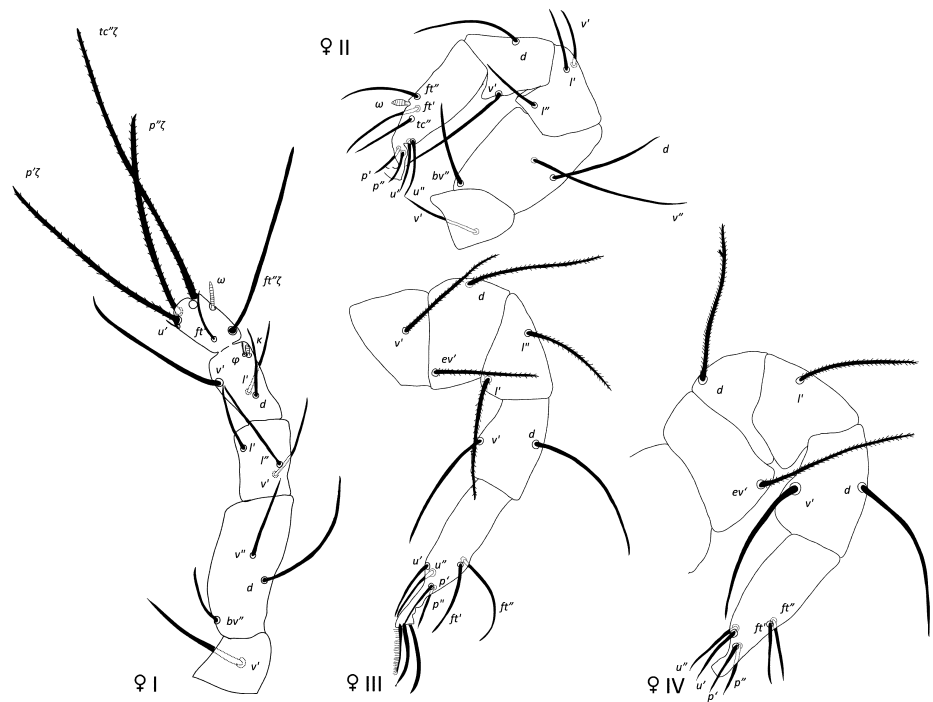


Figure 16 *Pseudopronematus tenuisetosus* (Meyer & Rodrigues, 1966) **n. comb.** Legs of holotype female.

Differential diagnosis

This species resembles *P. duffelensis* **n. sp.** by the long caudal setae but differs in that the four distal eupathidia on tarsus I are slightly serrate as opposed to proximal half being barbed in *P. duffelensis* **n. sp.** Setae *f1* and *f2* are clearly longer and *h2* clearly shorter in *P. tenuisetosus*.

Type locality and habitat

Collected from *Gossypium* sp., R. Quetxoio, Mozambique, 16 April 1964 by M.C. Rodrigues.

Type repository

Holotype female. Mite Collection, ARC-Plant Health Protection, Pretoria South Africa, NCA (Zhang, 2018).

Key to the *Pseudopronematus* species

As we transferred *Pseudopronematus nadirae* Silva, Da-Costa & Ferla to a new genus (see below), we recognise five *Pseudopronematus* species. For *P. acus* and *P. augrabiensis* dimensions of some structures are not known together with *P. tenuisetosus*. The range of the structure dimensions of these species is not known. The selected structures used for the key also can be found in Table 2, showing differences and similarities in their dimensions or state.

1. Setae $fl \approx 39$ and $f2 \approx 52$ *P. tenuisetosus*
— Setae $fl < 20$ and $f2 < 40$ 2
2. Setae $ro \approx 25$ and $ex \approx 38$ *P. augrabiensis*
— Setae $ro < 20$ and $ex < 33$ 3
3. Setae $ex \approx 21$ and $h2 \approx 36$ *P. acus*
— Setae $ex > 25$ and $h2 > 41$ 4
4. Tarsus I with ω 5-7; total length of eupathidia $p\zeta$ and $tc\zeta$ and proximal third of eupathidium $ft''\zeta$ barbed. *P. duffelensis* n. sp.
— Tarsus I with ω 11-14; eupathidia of tarsus I apparently smooth. *P. tocantinsensis* n. sp.

Description of *Dasilcoferla* De Vis & Ueckermann n. gen. and redescription of a species transferred to this genus

Dasilcoferla De Vis & Ueckermann n. gen.

Zoobank: 3AC41C22-6DF1-4C43-AB76-1F070F3A129A

Type species — *Pseudopronematus nadirae* Silva, Da-Costa & Ferla, 2017.

Diagnosis — Adult female with one seta on each of trochanters I and II, six setae on tarsus II and five on each of tarsi III and IV. Tarsus I with both tectals as well as both prorals not subequal in length. Seta homologous to *s* absent. Femur IV not divided. Leg chaetotaxy: leg I – 8 + ω – 3 + φ + κ – 3 – 3 – 1; leg II – 6 + ω – 2 – 3 – 3 – 1; leg III – 5 – 2 – 2 – 2 – 1;

Table 2 Selected structures to distinguish between the five known *Pseudopronematus* species.

Structure	<i>acus</i>	<i>augrabiensis</i>	<i>duffelensis</i>	<i>tenuisetosus</i>	<i>tocantinsensis</i>
<i>bo</i>	49	47	46 – 50.3	36.9	39.3-45.6
<i>ro</i>	15	25	16.5-20	17.8	16.5-18.6
<i>ex</i>	21	38	29-33	21.4	25.5-30.8
<i>fl</i>	15	19	14.7-17.1	39.2	13-15.9
<i>f2</i>	35	38	33-39.1	51.9	26.2-31.2
<i>h2</i>	36	50	50.6-56	39.4	41.5-46
<i>ol</i>		11	5.8-7.1	5.3	11.3-13.9
Tarsus I			14.8-19.5	13.9	20 - 21.7
Tibia I			16.1-21	17	21.8 - 25.2
Eupathidia tarsus I	slightly serrate whole length	smooth	proximal half/ third serrate	slightly serrate whole length	apparently smooth

leg IV – 5 – 2 – 1 – 2 – 0. Empodium and claws absent on leg I, each of other legs with ciliate empodium and two claws, without empodial hooks. Aspidosoma procurved with four pair of setae (*bo*, *ro*, *la* and *ex*) and opisthosoma 10 pairs of setae (*c1*, *c2*, *d1*, *e1*, *f1*, *f2*, *h1*, *h2*, *ps2* and *ps3*), *ps1* absent and four pairs of aggenital setae (*ag1*–*ag4*) in an atypical distribution with distance *ag2*–*ag2* wider than distance *ag4*–*ag4*. Poroidotaxy: *ia*, *im*, *ip*, *ih*.

Differential diagnosis — This genus resembles *Neopronematus* Panou, Emmanouel & Kaźmierski, 2000. It has the same leg chaetotaxy and tubercles on the striae but has 10 opisthosomal setae (setae *ps1* lacking) instead of 9 in *Neopronematus* (setae *h2* and *ps1* lacking, we interpret as *ps1* and *ps2* lacking) (Panou *et al.* 2000). Furthermore, the position of the *ag* setae is different and typical (Figure 17) and the *ag3* setae are not forked while in all *Neopronematus*, except for *N. aegeae*, *ag3* is forked (Panou *et al.* 2000; Darbemamieh *et al.* 2015; Ahmad-Hosseini *et al.* 2017).

