Acarologia
Open Science in Acarology

Pronematinae (Trombidiformes: Iolinidae) from Brazil, with original and complementary descriptions of taxa as well as with a reappraisal of the subfamily and of *Parapronematus*

Raf M. J. De Vis[a], José Dantas Araujo Lacerda[b], Gilberto J. de Moraes[b], Edward A. Ueckermann[c]

[a] Research Station for Vegetable Production (PSKW), 2860 Sint-Katelijne-Waver, Belgium.
[b] Departamento de Entomologia e Acarologia, Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo (ESALQ-USP), 13418-900 Piracicaba, São Paulo, Brazil.
[c] Unit for Environmental Sciences and Management, Potchefstroom Campus, North-West University, Private Bag X6001, Potchefstroom, 2520, South Africa.

Original research

ABSTRACT

Pronematinae was originally proposed as a subfamily of Tydeidae Kramer, 1877 and later transferred to Iolinidae Pritchard, 1956. Although apparently omnivorous, some species of this group have been reported as predators of mites. New collection records of Pronematinae from Brazil are presented. The original descriptions of *Peridasilcoferla paraensis* De Vis & Ueckermann **n. gen. n. sp.** and *Parapronematus connarus* De Vis & Ueckermann **n. sp.** are presented. Complementary descriptions of *Parapronematus geminus* Meyer & Rodrigues, 1966 and *Naudea richinda* Meyer & Rodrigues, 1966 are also presented, based on the examination of type specimens. A reappraisal of the subfamily and of *Parapronematus* Baker, 1965, is made based on the specimens collected and on literature information. Updated keys to the world genera of Pronematinae and to the world species of *Parapronematus* as well as suggestions of new generic characteristics to be considered in descriptions of new Pronematinae taxa are presented.

Keywords taxonomy; Tydeoidea; mites; opisthosomal setae; aggenital setae
Zoobank http://zoobank.org/E317A260-87BA-4FD9-A6D3-C57DABBD396A

In memory of the senior author who passed away in December 2024 before the completion of this article.

Received 03 November 2024
Accepted 31 March 2025
Published 14 April 2025

Corresponding author
Edward A. Ueckermann:
edalbert@lantic.net

Academic editor
Akashi Hernandes, Fabio

https://doi.org/10.24349/7w23-xsl9

ISSN 0044-586X (print)
ISSN 2107-7207 (electronic)

Introduction

An effort has been dedicated in Brazil to the knowledge of the mite species found on plants and in the soil. One of the main objectives is to determine the species potentially useful as biological control agents. Studies have focused mainly on taxa belonging to Phytoseiidae, given their recognized importance as biological control agents (Carrillo *et al.* 2015; Lofego *et al.* 2024).

Little effort has been dedicated to the study of mites of the family Iolinidae Pritchard, 1956 in Brazil (Da Silva *et al.* 2017). Although apparently omnivorous, some species of this family have been reported as predators (De Vis *et al.* 2006a; Hernandes *et al.* 2015; Marcossi *et al.* 2024). The present work refers to species of Pronematinae André, 1980, originally described in Tydeidae Kramer, 1877 and transferred to Iolinidae by André and Fain (2000). Ueckermann

et al. (2024) and De Vis *et al.* (2024a, b) provided new information about Pronematinae, but no recent publication provides a key for the separation of the nearly 20 genera presently placed in this subfamily. Before that is done, it is necessary to confirm the validity of the synonymy between *Pausia* Kuznetsov & Livshits, 1972 and *Naudea* Meyer & Rodrigues, 1966, proposed by Baker and Delfinado (1976). André (1980) did not accept this synonymy.

Parapronematus Baker, 1965, the type genus of Pronematinae, was originally described in Tydeidae and transferred to Iolinidae by André and Fain (2000). A recent unpublished evaluation showed that a species of this genus reported by De Vis *et al.* (2006b) as *Parapronematus* sp. in southern Brazil and deposited at Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo (ESALQ-USP) was recently collected in northern Brazil and it has still not been reported in the literature. Baker (1965) created *Parapronematus* based on a single species, *P. acaciae* Baker, 1965. Six additional species have been described, not always completely complying with all the reported generic characteristics: *P. geminus* Meyer and Rodrigues, 1966, *P. citri* Salviejo, 1969, *P. formosanus* Tseng, 1985, *P. ferox* Gupta, 1991, *P. camelia* Gupta, 1992 and *P. murshidabadensis* Gupta, 1992 (https://species.wikimedia.org/wiki/Pronematinae, accessed on 11/10/2024, André 2021). The genus has distinctive features facilitating its separation from other genera of the same subfamily: setae *la* absent, three pairs of *ag* setae, dorsal setae of femora III and IV forked and the following leg chaetotaxy (from tarsus to trochanter, solenidia in brackets): leg I (8 (ω) – 2 (φ + κ) – 2 – 3 – 1), leg II (6 (ω) – 2 – 2 – 3 – 0), leg III (5 – 2 – 2 – 2 – 1) and leg IV (5 – 2 – 1 – 1 – 0).

The objectives of this work were: a) to present new records of Pronematinae species from Brazil, describing some new taxa and complementarily describing others; b) to conduct a reappraisal of Pronematinae and *Parapronematus*, presenting keys for the separation of the respective genera and species; c) to suggest new generic characteristics for Pronematinae.

Material and methods

Samples of leaves, inflorescences and fruits of plants of economic interest as well as of surrounding vegetation were collected by J.D.A. Lacerda in July 2023 in rural communities and urban areas of Parauapebas (about 150–165 m altitude), southeastern municipality of Pará State, in the Amazon region of Brazil. These were transported to the Agricultural and Forestry Entomology Laboratory of Universidade Federal Rural do Amazonas, where mites were collected and preserved in 70% ethanol until mounted in Hoyer's medium (Krantz and Walter 2009) at ESALQ-USP. Those belonging to Iolinidae were sent to PSKW where taxonomic studies were conducted. Additionally, slides with *Parapronematus* specimens reported by De Vis *et al.* (2006a, b) and slides of other Brazilian localities deposited at the Mite Reference Collection of ESALQ-USP were also included in the study.

Morphological examination and principal component analysis

Specimens were measured using a Leica DM750 microscope with a Leica Flexacam c3 camera and Leica LAS-X software. Line drawings were made with a Leica DM750 equipped with a phototube and Wacom Cintiq 16 pen display and drawn using Adobe Illustrator 2024.

Nomenclature of the body regions, setae and organotaxy is that of Kaźmierski (1989). Leg setae nomenclature is that of André (1981b) and Khaustov *et al.* (2020). The tables of Kaźmierski (1989) were used for the interpretation of the setal nomenclature of different authors. In the text, measurements are given in micrometres, following the name of each structure. A principal component analysis (PCA) based on setal lengths (Ueckermann and De Vis *et al.* 2024) of specimens of *Parapronematus connarus* **n. sp.** was done with PAST (version 4.03).

Key to developmental stages and sexes of Pronematinae

As in any other mite group, the characterization of the specimens under analysis initially requires the identification of their developmental stage. In this study, that was done basically with the help of the key provided by André (1980), with some additional information considered relevant. That is important because most descriptions in the literature refer to adult females. Larvae are recognized by having only three pairs of legs, as in most mite groups. Other stages as well as adult sexes were separated according to the following characteristics:

A. With a dehiscence line (breakage line for ecdysis) anteriad the prodorsal setae, curved backwards towards *la* (or *ro* setae when *la* are absent; procurved) . . . . . nymph

• Leg IV with tarsus bearing five setae or more and other segments nude; reduced number of ventral idiosomatic setae (lacking *mtβ*, *3c*, *3d* and all *ag* setae) . . . . . protonymph

• Leg IV with all segments, except trochanter, bearing setae; venter of idiosoma lacking only *mtβ*, *3d*, *ag3* and either *ag4* (in species with four pairs of *ag* setae) or *ag2* (in species with three pairs of *ag* setae) . . . . . deutonymph

• Leg IV with all segments, often including trochanter, bearing setae; no idiosomatic or leg setae absent (as in adult) . . . . . tritonymph

B. Without dehiscence line . . . . . adult

• Genital opening shaped as an inverted T (exceptionally completely opened, then as a large circle), with 2–4 pairs of *ag* setae . . . . . female

• Genital opening not shaped as an inverted T; with two rounded dorsal structures laterad *e1*; with stout solenidion extending beyond the tip on tarsus I (in *Pronematus, Neopronematus*); with a dorso-distal adaxial spur on femur IV; aedeagus T-shaped (usually indistinguishable), with the same number of *ag* setae as in female or less (only one in *Homeopronematus anconai*), at least in *Parapronematus connarus* **n. sp.**, with two pairs of eugenital setae; smaller than female . . . . . male

Estimation of length of structures of previously described species in the review section

As we could not have access to the type specimens of *P. acaciae*, *P. citri* and *P. ferox*, the length of different structures of these species was estimated based on convertion factors calculated from the given values of the length and width of the idiosoma of those species and the length of those structures in the drawings. The calculated values are given in bold italics in Table 1. Additionally, for *P. acaciae*, the estimated length of the tarsus of Figure 84 of the original description was used as basis for the estimation of the length of the setae of tarsus I, depicted in Figure 85.