Remarks — Silva *et al.* (2017) redefined *Pseudopronematus*, reducing the “required” leg setation, so as to fit *P. nadirae* in the genus. However we stick to the Pronematinae genus definition of André (1980) and amplified above the genus definition of Fan and Li (1992). *P. nadirae* does not match this definition because it has only six setae on tarsus II (instead of seven) and five setae on each of tarsi III and IV (instead of six). Besides the differences in the leg chaetotaxy, the lengths of the eupathidia of *P. nadirae* are different, both tectals as well as both prorals not being subequal in length (adaxials shorter than abaxials). Furthermore, the striae have small tubercles which are absent in *Pseudopronematus*. The lengths of the eupathidia were not measured in *P. acus* and *P. augrabiensis*, but in the drawings of both species, both pairs of tectals and both pairs of prorals are subequal, the former longer than the latter. So, we suppose that this is a characteristic of the genus *Pseudopronematus*. In *P. nadirae* the four distal eupathidia are all of different lengths. The chaetotaxy of *P. nadirae* does not fit any other genus, so according to André (1980) we create the new genus *Dasilcoferla* De Vis & Ueckermann **n. gen.** to accommodate *P. nadirae*. To assure us about certain structures of the species we studied four paratypes and two newly found specimens in the state of Pará, Brazil and redescribed it below.

Etymology — The genus name is, in honour of the authors of the type species, a combination of letters of the authors’ names (Da Silva, Da-Costa & Ferla).

***Dasilcoferla nadirae* (Silva, Da-Costa & Ferla) n. comb.**

(Figures 17–20)

Pseudopronematus nadirae Silva, Da-Costa & Ferla (Da Silva *et al.* 2017)

Redescription

Adult female

All measurements given after each structure [mean ± standard error (min–max) n, with n number of measurements].

Idiosoma — (Figures 17 and 20). Ovaloid, tapering posteriorly. Completely striated, with tubercles.

Dorsum – (Figures 17 & 20a, b). Aspidosoma with divergent striation towards *das* furrow with spindle-shaped striation patterns on *das* furrow posterior to setae *bo*; dorsal part of opisthosoma with median longitudinal striation and lateral convergent striation posteriorly, turning transverse between level of *d1* to *h1* and then divergent towards posterior margin.

All idiosomal setae aciculate and barbed (Figure 17 & 20), trichobothrial setae (*bo*) on aspidosoma longer than subequal *ex* and *ro*; *la* shorter; all with subequal thickness; *bo* finely barbed except for an apparent smooth proximal third part (Figure 20e). Dorsal setae intermediate (Figure 17, 20b & f), except *f2*, *h2* relatively long (Figure 17, 20b, g), while *ps3* relatively short (Figure 17 & 20c). Setae *c1*, *d1* and *e1* not reaching bases of *d1*, *e1* and *f1*, respectively. Length of structures: length *bo*–*h1* 141.7 ± 2 (133.9–147) 6, width 119.5 ± 6.3 (95.6–139.5) 6, *bo* 31.2 ± 0.7 (29.2–34.6) 6, *bo*–*bo* 37 ± 0.8 (35–40.4) 6, *ro* 16.1 ± 0.9

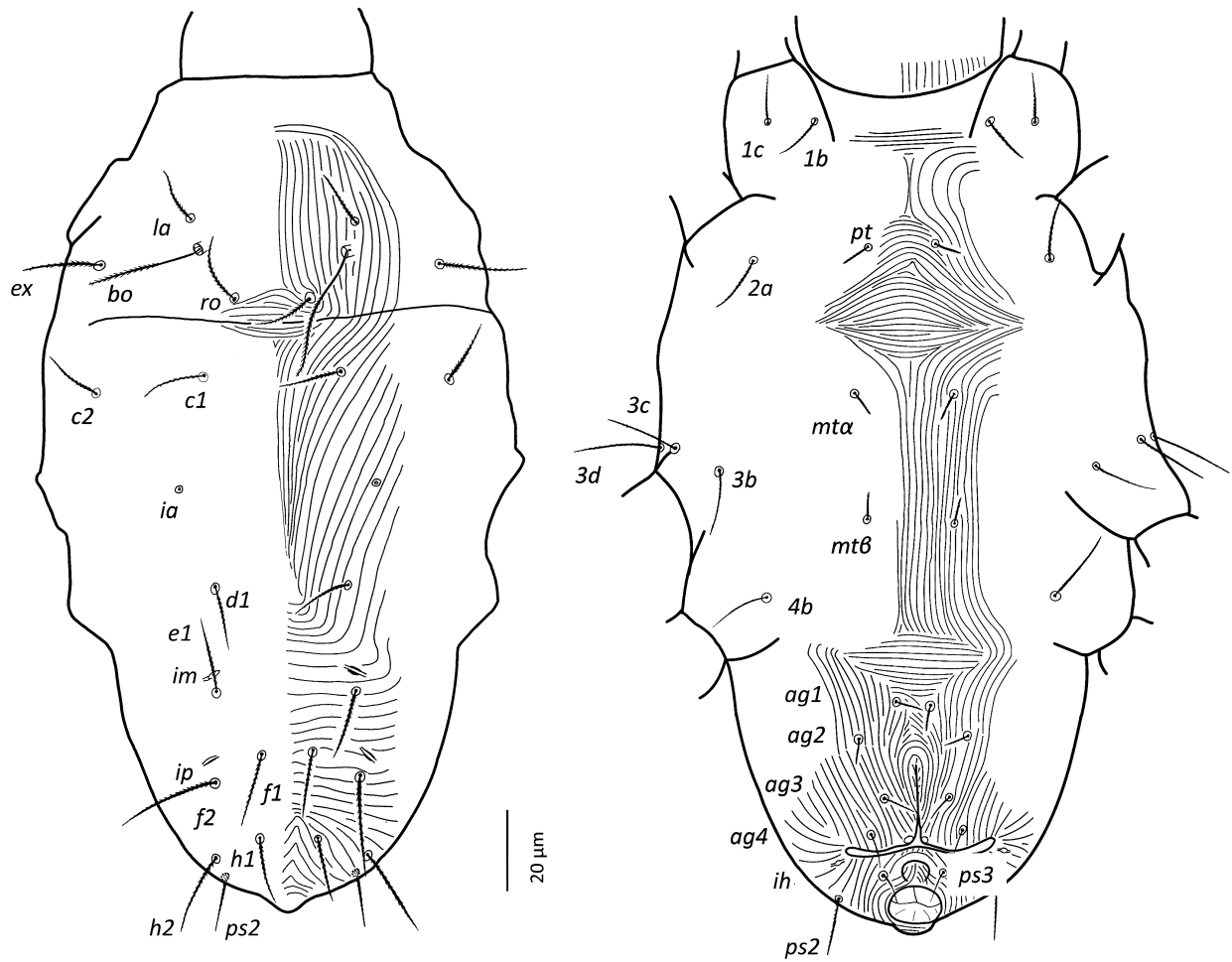


Figure 17 *Dasilcoferla nadirae* (Silva, Da-Costa & Ferla) n. comb. Dorsum (left) and venter (right) of female.

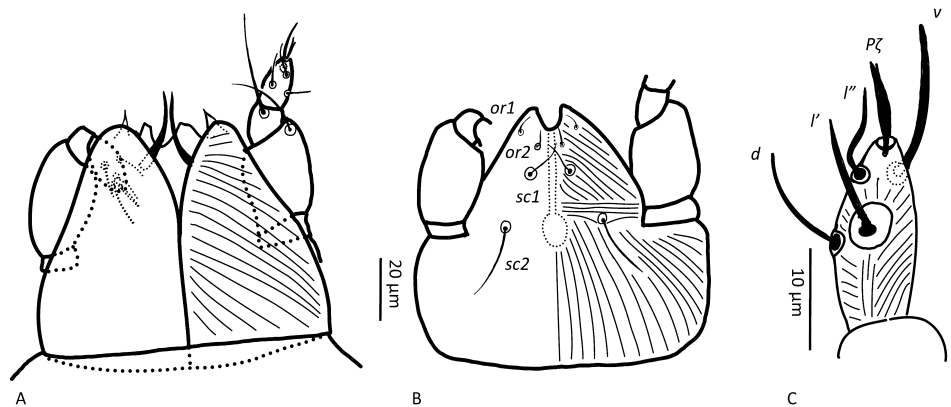


Figure 18 *Dasilcoferla nadirae* (Silva, Da-Costa & Ferla) n. comb. Female. A – dorsal view of gnathosoma, B – ventral view of gnathosoma, C – palptarsus.

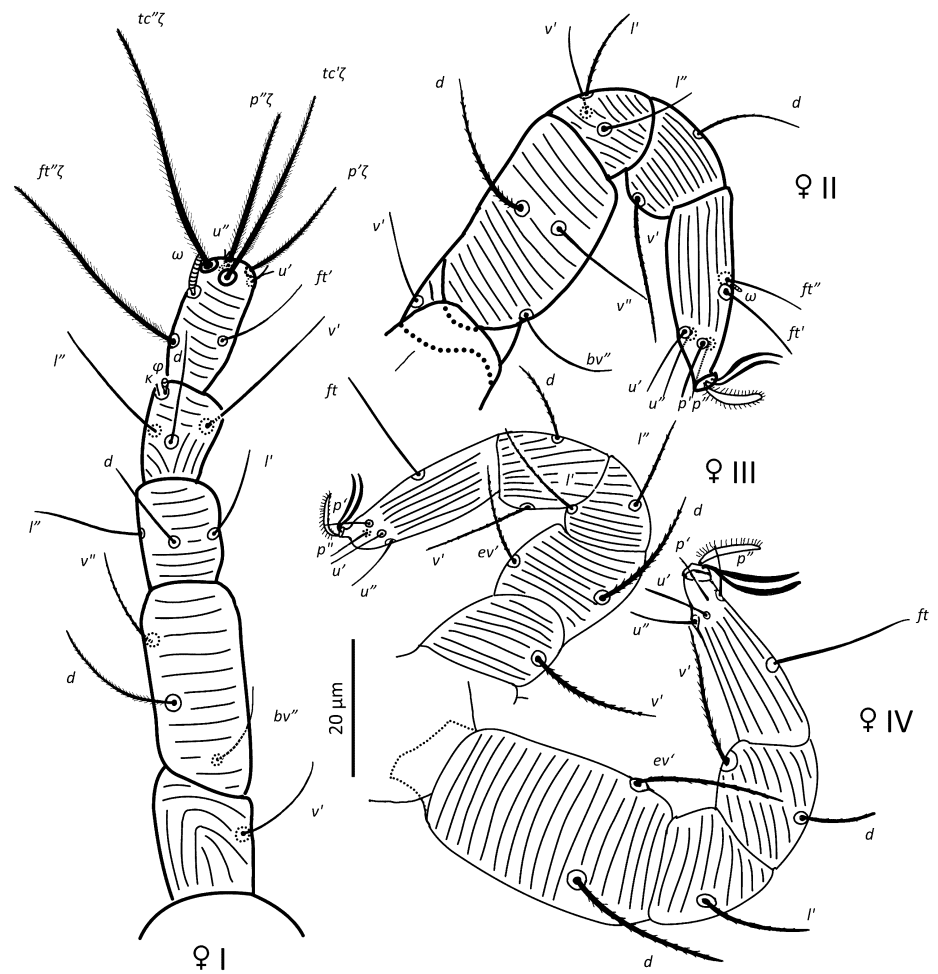


Figure 19 *Dasilcoferla nadirae* (Silva, Da-Costa & Ferla) **n. comb.** Legs of female.

(13.7–19.2) 6, *ro-ro* 20.4 ± 0.9 (17.2–22.7) 6, *la* 14.3 ± 0.6 (11.6–16) 6, *la-la* 40.2 ± 0.6 (37.4–42) 6, *ex* 19 ± 0.4 (17.3–20.1) 6, *cl* 15.2 ± 0.7 (12.1–17.5) 6, *c2* 14.4 ± 0.4 (12.8–15.9) 6, *cl-cl* 35.5 ± 1.8 (32.6–44.3) 6, *dl* 15.2 ± 0.6 (13.2–17.2) 6, *dl-dl* 34.6 ± 1 (31.8–37.9) 6, *el* 16.6 ± 0.4 (14.6–17.4) 6, *el-el* 34.7 ± 0.6 (33.5–36.5) 6, *fl* 16.8 ± 0.5 (15.2–18.7) 6, *fl-fl* 13.2 ± 0.3 (12.1–14.4) 6, *f2* 25.2 ± 0.4 (23.9–26.7) 6, *hl* 16.2 ± 0.6 (14.5–18.5) 6, *h2* 20.4 ± 0.1 (20.1–21.1) 6, *ps2* 11.7 ± 0.5 (10.4–13.2) 5.

Lyrifissure *ia* located between setae *cl* and *dl*, slightly mesad hypothetical line connecting the bases of these setae; lyrifissure *im* immediately anterior *el*; lyrifissure *ip* immediately anterior *f2*.

Venter – (Figure 17 & 20c). Transition area between venter and gnathosoma with transverse striation; striation longitudinal between legs I and II and convergent immediately posterior each of these legs; striation longitudinal between legs III and IV; transverse between setae *pt* and *mta* and anterior to setae *agl* (Figure 20c) constituting a pair of spindle-shaped patterns, broader than the distance between *mta* or *agl*; converging to level of genital opening (Figure 20c).

Setae *1b*, *1c*, *2a*, *3b*, *3c*, *3d* and *4b* courser and more clearly barbed than other ventral setae that are thinner and apparently barbed. With four *ag* setae, distance between *ag1* setae and between *ag3* setae, shorter than distance between *ag2* setae and *ag4* setae (see below for