Results

New collection records of Pronematinae from Brazil

Iolinidae Pritchard, 1956

Pronematinae André, 1980

Pronematus Canestrini, 1886

Pronematus brasiliensis Ueckermann & De Vis, 2024

Specimens examined — all collected in Parauapebas; 5°59′11.68″ S, 49°52′34.73″ W, on *Vitis labrusca* L. (MZLQ 4415: 1♂); 6° 4′35.49″ S, 49°52′51.54″ W, on *Senna occidentalis* (L.) Link (MZLQ 4416: one ♂); 6° 4′13.53″ S, 49°54′1.40″ W, on *Adenanthera pavonina* L. (MZLQ 4417: one protonymph).

Remarks — The following arthropods were found in association with *P. brasiliensis*: on leaves of *A. pavonina*, unidentified *Euseius* Wainstein species (Phytoseiidae) and insects of the order Psocoptera; on *V. labrusca*, the pronematids *Dasilcoferla nadirae* (Da Silva *et al.*(2017) and *Peridasilcoferla paraensis* **n. gen. n. sp.**, and unidentified *Amblyseius* Berlese and *Iphiseiodes* De Leon species (Phytoseiidae); on *S. occidentalis*, *Eutetranychus banksi* (McGregor) (Tetranychidae).

Peridasilcoferla De Vis & Ueckermann n. gen.

Zoobank: A2AB2608-895A-4D9D-9FBB-6BF0B4AAE4F8

Diagnosis

Adult females with four pairs of setae on aspidosoma, 11 pairs on the opisthosoma, one on trochanters I to III, six on tarsus II and five on each of tarsi III and IV. The leg chaetotaxy is the same as in *Neopronematus* Panou, Emmanouel & Kaźmierski, 2000 and *Dasilcoferla* De Vis & Ueckermann, 2024a, the former differing in having nine and the latter ten pairs of opisthosomal setae.

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*) and four pairs of lyrifissures (*ia*, *im*, *ip* and *ih*). Eye spots absent. Four pairs of aggenital setae. One pair of genital papillae. Leg I without apotele; each of other legs with ciliate empodium and two claws, without empodial hooks. Seta homologous to seta *s* (see Ueckermann and De Vis et al, 2024) on tarsus I absent. Femur IV undivided. Leg chaetotaxy (tarsus to trochanter): leg I ($8 + \omega - 3 + \varphi + \kappa - 3 - 3 - 1$); leg II ($6 + \omega - 2 - 3 - 3 - 1$); leg III ($5 - 2 - 2 - 2 - 1$); leg IV ($5 - 2 - 1 - 2 - 0$). Epimeral formula: 3-1-4-2.

Etymology

The ancient Greek prefix “peri” means “near”; hence, the *Peridasilcoferla* refers to the similarity between the new genus and *Dasilcoferla*.

Remark

The new genus differs from *Dasilcoferla* (also described from Brazil) by having setae *ps1* (absent in *Dasilcoferla*). Some other characteristics distinguish the new genus from *Dasilcoferla* as well as from *Neopronematus*, but these are not included in the description of the genus (adopting the model of generic characterization proposed by André, 1980). In *Dasilcoferla*, the eupathidia of tarsus I with fine instead of course barbs in *Peridasilcoferla* **n. gen.** and *Neopronematus* spp. In all *Neopronematus*, except *N. aegeae* Panou, Emmanouel & Kaźmierski,

2000 (Kuznetsov 1972; Panou *et al.* 2000; Sadeghi *et al.* 2012; Darbemamieh *et al.* 2015), and *Dasilcoferla* (De Vis *et al.* 2024a), the eupathidia are thoroughly barbed whereas in *Peridasilcoferla* **n. gen.** the distal third is smooth. Conversely, the body and leg setae have heavier barbs in *Dasilcoferla* and in *Neopronematus* (except *N. aegeae*), compared to those in *Peridasilcoferla* **n. gen.** The placement of the *ag* setae in the new genus is similar to that in *Dasilcoferla* (well separate from each other), while in *Neopronematus* species *ag3* setae are inserted close to each other, at the anterior end of the genital opening and near *ag2*. Additionally, *ag3* is simple in the former two genera but forked in *Neopronematus*, except in *N. aegeae*. With the description of other *Neopronematus* species, *N. aegeae* seems to differ in many respects from those species, suggesting that their generic classification should be re-evaluated.

Type species

Peridasilcoferla paraensis **n. gen. n. sp.**

Peridasilcoferla paraensis De Vis & Ueckermann n. gen. n. sp.

Zoobank: A004CFA0-A311-4917-B8E5-DC9E3137F14A

(Figures 1–4)

Adult female (n = 3)

Idiosoma — (Figures 1, 4). Ovaloid, tapering posteriorly. Distance *bo-h1* 134 (127–140), width at level of *c1* 118 (106–131). Completely striate, and striae with tubercles.

Dorsum — (Figures 1, 4a-b). Aspidosoma with striation diverging towards the *das* (sejugal) furrow (Kaźmierski 1989); dorsal part of opisthosoma with longitudinal striation between *c1* and *d1*; diverging towards *das*, to form a short but wide spindle-shaped striation pattern between *ro* and *c1*; also diverging posteriorly to form a spindle-shaped pattern between *d1* and *e1*; striation transverse between *f1* and *h1* and inversed V-shaped posteriorly, up to *ps1*, and about transverse between *ps1* and the posterior margin.

Most idiosomal setae aciculate (Figures 4a, b, g, h), apparently serrate, their surface at least with a rough aspect (overlapping with striae makes it unclear); trichobothrial setae (*bo*) on aspidosoma longer than *ex*, which in turn is longer than subequal *la* and *ro*; *la* somewhat thinner than others of subequal thickness (Figures 1, 4a); *bo* finely barbed, except for a smooth proximal section (Figure 4f). Dorsal setae *f2* (Figure 4h) and *h1* longest followed by *c1*, *e1* and *ps2*; other setae shorter, with *ps1* very short. Setae *f1* (Figure 4g), *h1* and *ps1* almost in a straight row and decreasing in length and much shorter than respectively *f2*, *h2* and *ps2*, also in a straight row and decreasing in length. Setae *c1* and *d1* not reaching bases of respectively *d1* and *e1* but *e1* about as long as distance between its base and the base of *f1*. Setal lengths and distances between setae: *bo* 27 (24–28), *bo-bo* 26 (26–27), *ro* 12 (12–13), *ro-ro* 21 (20–21), *la* 15 (14–16), *la-la* 27 (27–28), *ex* 19 (19–20), *c1* 15 (14–15, *c2* 15 (15–16), *c1-c1* 33 (31–35), *d1* 15 (15–16), *d1-d1* 25 (22–27), *e1* 16 (15–17), *e1-e1* 34 (33–35), *f1* 12 (11–13), *f1-f1* 10 (9–10), *f2* 24 (22–26), *h1* 10 (9–11), *h2* 22 (21–23), *ps1* 4 (3–4), *ps2* 14 (13–14).

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

Venter — (Figures 1, 4 c-d). Striation transverse immediately behind gnathosoma, longitudinal between coxae I and II and between coxae III and IV; striation spindle-shaped between setae *pt* and *mtα* and anteriad *ag1*, the former much larger than the latter; striae converging from *ag1* to level of genital opening.