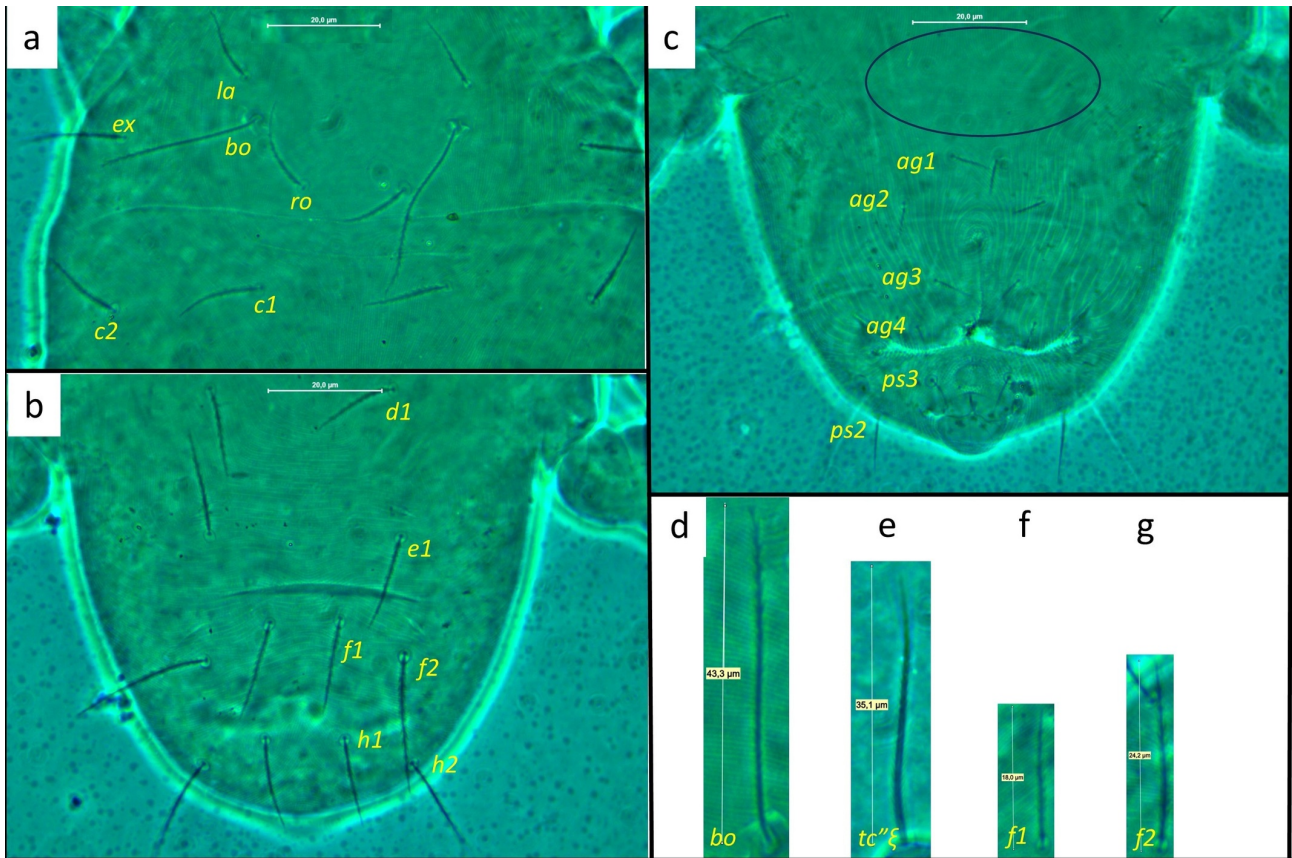


Figure 20 *Dasilcoferla nadirae* (Silva, Da-Costa & Ferla) **n. comb.** a – aspidosoma, b – posterior region of dorsum, c – area anterior to *ag1* with transversal spindle-shaped striae and genital area with four *ag* setae. d – *tc''ζ*, e – *bo*, f – *f1* and g – *f2*.

measurements and Figure 17 & 20c). One pair of genital papillae. Seta *ps3* anterolaterad anal opening, with small excrescence in between, on which longitudinal striation. Lyrifissure *ih* posterolaterad genital opening. Setal lengths and distances: *1b* 12 ± 0.3 (11–13.1) 6, *1c* 10.9 ± 0.2 (10.1–11.7) 6, *pt* 7 ± 0 (6.9–7.4) 5, *pt-pt* 14.8 ± 0.3 (13.9–15.4) 5, *2a* 14 ± 0.4 (12.7–15.8) 6, *mta* 6.9 ± 0.4 (5.7–8) 6, *mta-mta* 25.8 ± 1.7 (19.8–32.1) 6, *3b* 14.9 ± 0.3 (14.2–16) 6, *3c* 17.5 ± 0.5 (14.9–18.8) 6, *3d* 17.1 ± 0.8 (14.2–19.7) 6, *mtβ* 6.4 ± 0.3 (5.2–7.2) 6, *mtβ-mtβ* 20.9 ± 1.1 (17.9–25) 6, *4b* 15 ± 0.4 (12.8–16) 6, *ag1* 6.6 ± 0.2 (5.9–7.4) 6, *ag1-ag1* 8.4 ± 0.5 (6.4–10.4) 6, *ag2* 6.6 ± 0.3 (5.9–8.2) 6, *ag2-ag2* 29.1 ± 1.5 (24.7–33.8) 6, *ag3* 7 ± 0.1 (6.8–7.4) 6, *ag3-ag3* 16.7 ± 1.6 (13.1–22.9) 6, *ag4* 8.2 ± 0.3 (7.4–9.2) 6, *ag4-ag4* 23.9 ± 2.2 (19–31.9) 6, *ps3* 7.3 ± 0.3 (6–8.1) 6.

Gnathosoma — (Figure 18). Chelicerae with parallel diagonal striae converging anteromedially, with dorsal fixed digit and ventral stylets 16.7 ± 0.1 (16.2–17.5) 6. Stylet tips in oral cavity. Subcapitulum with striae in section anteriad *sc2* almost transverse and parallel to each other, converging anteromedially; in section posteriad *sc2*, almost longitudinal converging anteromedially; with two pairs of subcapitular setae, *sc1* 7.5, *sc2* 12 and two adoral setae *or1* 4.5 and *or2* 3.5. Palp: chaetotaxy (5-1-2); palptarsus length 8.4 ± 0.2 (7.6–9.2) 6 with longitudinal striae, terminating with a straight eupathidium *pζ* 3.7 ± 0.2 (3.3–4.9) 6, bifurcated distally, all setae smooth, ventral seta *v* stouter, seta *l'* 5 bent at base, sigmoid, close to eupathidium, *d* and *l''* 6, more erected, *d* is inserted at the same level as *l''*, near the middle of the segment. Solenidion and *ba* not visible, Femorogenu length 17.8, width 10.5.

Legs — (Figure 19). Legs shorter than in other genera. Leg lengths (from base of trochanter to base of claws): I 92.4 ± 1.5 (87–96) 6, II 85.2 ± 0.6 (82.3–87) 6, III 86.2 ± 2 (78–93.4) 6,

IV 89.9 ± 2.2 (85.4–97.1) 6. Setae v' and d on tibia II to IV, setae d on genu II to IV, seta d on femur I to IV, and v' on trochanter III stouter than other setae on legs. Some leg setae clearly barbed, others not clear if they are barbed or serrated (drawn as smooth in Figure 19; leg I: ft' , setae on tibia and genu, v'' on femur, seta v' on trochanter; leg II: tarsal setae, setae l'' and v' on genu, seta v'' and basiventral seta bv'' on femur, seta v' on trochanter; leg III and IV: tarsal setae). **Leg I** with solenidion ωI almost reaching tip of tarsus, eupathidia $ft''\zeta$, $tc'\zeta$, $tc''\zeta$, $p'\zeta$ and $p''\zeta$ barbed, barbs gradually shorter to the tip of the eupathidia with the tip 5–8 apparently not barbed in some specimens, and a pair of small forked unguinal setae proximolateral to prorals on ventral side; seta homologous to s absent (see Ueckermann & De Vis *et al.* 2024). Tibia with bifurcate famulus κ shorter than solenidion ϕ_I . Leg IV with tarsal seta ft 20; femur IV undivided; femoral setae d and ev'' both unforked. Length of structures: **Leg I:** tarsus I length 19.4 ± 0.3 (18.3–20.5) 6, tibia I length 15 ± 0.1 (14.6–15.5) 6, ωI 4.4 ± 0.5 (3–6.2) 6, $ft'\zeta$ 14.4 ± 0.3 (13.4–15.7) 6, $ft''\zeta$ 30.1 ± 0.6 (28.6–32.3) 5, $tc'\zeta$ 27.2 ± 0.5 (26–29.6) 6, $tc''\zeta$ 34.2 ± 0.3 (33–35.4) 6, $p'\zeta$ 17.2 ± 0.3 (15.9–18.3) 6, $p''\zeta$ 21.3 ± 0.2 (20.5–22.2) 6, u' 3.2 ± 0.1 (2.7–3.8) 6, u'' 3.5 ± 0.2 (2.8–4.9) 6, ϕ_I 1.9 ± 0.2 (1.3–2.7) 6, κ'' 1.4 ± 0.1 (1.1–2.2) 6. **Leg II:** ωII 2.5 ± 0.1 (2–3.1) 6, tibia II v' 19.9 ± 0.3 (19–21.6) 6, tibia II d 13.2 ± 0.2 (12.5–14.2) 6, femur II v'' 15.6 ± 0.3 (14.4–16.5) 6, femur II d 19.4 ± 0.7 (16.5–21.8) 6. **Leg III:** tibia III v' 20.1 ± 0.4 (18.5–21.7) 6, tibia III d 10.7 ± 0.2 (9.6–11.6) 6, femur III ev' 16.3 ± 0.5 (15–18.4) 6, femur III d 18.7 ± 0.6 (16.9–21.1) 6. **Leg IV:** tibia IV v' 20.1 ± 0.5 (18.3–22.1) 6, tibia IV d 10.6 ± 0.1 (10–11.2) 6, femur IV ev' 21 ± 0.2 (20.3–21.6) 6, femur IV d 22.8 ± 0.8 (20.9–26.1) 6

Tritonymph

Dorsal, ventral and leg chaetotaxy as in adult female. Dehiscence line anterior to aspidosomal setae, mesad arching towards setae ro . Bivalved genital pore mesad setae ($ag3$). Distance setae ($ag3$) subequal distance ($ag4$). Measurements: length $bo-h1$ 153.1, width 140.1, bo 31.3, $bo-bo$ 34.5, ro 12.6, $ro-ro$ 14.6, la 13.3, $la-la$ 39.5, ex 16.3, cl 11.2, $c2$ 12.1, $cl-cl$ 36.2, $d1$ 12.2, $d1-d1$ 27.9, $e1$ 14.4, $e1-e1$ 26.4, fl 14.9, $fl-fl$ 10.1, $f2$ 23, $h1$ 12.3, $h2$ 16.8, $ps2$ 9.3, $ps3$ 6.4, lb 9, lc 8.8, pt 6.2, $pt-pt$ 13.1, $2a$ 11.1, mta 5.5, $mta-mta$ 26.3, $3b$ 12.8, $3c$ 14.1, $3d$ 9.7, $mt\beta$ 5.7, $mt\beta-mt\beta$ 21.6, $4b$ 10.9, agl 5, $agl-agl$ 10.1, $ag2$ 5, $ag2-ag2$ 24.1, $ag3$ 4.4, $ag3-ag3$ 18.5, $ag4$ 4.5, $ag4-ag4$ 18.9, palptarsus 7.5, palp $p'\zeta$ 3.6, stylet 13.7, leg I 84.3, leg II 75.9, leg III 77.9, leg IV 91.7, tarsus I length 16.6, tibia I length 13.4, ωI 1.9, $ft'\zeta$ 12.2, $ft''\zeta$ 23, $tc'\zeta$ 23.1, $tc''\zeta$ 28.6, $p'\zeta$ 14.2, $p''\zeta$ 16.8, u' 3.5, u'' 4.2, ϕ_I 2.4, κ'' 2.8, ωII 1.8, tibia II v' 17.4, tibia II d 9.2, femur II v'' 12.5, femur II d 16.6, tibia III v' 17.2, tibia III d 9.1, femur III ev' 14.6, femur III d 14, tibia IV v' 14.6, tibia IV d 7.1, femur IV ev' 14.6, femur IV d 16.1.

Male and other immature stages

Not available.

Differential diagnoses

This is the only species in this genus. It can be distinguished from the closely related *Neopronematus* species primarily by the presence of ten opisthosomal setae instead of nine. Further characteristics of the species are the position of the ag setae with setae agl and setae $ag3$ close to each other, setae $ag4$ more apart and $ag2$ further apart while in *Neopronematus* the position of the ag setae is 'normal' with $ag2$ and $ag3$ close to the anterior part of the genital opening with $ag3$ closer to it than $ag2$; $ag3$ is not forked while in *Neopronematus* species (except *N. aegeae* Panou, Emmanouel & Kaźmierski, 2000) it is forked; the length of the eupathidia in decreasing order $tc''\zeta$, $tc'\zeta$, $p''\zeta$ and $p'\zeta$ with $p'\zeta$ the shortest while in many species like *P. ubiquitous* or *H. anconai* $p''\zeta$ is the shortest; the position of seta d on palptarsus is at the same level of l'' and these two setae are erected, while l' is sigmoid and close to the eupathidium; the barbed status of almost all setae.

Type locality and habitat

The paratypes collected by C. S. Ferraz from *Litchi chinensis* Sonn. (Sapindaceae) at Viçosa, Minas Gerais state, Brazil. Three more specimens recently collected by José Dantas Araujo Lacerda at Parauapebas, Para State, Brazil, on leaves of *Clusia rosea* Jacq, *Vitis labrusca* L. and *Andropogon gayanus* Kunth, the latter near an experimental dragon fruit crop [*Selenicereus* sp. (A. Berger) Britton & Rose] at the Federal Rural University of Amazonia, Campus Parauapebas.

Type repository

We studied seven specimens. **Four paratypes:** one female, 09-V-2015, one female, 12-VI-2015, one female, 25-VII-2015, one female, 21-V-2015, deposited at Museu de Ciências Naturais (ZAUMCN), UNIVATES–Centro Universitário, Lajeado, Rio Grande do Sul state, Brazil, ZAUMCN (Zhang 2018). The **Holotype** female 26-X-2015, deposited at Mite Reference Collection of Departamento de Entomologia e Acarologia, Escola Superior de Agricultura “Luiz de Queiroz” (ESALQ), Universidade de São Paulo (USP), Piracicaba, São Paulo state, Brazil, USPB (Zhang 2018) was not available for study due to inaccessibility of the mite collection because of construction works. **Three recently collected specimens** 08-VII-2023, 6°04'25.52"S, 49°48'57.34"W, 1 female; 16-VII-2023, 5°59'11.68"S, 49°52'34.73"W, 1 tritonymph; and 22-VII-2023, 6°04'20.59"S, 49°49'02.31"W, 1 female, deposited at USPB.

Remarks

This redescription differs from the original descriptions in the position and naming of the setae on tarsus and tibia I, the striation pattern of dorsum and venter, the absence of seta *ps1*, the presence of fixed digit on the chelicerae and the position of the setae on the palptarsus.

Molecular and morphological comparison

From the samples containing *Pseudopronematus duffelensis* **n. sp.**, one lab colony (1) was set up, two SFEL (1.1-2) could be established, and both were successful. The resulting COI sequences were combined with the phylogenetic analysis of Ueckermann & De Vis *et al.* (2024). Figure 21 shows the new tree obtained in this study. It shows a larger distance between *P. ubiquitous* from the other two species, *H. anconai* and *P. duffelensis* **n. sp.**

This result is consistent with the lower number of leg setae of *P. ubiquitous* and its undivided femur IV, as detailed in Table 3.

Figure 22 shows the results of the PCA of the species studied in this work. The differential characteristics between the species is represented by the loading of component 1 with highest loadings (> 0.2) for dorsal setae *h2* and *ps2*, ventral setae *3c* and the eupathidial setae (*tcζ*) and (*pζ*), followed by dorsal seta *bo*; ventral setae *4b*, *ag3* and *ag4* and the eupathidial setae *ft"ζ* with loadings between 0.15 and 0.2 (Figure 22A). The species are separated in the plot with a small distance between *P. duffelensis* **n. sp.** and *P. tocantinsensis* **n. sp.** while for *D.*

Table 3 Morphological differences between *Pronematus*, *Homeopronematus* and *Pseudopronematus*.

Leg setation	Leg	Segment	Number of setae		
			<i>Pseudopronematus</i>	<i>Homeopronematus</i>	<i>Pronematus</i>
	I	Trochanter	1	1	0
	II	Tarsus	7+ω	6+ω	6+ω
	II	Trochanter	1	1	0
	III	Tarsus	6	6	5
	IV	Tarsus	6	6	5
Pseudanal setae (<i>ps</i>)			3	3	2
Femur IV divided	IV		yes	no	no