With four pairs of *ag* setae; distances between *ag1-ag1* 11 (11–12), *ag2-ag2* 21 (17–25), *ag3-ag3* 18 (17–19) and *ag4-ag4* 30 (30–31). Setae *ag1* positioned within the spindle-shaped striation pattern. One pair of genital papillae. Seta *ps3* very short, anterolaterad anal opening,

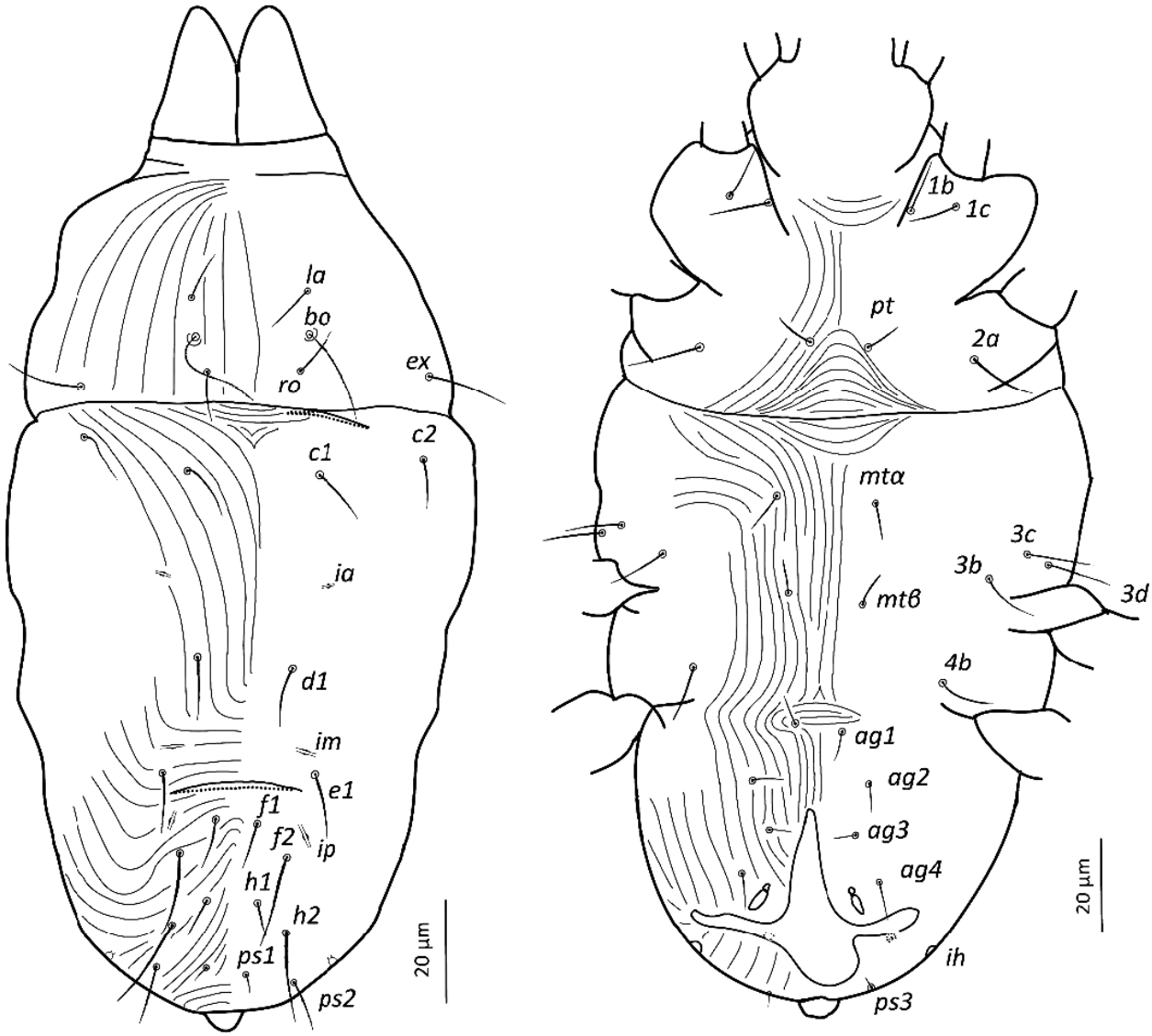

Figure 1 *Peridasilcoferla paraensis* De Vis & Ueckermann **n. gen. n. sp.**, dorsum (left) and venter (right) of holotype female.

without small excrescence in between them (which is present in other genera). Lyrifissure *ih* laterad genital opening.

Setal lengths and distances: *1b* 13 (11–14), *1c* 12 (11–14), *pt* 8 (8–9), *pt-pt* 14 (13–14), *2a* 17 (16–17), *mtα* 9 (9–10), *mtα-mtα* 26 (22–31), *3b* 14 (13–14), *3c* 14 (14–16), *3d* 15 (14–16), *mtβ* 8 ± (8–9), *mtβ-mtβ* 19 (16–24), *4b* 14 (13–15), *ag1* 7 (7–8), *ag2* 7 (7–8), *ag3* 5 (4–5), *ag4* 10 (9–11), *ps3* 4 (4–5).

Gnathosoma — (Figure 2). Chelicera (abaxial view) with parallel diagonal striae converging posteriorly; stylet 17 (16–18). Subcapitulum with striae in section anteriad *sc2* almost transverse; posteriad *sc2* diverging posteriorly, except behind palp, where they are transverse; with two pairs of oral setae, *or1* 5 and *or2* 5 and two pairs of scapular setae, *sc1* 8, *sc2* 11. Palp tarsus 7 (7–8) long, with lobed longitudinal striae, bearing distally a lanceolate and smooth eupathidium *pζ* 4 (4–5); setae *l′* and *l″* curved towards eupathidium, seta *v* stout, longer than other setae and finely serrated (barely distinguishable); setae *l′*, *l″* and *d* smooth, *l′* a bit shorter

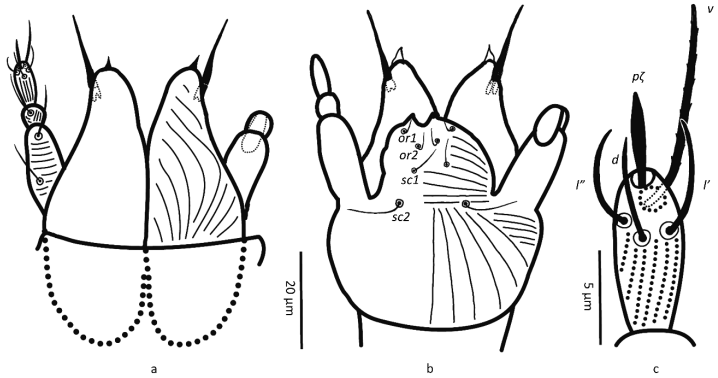

Figure 2 *Peridasilcoferla paraensis* De Vis & Ueckermann **n. gen. n. sp**. Female. a – Dorsal view of gnathosoma; b – Ventral view of gnathosoma; c – Palptarsus.

than the other two setae, solenidion and *ba* not visible; *l′*, *l″* and *d* inserted at about same level, slightly more proximal than *v*; chaetotaxy from distal to proximal segment 5-1-2. Femorogenu 21 long and 8 in diameter.

Legs — (Figure 3). Leg lengths (from base of trochanter to base of claws): I 96 (95–98), II 81 (79–85), III 78 (77–80), IV 88 (83–93), tarsus I length 20 (20–21), tibia I length 19 (18–20). Leg I without pretarsus; each of other legs with ciliate empodium and two claws, without empodial hooks. All leg setae aciculate, finely serrate. Ventral setae of all tibiae stouter than other leg setae, serration hardly visible. Leg I with solenidion *ωI* not reaching tip of tarsus, eupathidia *ft″ζ*, *tc′ζ*, *tc″ζ* (Figure 4e), *p′ζ* and *p″ζ* barbed, except distal third; subequal prorals about 0.6 as long as subequal tectals, and a pair of small forked unguinal setae proximal to prorals on ventral side, seta homologous to *s* absent (see Ueckermann and De Vis *et al.* 2024). Tibia I with bifurcated famulus *κ*, about half as long as solenidion *φI*. Femur IV undivided. Setal lengths: **leg I**: *ωI* 4 (4–5), *ft′ζ* 11 (11–12), *ft″ζ* 18 (18–19), *tc′ζ* 19 (19–20), *tc″ζ* 20 (19–22), *p′ζ* 12 (11-12), *p″ζ* 11 (10–11), *u′* 3 (2–3), *u″* 2 (2–3), *φI* 3 (2–3), *κ″* 1 (1–2); **leg II** :*ωII* 2 (1–2), tibia *v′* 23 (22–23), femur v″ 18 (16–19); **leg III**: tibia *v′* 21 (20–22), tibia *d* 17 (16–18); **leg IV**: tibia *v′* 21 (19–22), tibia *d* 21 (20–22), femur *ev′* 18 (17–18), femur *d* 17 (16–18).

Protonymph (n = 1)

Idiosomal chaetotaxy as in female but *mtβ* and all aggenital setae absent, two setae on coxa III (*3d* absent) and *4b* absent, hence epimeral formula 3-1-3-0. Leg chaetotaxy like female but with no setae on trochanters I and II (instead of one in each), and segments of leg IV nude except for tarsus IV (as in adult female). Hence, protonymph with the following chaetotaxy: I (8+*ω*-3+k+*φ*-3-3-0), II (6+*ω*-2-3-3-0), III (5-2-2-2-1), IV (5-0-0-0-0).