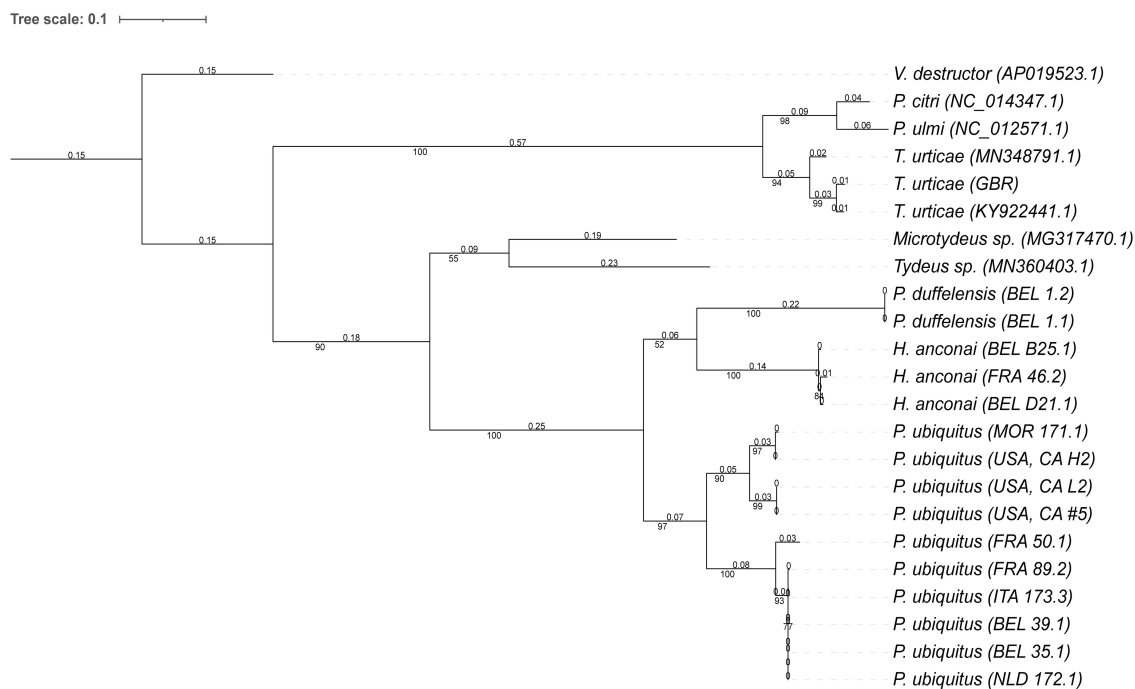


Figure 21 Maximum Likelihood analysis showing position of *Pronematus ubiquitous* (McGregor 1932), *Homeopronematus anconai* (Baker, 1943) and *Pseudopronematus duffelensis* De Vis & Ueckermann n. sp., and its relationships with other Trombidiformes species based on sequences of the COI gene. Bootstrap values and branch lengths are shown respectively below and above the branches.

hyeresensis n. gen. n. sp. or *D. nadirae* n. comb. the distance to each of the other species is much larger (Figure 22B).

Discussion

Morphology

When examining the dorsum of the idiosoma of *D. hyeresensis* n. gen. n. sp., an outstanding characteristic is the large distance *cl-dl*, combined with a short distance *dl-dl* and a long distance *el-el*. More specimens are needed to confirm if these characters are general or not.

The width and height of the transversal spindle-shaped striation differs between genera and species. In contrast to the original description of *D. nadirae* n. comb. (Da Silva *et al.* 2017), the two spindle-shaped striations near *mta* and *agl* setae are broader than the distances *mta-mta* and *agl-agl*. The first spindle shape striation extends between and anterior to setae *pt* (Figure 17). In *D. hyeresensis* n. gen. n. sp. the first is wider than the distance between setae *mta* and the second is reduced, irregular and small and about half the distance between setae *agl* (Figures 1 & 4). In *P. duffelensis* n. sp. and *P. tocantinsensis* n. sp., the first is similar and wider than the distance between setae *mta*. The second is about as wide as the distance between *agl* setae for *P. duffelensis* n. sp. and clearly wider than the distance between setae *agl* for *P. tenuisetosus* and *P. tocantinsensis* n. sp. The shape of the second spindle of *P. tocantinsensis* n. sp. is however more like a bow than like a spindle because the posterior ‘edge’ is not convex but rather straight. In *P. ubiquitous* the first spindle-shaped striae are much higher and wider while the second is comparable to that of *P. duffelensis* n. sp. (Ueckermann & De Vis *et al.* 2024).

Duoparus hyeresensis n. gen. n. sp. is the first genus within the Pronematinae with two *ag* setae. According to André (1981) when *ag* setae are lost during evolution, the missing pairs are

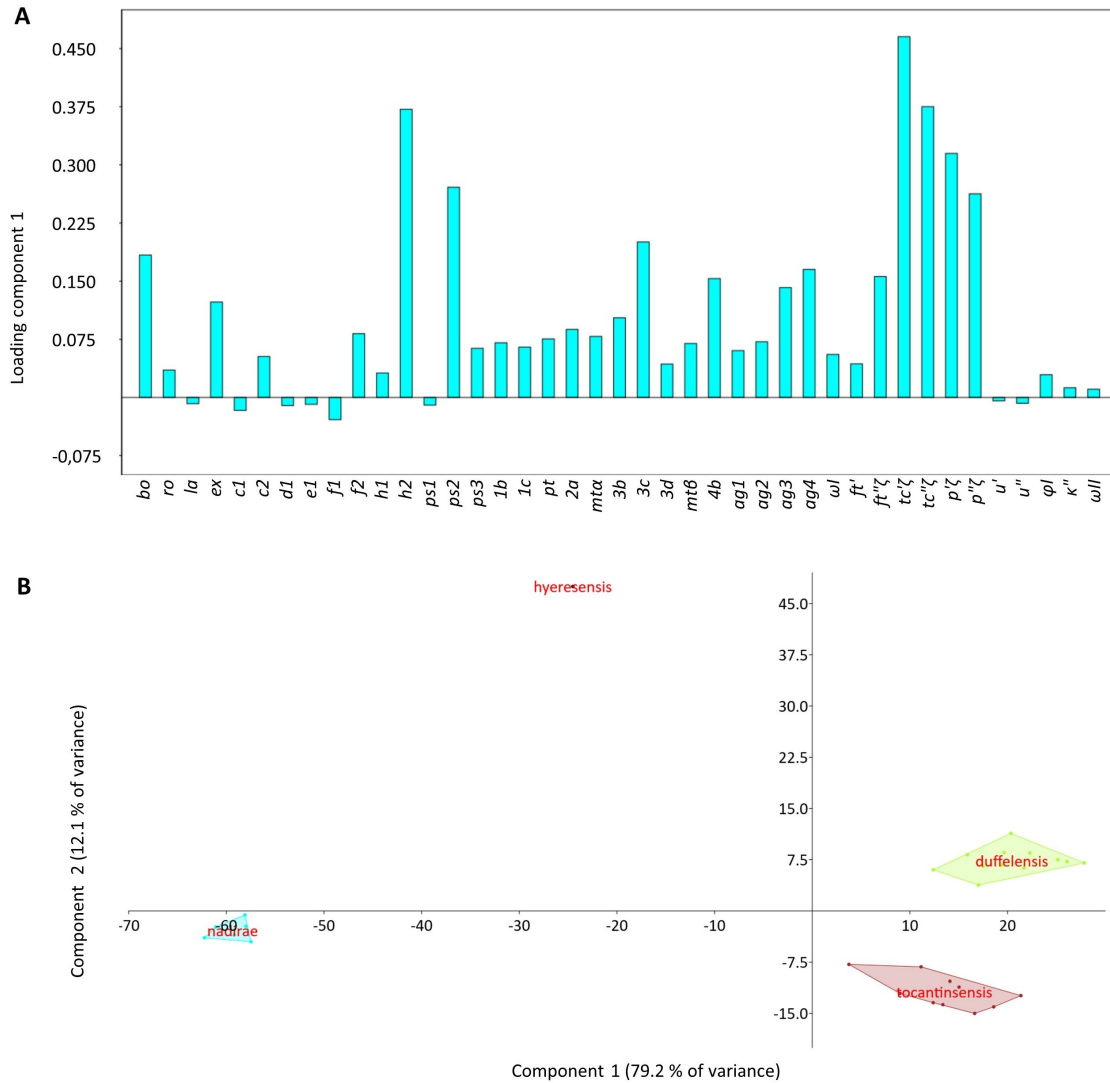


Figure 22 Principal component analysis (PCA) of morphometric characters measured on females of *Duoparus hyeresensis* De Vis & Ueckermann **n. gen. n. sp.**, *Pseudopronematus duffelensis* De Vis & Ueckermann **n. sp.**, *Pseudopronematus tocantinsensis* De Vis, Castilho & Ueckermann **n. sp.**, and *Dasilcoferla nadirae* (Silva, Da-Costa & Ferla) **n. comb.** A – loading of component 1 for different characters B – Polygon graph. Each polygon refers to a different species.

the posterior ones, although in a specimen of *Apopronematus* André, 1980 one single anterior seta was lost. When we look at the striation pattern, we suppose that *ag1* was not lost because the first pair is inserted close to the spindle-shaped striation. The second pair is inserted lateral to and in the middle of the anterior part of the genital opening, where *ag2* is generally inserted at the anterior edge of the genital opening. Therefore, we suppose that the second pair is *ag3* and that in this genus/species *ag2* and *ag4* were lost and not both the two posterior ones.

Although leg lengths are difficult to measure correctly when they are bent, the legs of *Pseudopronematus* species (Table 3) are longer than those of *Duoparus* and certainly than those of *D. nadirae* **n. comb.** which are all shorter than 97 μm. Leg lengths of *Pronematus* species (Ueckermann & De Vis *et al.* 2024) are comparable to those of *Pseudopronematus* species. Leg length might be a generic characteristic. The short leg I of *P. tenuisetosus* is probably a mounting artifact.

Whether setae are barbed or not differs between genera but also between species:

- Opisthosomals. In *D. hyeresensis* **n. gen. n. sp.** these setae are apparently not serrated but have a rough surface. In *P. duffelensis* **n. sp.** and *P. tenuisetosus* opisthosomal setae are serrated whereas in *P. tocantinsensis* **n. sp.** all setae are smooth or apparently smooth. In *P. acus*, all setae are smooth according to Ueckermann and Grout (2007). In *P. augrabiensis* all setae are slightly serrate (Ueckermann and Grout 2007). Finally, in *D. nadirae* **n. comb.** they are clearly barbed.

- Setae *bo*. These are similarly barbed for all *Pseudopronematus* species (Figure 5f, g, Ueckermann and Grout (2007)) but in *D. hyeresensis* **n. gen. n. sp.** the barbs of this seta (Figure 5e) seem shorter, and in *D. nadirae* **n. comb.** the barbes seem a bit stouter and less dense.

- Eupathidia on tarsus I. The eupathidia in *D. hyeresensis* **n. gen. n. sp.** are smooth. The serration of the eupathidia in *Pseudopronematus* depends on the species, with *P. tenuisetosus* having them completely but finely barbed. *P. duffelensis* **n. sp.** has the basal half of the prorals and tectals and the basal third of the fastigial barbed, and *P. tocantinsensis* **n. sp.** has all eupathidia smooth. In *P. acus* these appear slightly serrate on the drawings (Fan and Li 1992) while in *P. augrabiensis* the eupathidia are smooth. In comparison, in all *Pronematus* species (Ahmad-Hosseini *et al.* 2017; Menon *et al.* 2007; Meyer and Rodrigues 1966; Ryke and Meyer 1960; Tseng 1985a; Ueckermann & De Vis *et al.* 2024), and *D. nadirae* **n. comb.**, the eupathidia seem to be completely barbed (except for the 5-8 μm tip in some *P. ubiquitous* specimens and in *D. nadirae* **n. comb.** the tip is apparently unbarbed in most specimens). In *Homeopronematus* species (André 1980; Knop and Hoy 1983; Schruft 1972) the basal two-thirds is barbed. So, in the genus *Pseudopronematus* it varies with the species but in other genera, it does not. We suppose that the smooth part touches the substrate, while the barbed part is more in the air while walking. It might also be related to the substrate where the species lives. In soil or litter environment (e.g. *P. tocantinsensis* **n. sp.**) the barbed eupathidia or setae might easily accumulate soil particles, while this is less the case when living on leaves or plants (e.g. *P. tenuisetosus*).

- Most leg setae are barbed in *D. nadirae* **n. comb.** while they are smooth in *Pseudopronematus* species or in *D. hyeresensis* **n. gen. n. sp.**, except for the ventral setae on the tibiae II-IV which are apparently barbed in *P. duffelensis* **n. sp.** but apparently smooth in *P. tocantinsensis* **n. sp.** or in *D. hyeresensis* **n. gen. n. sp.**

- The ventral seta *v* on the palptarsus of *D. hyeresensis* **n. gen. n. sp.** is heavily barbed while it is smooth in the *Pseudopronematus* species described in this study and also in *D. nadirae* **n. comb.**

In both *D. hyeresensis* **n. gen. n. sp.** and *Pseudopronematus* spp., the prorals of tarsus I are subequal as are also the tectals, the latter being considerably longer. In other Pronematinae such as *P. ubiquitous* (Ueckermann & De Vis *et al.* 2024) or *Homeopronematus* (André 1980; Schruft 1972) the tectals are subequal but $p''\zeta$ is shorter than $p'\zeta$. In contrast, in *D. nadirae* **n. comb.**, the length of each terminal eupathidium is different and the adaxials are shorter than the abaxials: $tc''\zeta$ 35 > $tc'\zeta$ 28 > $p''\zeta$ 21 > $p'\zeta$ 17. The length and relative length of the eupathidia can be used as generic characteristics (e.g. adaxial prorals when compared to abaxials: shorter in *D. nadirae* **n. comb.**, longer in *P. ubiquitous* and *H. anconai* or subequal in *Pseudopronematus* and *Duoparus*). Furthermore, it can indicate how the legs are used. In *P. ubiquitous* we observed that the legs are stretched/extended laterally when walking, in such a way that the tips of the eupathidia are touching the substrate. In the case of *P. duffelensis* **n. sp.**, the legs are used more in front so that both prorals and tectals need to have the same length to touch the substrate with the tips at the same time.

As in *D. hyeresensis* **n. gen. n. sp.**, the small seta homologous to *s* on tarsus I, firstly reported for *P. ubiquitous* (Ueckermann & De Vis *et al.* 2024), is vestigial and hardly detectable in the *Pseudopronematus* species described in this work. Digital augmentation is needed to observe it and scanning electron microscopy might be needed to visualise the seta clearly and confirm its presence in these species. In other genera like *Pronematus* this seta is clearly visible and up to 2.5 μm long (Ueckermann & De Vis *et al.* 2024). In *D. nadirae* **n. comb.** on

the contrary, it is absent. Its presence is thus not general in the Pronematinae. Its presence or absence and length can be used as a generic characteristic.

Three genera have similar chaetotaxy: besides *Pseudopronematus* and *Duoparus* also *Pronematus* Baker, 1965 (Baker 1965) has seven setae on tarsus II. While the leg chaetotaxy of *Duoparus* and *Pseudopronematus* is the same, *Pronematus* has two setae on genu II (Baker 1965; André 1980) instead of three in the two other genera. *Duoparus*, on the other hand, has only two pairs of *ag* setae, while the other two genera have four pairs. Additionally, both *Duoparus* and *Pseudopronematus* have a divided femur IV. In *Pronematus*, femur IV is also divided (Baker 1965; Tseng 1985b), however, in some species, it may be not, according to Ueckermann and Grout (2007). We also found a difference in the insertion of the dorsal setae of tarsus III and IV. In *Pseudopronematus* species they are inserted close to each other, about in the middle of the segment, while in *Duoparus* one is inserted more distally. These three genera seem to be closely related. Future (molecular) studies can help to confirm this.

Up to now, the length of the leg setae has only been studied for tarsus I. Other leg setae also deserve attention, especially on the tibiae and femora. The ventral setae of *D. hyeresensis* **n. gen. n. sp.** on tibiae II to IV are less stout and clearly shorter than the dorsals, whereas in *Pseudopronematus* and *Dasilcoferla* these ventral setae are stout on all tibiae, being also the longest of that segment (except in *P. tocantinsensis* **n. sp.**). The posterolateral/ventral seta on femur II of *D. hyeresensis* **n. gen. n. sp.** is considerably longer 40 than those of *Pseudopronematus* species 22.5–32.5 or 19.3–22.3 in *D. nadirae* **n. comb.**

One peculiarity is the forked seta on the telofemur of the *Pseudopronematus* species described in this work. This is not always visible, most probably because the members of the fork stick together. We suppose that this is a characteristic of the genus *Pseudopronematus*. It was, however, not mentioned for the type species *P. acus* (Fan and Li 1992) nor for *P. augrabiensis* (Ueckermann and Grout 2007). In *P. duffelensis* **n. sp.** and *P. tocantinsensis* **n. sp.** the lateral branch is about 5 µm, in *P. tenuisetosus* the lateral branch is only 1.7 µm. No lateral branch could be observed on that seta in *D. hyeresensis* **n. gen. n. sp.** In *Parapronematus* spp. e.g. *P. acaciae* Baker, 1965 this forked seta is not only present on femur IV but also on femur III and both members of the forked setae are equal in length and strength (Baker 1965; Meyer and Rodrigues 1966) and in males (but not females!) of *Proctotydaeus* (*Oriolella*) not only the dorsal seta on femur IV is forked but also seta *ps1*, with one fork shorter than the other (Kaźmierski 1998). Baker (1965) included this characteristic in the genus description of *Parapronematus*. André (1980), however, omitted it. Forked setae on the legs can thus be used as a characteristic to separate genera and species.