Male and other immature stages

Not found.

Differential diagnosis

This is the only species in this genus, but differences with related species of other genera are subsequently mentioned. The placement of the *ag* setae is similar to that of the closely related *D. nadirae*, but it differs by having 11 pairs of opisthosomal setae, seta *l″* on palp not sigmoid, setae *p* subequal to each other, *tc* also subequal to each other, setae *tc* about twice as long as setae *p*; eupathidia not completely barbed, spindle-form striae near *ag1* small, only a bit broader

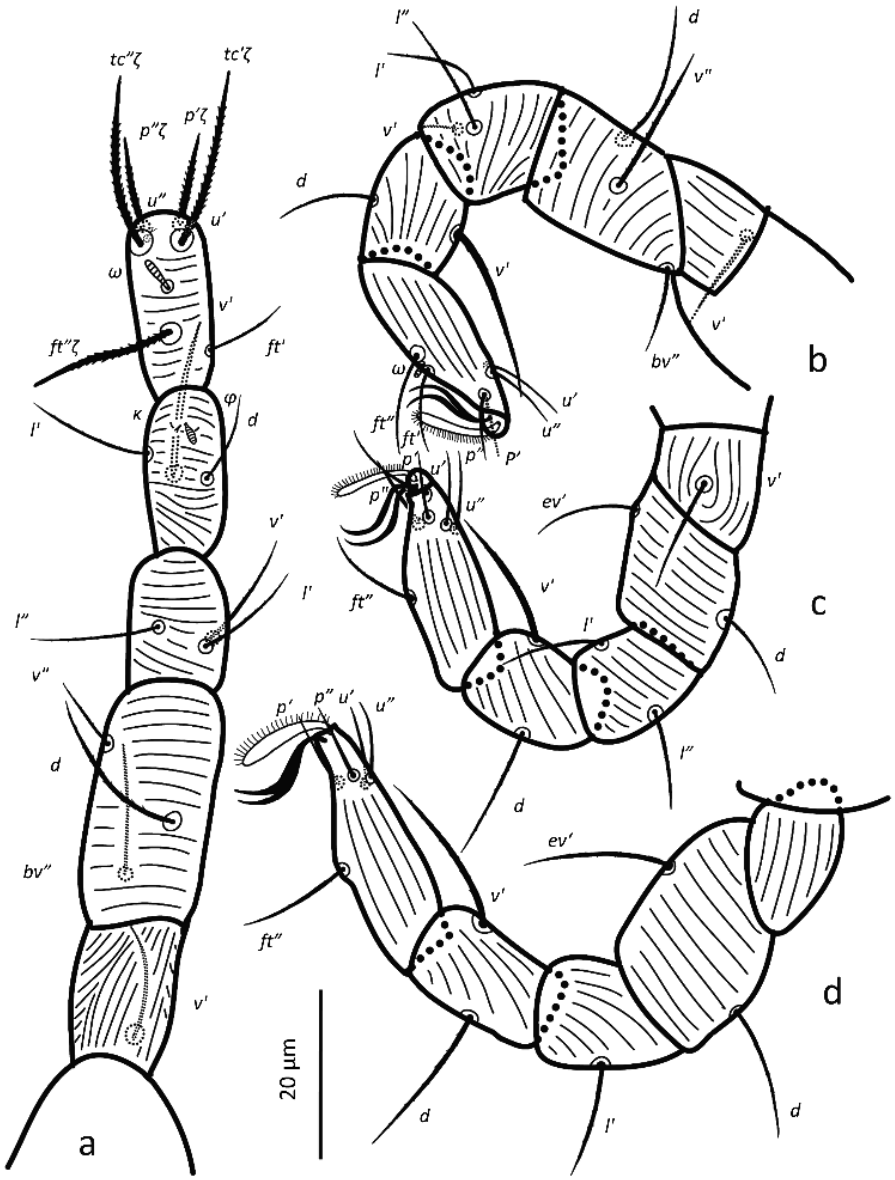

Figure 3 *Peridasilcoferla paraensis* De Vis & Ueckermann **n. gen. n. sp.**, legs of holotype female. a – leg I; b – Leg II; c – Leg III; d – Leg IV.

than distance *ag1-ag1*. It can be distinguished from the closely related *Neopronematus* species by the presence of 11 pairs of opisthosomals, non-forked *ag3* and the position of *ag* setae.

Type locality and habitat

Collected by J. D. A. Lacerda on July 13, 2023, on leaves of an unidentified *Bauhinia* L. (Fabaceae) species at Fazenda Vitória (5°58′6.79″ S, 49°47′39.71″ W, and 166 m altitude), Palmares II, Parauapebas, Pará State, Brazil.

Type specimens and depository

Holotype female (MZLQ 4382), two paratype females (MZLQ 4383 and MZLQ 4384) and one paratype protonymph (MZLQ 4385) deposited at the Mite Reference Collection of

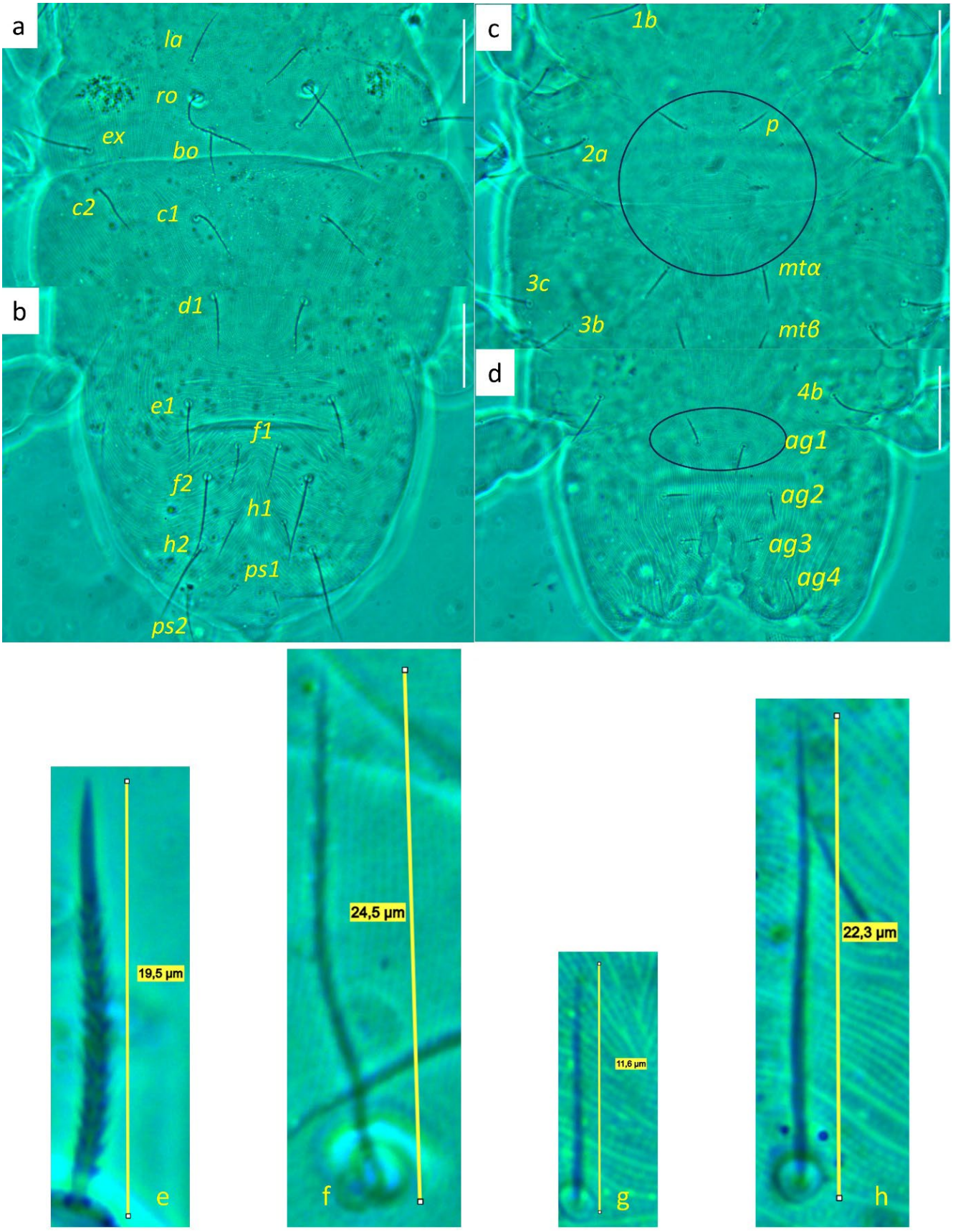

Figure 4 *Peridasilcoferla paraensis* De Vis & Ueckermann **n. gen. n. sp**: a – Aspidosoma; b – Posterior region of dorsum; c – Anterior region of venter with transversal spindle-shaped striae (within circle); d – Posterior region of venter with transversal spindle-shaped striae (within ellipse) and genital area (bar on each image = 20 µm); e–h setae: e – *tc"ζ,* f – *bo*, g – *f1* and h – *f2*.

Departamento de Entomologia e Acarologia, Escola Superior de Agricultura "Luiz de Queiroz" (ESALQ-USP), Universidade de São Paulo (USP), Piracicaba, São Paulo state, Brazil, ESALQ (Zhang 2018).

Etymology

The species name refers to Pará, the Brazilian state where the type specimens were collected.

Parapronematus Baker, 1965

Parapronematus connarus De Vis & Ueckermann n. sp.

Zoobank: 8DEAC753-7D23-4907-B906-A6D7D596FCC6

(Figures 5–11)

Measurements — Measurements of different structures of each life stage shown in Table 1.

Adult female (n = 20)

Idiosoma — (Figures 5, 8). Broad, pyriform, tapering posteriorly. Completely covered with fine tuberculate striae, less discernible than in other pronematid genera. Aspidosoma with three pairs of setae (*bo*, *ro* and *ex*; *la* absent) and opisthosoma with nine pairs of setae (*c1*, *c2*, *d1*, *e1*, *f1*, *f2*, *h1*, *h2* and *ps2*; *ps1* and *ps3* absent); lyrifissures *ia, im, ip* and *ih* present, but mostly not discernible in adult female, most distinguishable in adult males and immatures.

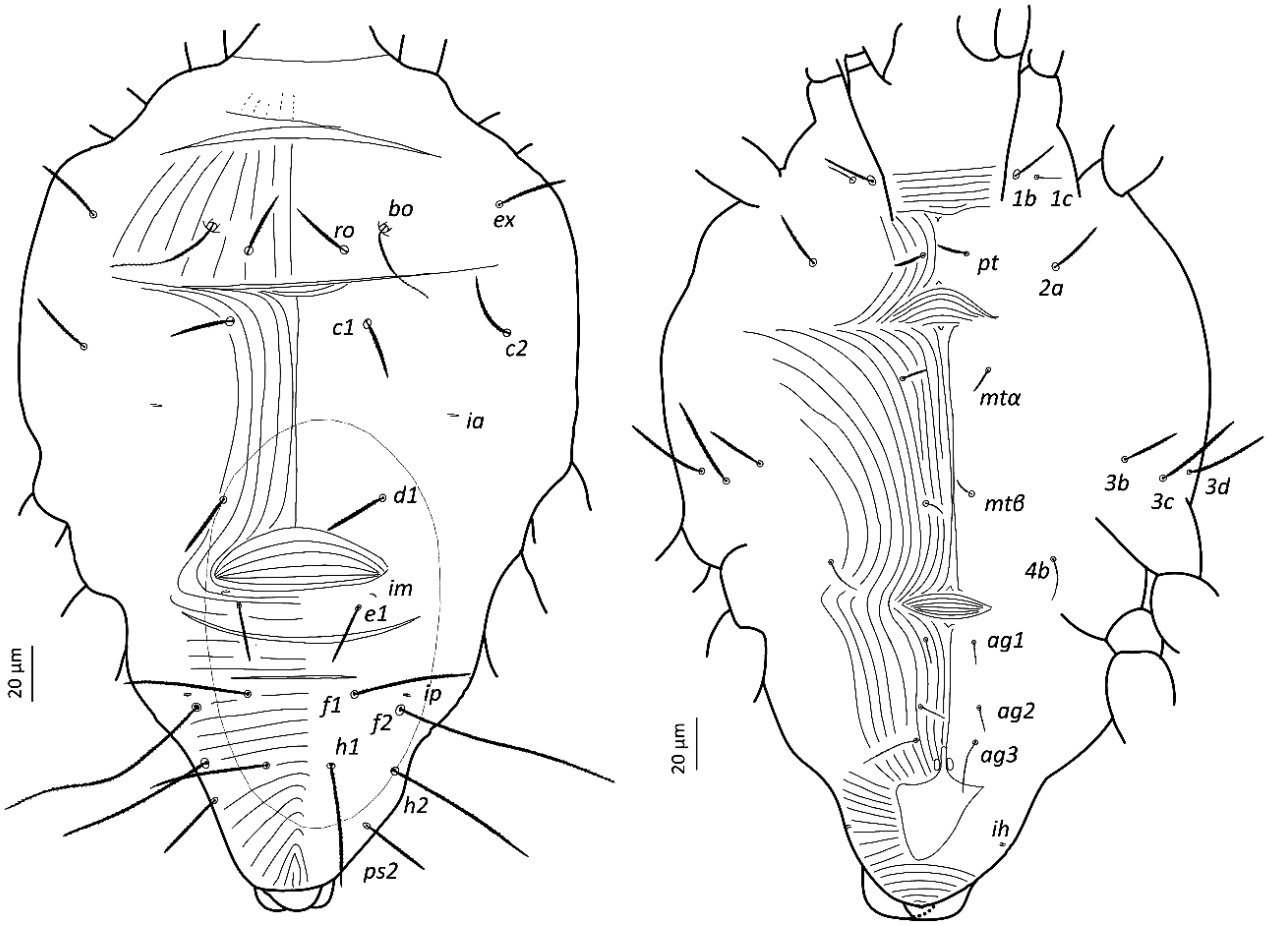

Figure 5 *Parapronematus connarus* De Vis & Ueckermann **n. sp.** Female: dorsum (left) and venter (right).

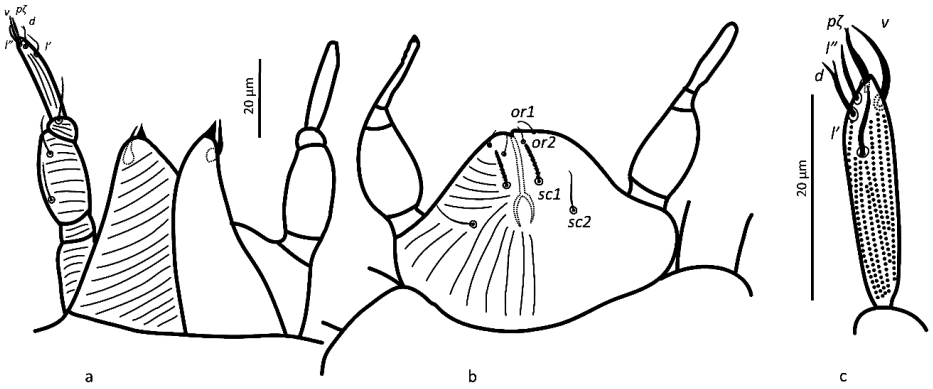

Figure 6 *Parapronematus connarus* De Vis & Ueckermann **n. sp.** Female: a – Dorsal view of gnathosoma; b – Ventral view of gnathosoma; c – Palptarsus.

Dorsum — (Figures 5, 8a-b). Aspidosoma with diverging striation towards *das* furrow (Kaźmierski 1989); dorsal part of opisthosoma with longitudinal striation between *c1* and *d1*; diverging towards *das* to form a short but wide spindle-shaped striation pattern between *ro* and *c1*; also diverging posteriorly to form a spindle-shaped pattern between *d1* and *e1*; striation transverse between *f1* and *h1* and inversed V-shaped posteriorly.

Idiosomal setae aciculate and distinctly serrate (Figures 5, 8a-b, 9c-d); trichobothrial setae *bo* (Figures 5, 9b) on aspidosoma longer than *ex*, which is in turn longer than *ro*; *ex* and *ro* stouter than *bo* (Figures 1, 4b); *bo* finely barbed, barbs longer in distal half (Figure 9b). Dorsal setae *f2* (Figure 9d) and *h2* longest, followed by *f1* (Figure 9c) and *h1*, and then *c2* and *ps2*; *c1* shortest. Setae *c1, d1* and *e1* not reaching bases of respectively *d1, e1* and *f1,* but *f1* passing base of *h1*.

Lyrifissures not always distinguishable, *ia* located between setae *c2* and *d1*; lyrifissure *im* immediately anteriad *e1*; lyrifissure *ip* immediately anteriad *f2*.

Venter — (Figures 5, 8c-d). Striae transverse between coxae I; concave outwards in the region of *pt* setae; about longitudinal medially between levels of *mtα* and *4b*; spindle-shaped between setae *pt* and *mtα* and anteriad *ag1*; converging posteriorly to level of genital opening, around which it is radiating and behind of which it is about transverse.