The ontogeny of *P. duffelensis* **n. sp.** shows two peculiarities: the seta on telofemur appears only forked in adults, being unforked in the earlier stages. Additionally, the femur is only divided in the adult and tritonymph stage, being undivided in deutonymph and protonymph. This differs from *Triophtydeus lebruni* (André, 1980), in which femur IV is undivided in the protonymph but is divided in the deutonymph and next stages (André 1985). As far as we know this is the first time that this is described in the Iolinidae.

In many specimens, we observed that the tips of the movable digit are situated in the oral cavity. We suppose that they enter dorsally into oral cavity and move up and down through the oral cavity to puncture structures or cells of the leaf, fungi, or prey as to release the content, while sucking.

The PCA shows that the distance between the two *Pseudopronematus* species is shorter than the distance of these to the two other species, *D. hyeresensis* **n. gen. n. sp.** or *D. nadirae* **n. comb.** or between the two latter species (Figure 22A). This supports the allocation of the latter two in different genera. Six setae contribute distinctly more to the separation of the species: *h2*, *ps2* and the four distal eupathidia of tarsus I (Figure 22B).

Molecular and morphological comparison

Leg and body chaetotaxy play a major role in the present definition of the genera of Pronematinae (André 1980). André and Fain (2000) suggested that a higher number of leg setae

implied a plesiomorphic character state, in contrast with a comparatively lower number of setae representing an apomorphic character state. They also considered the division of femur IV an ancestral character state. Ueckermann & De Vis *et al.* (2024) presented a phylogenetic analysis of *P. ubiquitous* and *H. anconai* in relation to less related taxa. In this paper, we add *P. duffelensis* **n. sp.** to that analysis, for considering *Pseudopronematus* closely related to *Pronematus* and *Homeopronematus*.

Taking into consideration the ancestral concept of André and Fain (2000), *P. duffelensis* **n. sp.** and *H. anconai* are expected to have arisen earlier because they have respectively four and five more setae on the legs than *P. ubiquitous*. They might be closely related to each other because the difference in leg setation is only one seta. *Homeopronematus anconai* might have arisen more recently than *P. duffelensis*, because of the fused femur IV and the loss of one seta on the legs. *Pronematus ubiquitous* might have been the latest to arise because of the highest number of lost setae on the legs, the loss of *ps*₂, and the fused femur IV (Table 3).

These hypotheses are supported by the results of the present study. The phylogenetic tree (Figure 21) shows a larger distance of *P. ubiquitous* to *H. anconai* and *P. duffelensis* **n. sp.** than the distance between the latter two. The lower number of setae of *P. ubiquitous* as compared to the other two species (Table 3) is apparently reflected in the phylogenetic tree. As more molecular analysis becomes available, the phylogenetic relations between genera and species of Pronematinae will be more completely understood. The results of this work show that molecular and morphological analysis can be complementary in the study of the taxonomy of the Pronematinae.

In Eriophyoidea multibranch setae seems to be an ancestral characteristic with gradually loss of branches during evolution (Chetverikov *et al.* 2023). According to this concept, the lower number of branched setae on the legs and the weaker lateral branch of the seta of the telofemur in *Pseudopronematus* might indicate that it is related and/or evolved later than *Parapronematus*. However, this is in contradiction with the ancestral concept of André and Fain (2000) as *Parapronematus* species have at least four leg setae less when compared to *Pseudopronematus* species (André 1980).

Ecology

The only specimen of *D. hyeresensis* **n. gen. n. sp.** was kept on a tomato leaf with pollen and tomato russet mites for several days as to set up a laboratory culture. However, it did not oviposit and was apparently becoming weak. It might be that its preferred food was not pollen or tomato russet mite but rather one of the above-mentioned mite species that were also present on the leaves on which it was found. More research is needed to confirm this. Species of *Pseudopronematus* seem to have a polyphagous diet that needs further investigation. Some species were collected from plants: *P. tenuisetosus* from cotton (Meyer and Rodrigues 1966), *P. tocantinsensis* **n. sp.** from rubber tree and *P. augrabiensis* from *Citrus sinensis* (Ueckermann and Grout 2007). *Pseudopronematus acus*, on the contrary, was found on the fungus *Auricularia auricula-judae* (Fan and Li 1992), and two species were collected from litter: *P. duffelensis* **n. sp.** and *P. tocantinsensis* **n. sp.** The latter was thus recovered from plant and soil. These last two species were associated with many other arthropods. At least *P. duffelensis* **n. sp.** has been proven to prey on mites, in this case, tomato russet mite. We could rear it on bean leaves with a diet of *Typha* pollen, but they could also survive and reproduce on fungi growing on a leaf/*Typha* pollen of a decaying rearing unit. Furthermore, they could survive for at least four weeks on sweet pepper leaf litter kept in an almost closed plastic bag (oxygen could enter) where they presumably survived on fungi. Laboratory observations showed the mite feeding on hyphae, but it might also be a predator of other mites present in the litter. *Pseudopronematus tocantinsensis* **n. sp.** was recovered from the litter-soil samples from a corn field where no-tillage farming was applied for years. The litter layer contains many arthropods but also free-living nematodes.

Finally, *D. nadirae* **n. comb.** was found on litchee trees in Brazil. No ecological information was given by Da Silva *et al.* (2017) but they may be an interesting alternative for the control of

the litchi erineum mite, *Aceria litchii* (Keifer) that is present in Brazil (Picoli *et al.* 2010; Raga *et al.* 2010; Fornazier *et al.* 2014) because it is smaller than phytoseiid predators and might have higher possibilities to penetrate in the erineum induced by the eriophyid.

Chaetotactic notation in descriptions

We want to draw attention to this topic, as we have seen different notations for the same setae in several papers which may lead to misinterpretation and difficult identification: in several papers (Sadeghi *et al.* 2012; Darbemamieh *et al.* 2015; Ahmad-Hosseini *et al.* 2017), the ventral setae 3b and 3d are switched. Kaźmierski (1989) made an overview of all chaetotactic notation systems and in all the systems, the most ventral/mesad of the setae, is 3b, followed by 3c and 3d, which is the most dorsal. Also, in the chaetotactic notation of the terminal eupathidial setae on tarsus I, as described in (André 1981b), we see in the description of *Neopronematus kamalii* Darbemamieh & Hajiqanbar, 2015 that $p'\zeta$ and $p''\zeta$ are switched (Darbemamieh *et al.* 2015), and confusion was observed in Da Silva *et al.* (2017). The (relative) lengths of these setae are used in identification, which can be seen in the loading of seta 3c in Figure 22A. A correct notation of those setae is therefore very important.

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Distribution of work

Raf M.J. De Vis coordinated the survey in Belgium and France, made the slide mounts, started rearings, took the pictures, measured specimens, and made the (re)descriptions of all species but *P. tenuisetosus*; Lore Vervaeet set up single female lines and performed the genetic study; Thomas Van Leeuwen supervised the work of Lore Vervaeet; Alice de Freitas Braga collected samples, extracted and mounted the mites in Brazil; Raphael de Campos Castilho identified mites and supervised the work of Alice Braga; Edward A. Ueckermann measured and made the redescription of *P. tenuisetosus* and supervised the work as senior acarologist.

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