With three *ag* setae. One pair of genital papillae, only occasionally distinct. Lyrifissure *ih* between genital opening and seta *ps2*.

Gnathosoma — (Figure 6). Chelicera with parallel diagonal striae in dorsal view. Striae in section anteriad *sc2* of subcapitulum almost transverse, posteriad *sc2* almost longitudinal medially, diverging posteriorly elsewhere; with two pairs of oral setae (*or1* 4 and *or2* 4) and two subcapitular setae (*sc1* 10, stout and barbed and *sc2* 13, thin and smooth). Palp tarsus long and narrow, with lobed longitudinal striae, bearing distally a slightly forked eupathidium *pζ*; setae *l′* and *l″* curved towards eupathidium; seta *d* distally forked; seta *v* stout and barely longer than eupathidium; all setae smooth, solenidion *ω* and *ba* not distinguishable; *l′* inserted more proximal than *d*, which is more proximal than *l″*, which is about at the same level as *v*; chaetotaxy (5-1-2). Femorogenu 21 long and 12 in larger diameter.

Legs — (Figure 7). All leg setae aciculate, finely serrate with dorsal setae, in general, stouter and longer than ventral setae of the same leg segment (although less clearly on leg III). Ventral setae on tibiae gradually varying from stout and long on tibia I to fine and short on tibia IV. Leg I with solenidion *ω* not reaching tip of tarsus, eupathidia *ft″ζ*, *tc′ζ*, *tc″ζ*, *p′ζ* and *p″ζ* barbed for their entire length, except for smooth tip 2 µm, tectals subequal, prorals shorter and unequal, with *p″ζ* the shortest, and a pair of small forked unguinal setae proximal to prorals on ventral side, seta homologous to *s* absent (see Ueckermann and De Vis *et al.* 2024). Tibia I with

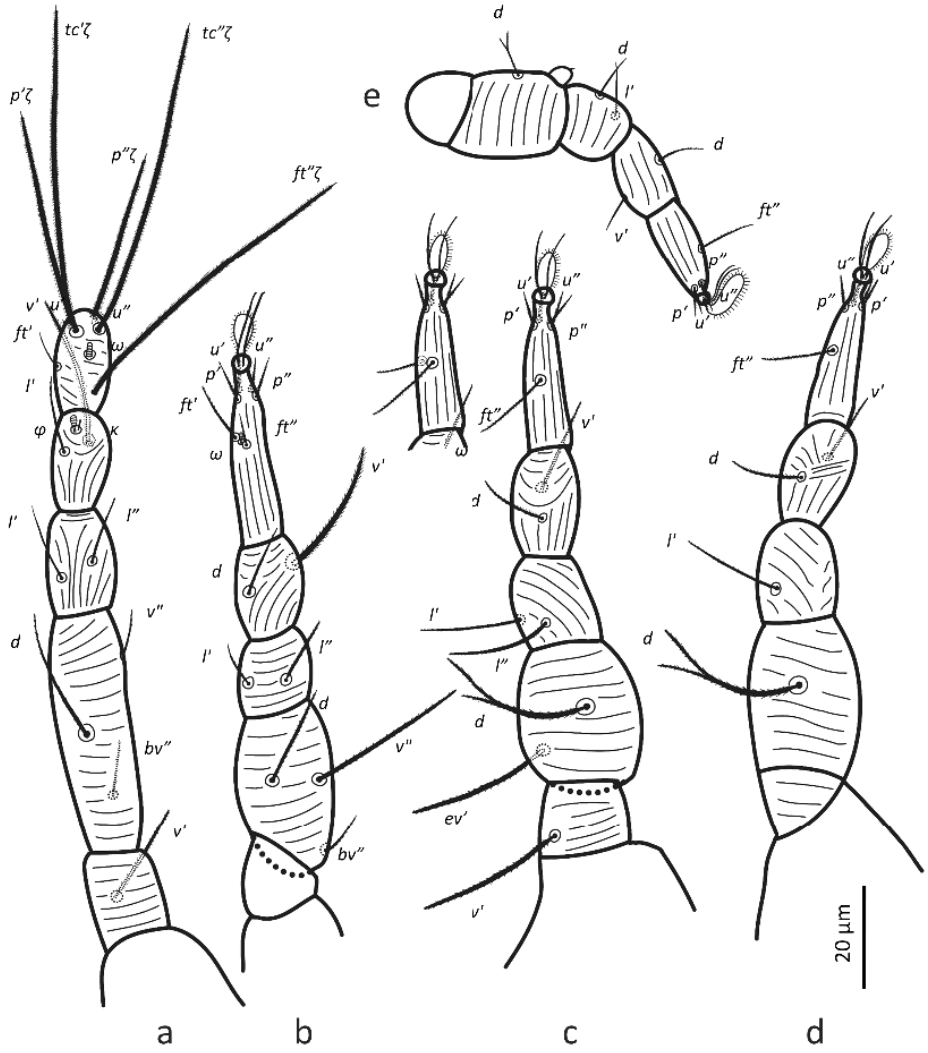

Figure 7 *Parapronematus connarus* De Vis & Ueckermann **n. sp.** legs: a–d female: a – Leg I; b – Leg II; c – Leg III with variation on the number of setae on tarsus III (five or six setae); d – Leg IV; e – Male, leg IV.

bifurcated famulus κ but this not always visible, and tip can also appear as a knot (bifurcation not visible), about half as long as solenidion φ. Tarsus III with six setae, but two specimens with only five (specimens 113 and 112 in Table 1; probably shortest, most distal *ft'* absent and no setal base visible); these two specimens lack the other leg III, so double checking is not possible. Femur IV undivided. Dorsal setae *d* on both femora III and IV forked.

Male (n = 7) (Figures 7, 10)

Idiosoma — Most characters as in female, except: dorsal setae shorter, serrate; with one pair of rounded structures of 11 µm in diameter posterolaterad *e1*, genital opening with two pairs of eugenital setae. Femora III and IV each with forked seta relatively shorter than in female. Femur IV with a small and pointed dorso-distal adaxial spur inserted on a thumb-like process (Figure 7).

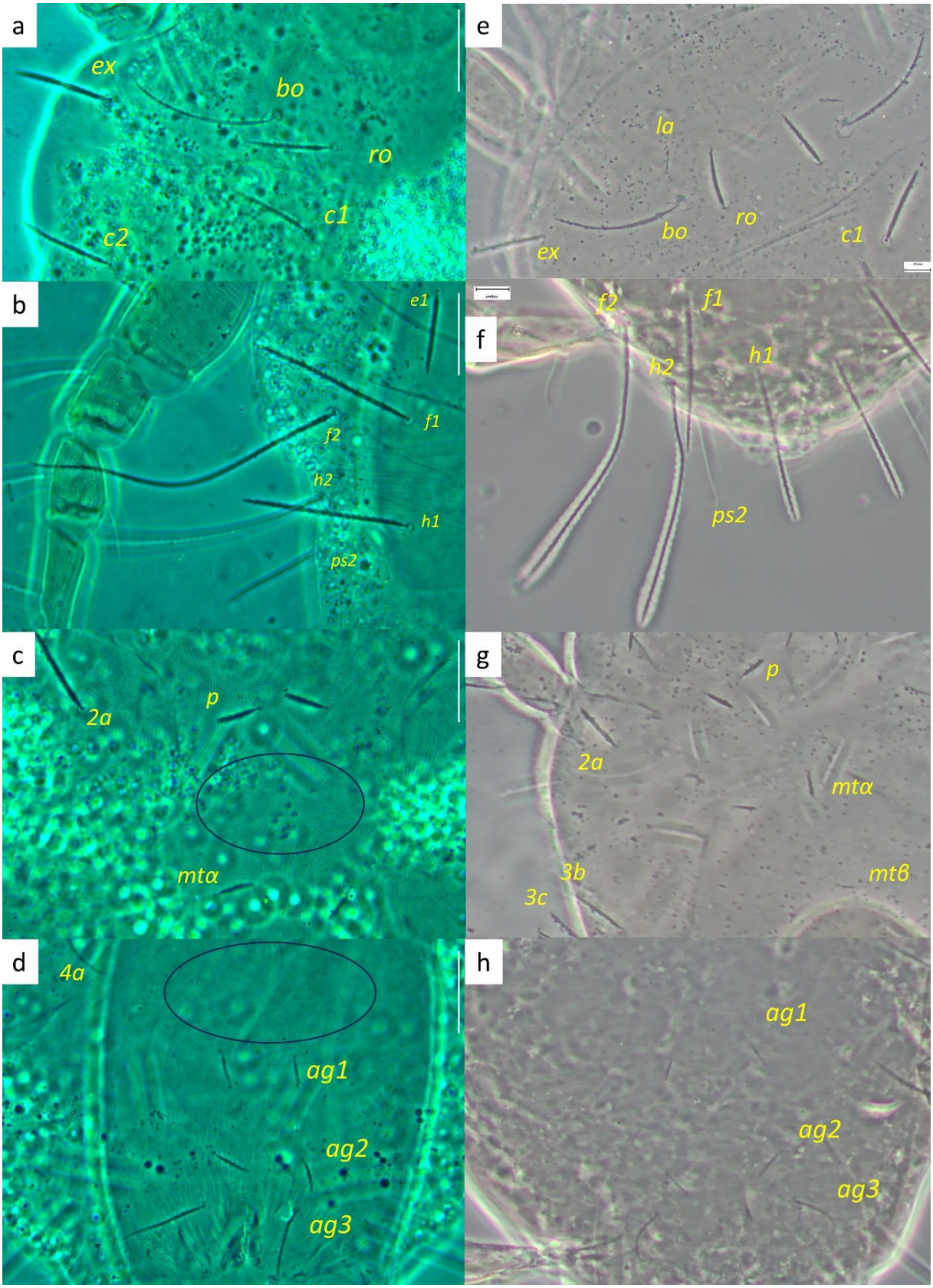

Figure 8 *Parapronematus connarus* De Vis & Ueckermann **n. sp.**: a – Aspidosoma; b – Posterior region of dorsum of idiosoma; c – Anterior region of venter of idiosoma with transverse spindle-shaped striae (within ellipse); d – Posterior region of venter with transverse spindle-shaped striae (within ellipse) and genital area; e–h *Parapronematus geminus* Meyer & Rodrigues: e – Aspidosoma; f – Posterior region of dorsum of idiosoma; g – Anterior region of venter of idiosoma, transverse spindle-shaped striae not visible; h – posterior region of venter, transversal spindle-shaped striae not visible and genital area. Scalebar for a–d = 20 µm.

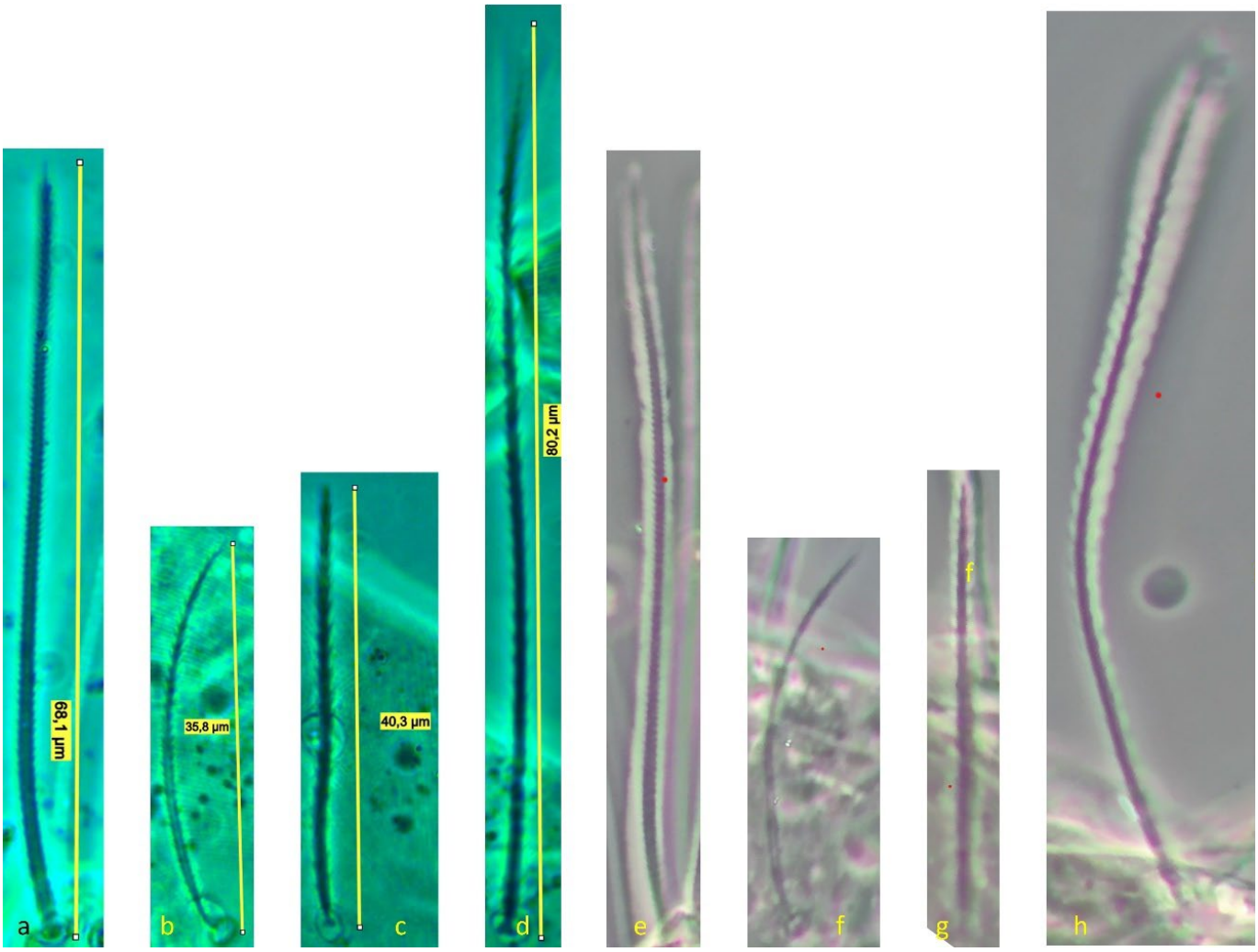

Figure 9 Different setae of *Parapronematus connarus* De Vis & Ueckermann **n. sp.**: a – *tc"ζ*, b – *bo*, c – *f1*, d – *f2*; and *Parapronematus geminus* Meyer & Rodrigues, 1966: e – *tc"ζ*, f – *bo*, g – *f1*, h – *f2*.

Tritonymph (n = 5) (Figure 11)

Dehiscence line anteriad *bo*, *ro* and *ex*, projecting toward *ro*; idiosomal and leg chaetotaxy as in adults. Lyrifissures clearly visible. Epimeral formula as in female. With longitudinal invagination connecting genital and anal openings. With distal excrescence, inserted anteriad anal opening and bending over it. Seta *ft'* on tarsus III present. Dorsal setae on femur III not forked or with one very short branch (1 µm); femur IV with dorsal seta not forked.

Deutonymph (n = 1)

Dehiscence line as in tritonymph. Idiosomal chaetotaxy as in female but with only one *ag* seta instead of three. Epimeral formula as in female. With longitudinal invagination connecting genital and anal openings. With distal excrescence as in tritonymph. Leg chaetotaxy as in female, but with trochanter I nude instead of with one seta; with one dorsal seta on tarsus III instead of two (*ft'* lacking); and setae on femora III and IV not forked. Hence, leg chaetotaxy as follows: leg I ($8 + \omega - 2 + \varphi + \kappa - 2 - 3 - 0$); leg II ($6 + \omega - 2 - 2 - 3 - 0$); leg III ($5 - 2 - 2 - 2 - 1$); leg IV ($5 - 2 - 1 - 1 - 0$).

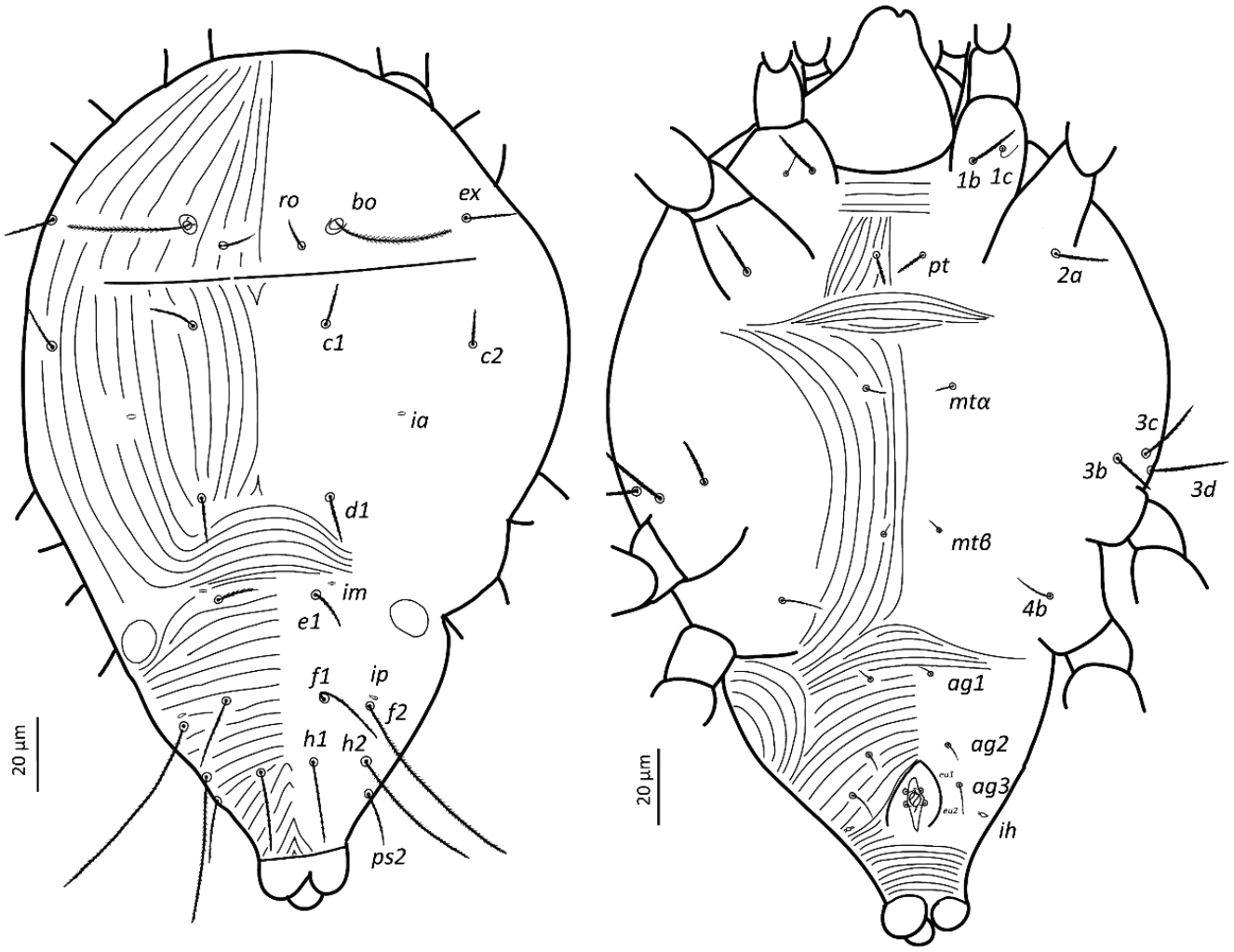

Figure 10 *Parapronematus connarus* De Vis & Ueckermann **n. sp.**: dorsum (left) and venter (right) of male.

Protonymph (n = 2)

Dehiscence line as in tritonymph. Idiosomal chaetotaxy as in female, but without *ag* setae, with only two setae on coxa III and without setae *mtβ* and *4b*, hence epimeral formula 3-1-3-0. With longitudinal invagination connecting genital and anal opening. With distal excrescence as in tritonymph. Leg chaetotaxy as in female but trochanter I nude instead of with one seta, with only five setae on tarsus III instead of six, and leg IV segments nude except tarsus, as in female. Hence, protonymph with the following chaetotaxy: leg I (8 + ω – 2 + φ + κ – 2 – 3 – 0), leg II (6 + ω – 2 – 2 – 3 – 0); leg III (5– 2 – 2 – 2 – 1); leg IV (5– 0 – 0 – 0 – 0).

Larva (n = 2)

Idiosomal chaetotaxy as female but all *ag* setae absent and coxa III with only one seta (*3c* and *3d* absent); epimeral formula 3-1-2. Leg chaetotaxy as in female, but with no unguinal setae (*u*), trochanter III nude instead of with one seta. Thus, chaetotaxy: leg I (6 + ω – 2 + φ + κ – 2 – 3 – 0), leg II (6 + ω – 2 – 2 – 3 – 0), leg III (5– 2 – 2 – 2 – 0). Tarsus I with small pad like empodium, without claws (*om*), setae *p* and *ft* not eupathidial, setae *tcζ* eupathidial.

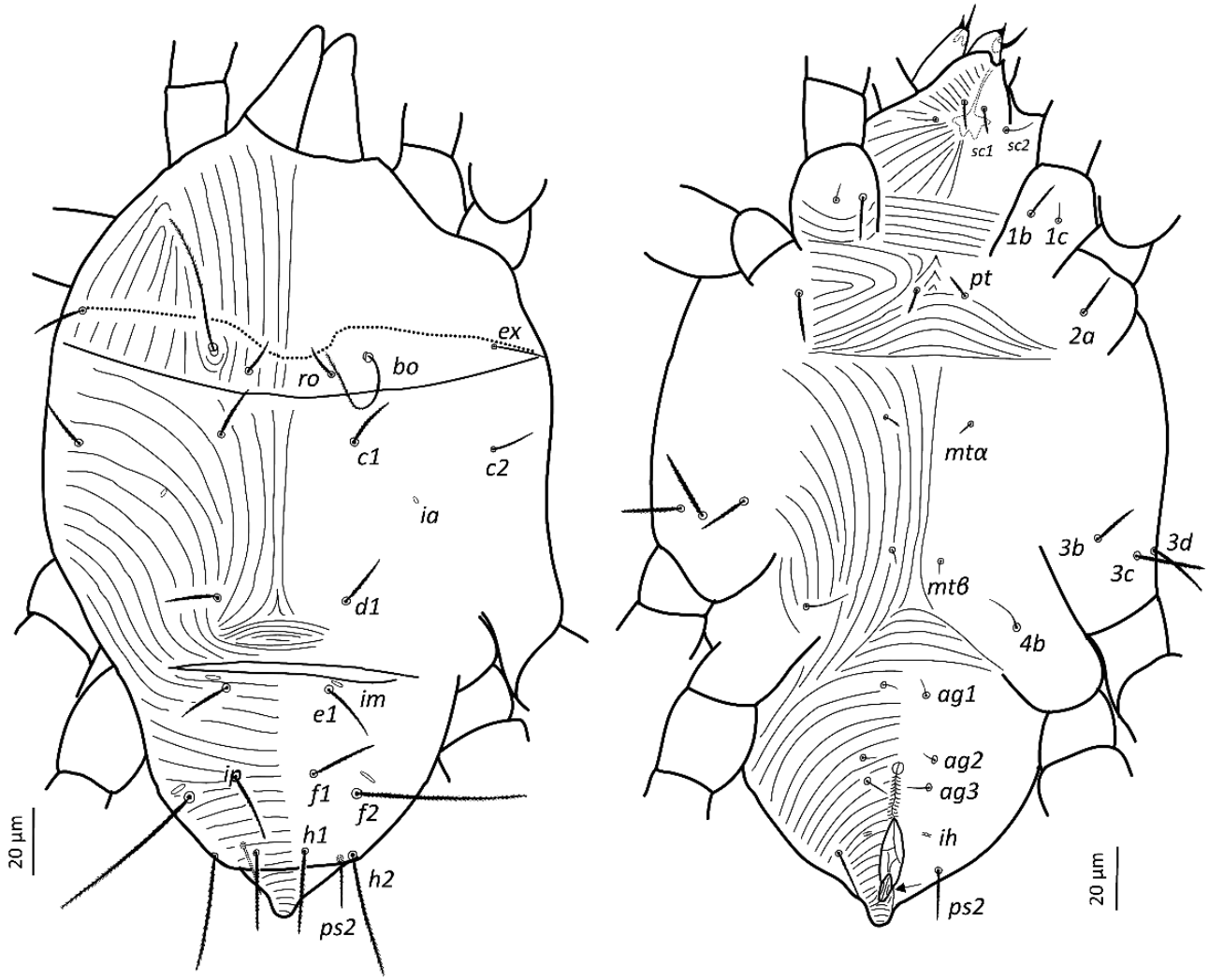

Figure 11 *Parapronematus connarus* De Vis & Ueckermann **n. sp.** Tritonymph: dorsum (left) with dehiscence line anterior to aspidosomal setae; venter (right), arrow indicates distal excrescence bending over the anal opening.

Differential diagnosis

This species differs from *P. geminus* by having three setae on aspidosoma instead of four; from *P. formosanus* by having three setae on each of femora I and II instead of two; from *P. citri* by having dorsal setae *ro, ex, c1, c2, d* and *e2* longer than 13 µm; from *P. acaciae* by having setae *f1* 30 ± 0,9 (25–41) 19, *h1* 33 ± 0,7 (28–43), *h2* 56 ± 0,6 (51–63) shorter and *p"ζ* 42 ± 0,6 (38–47), instead of *f1*≈49 , *h1*≈49, *h2*≈68 and *p"ζ*≈34; and from *P. camelia*, *P. ferox* and *P. murshidabadensis* by having *tc"*/tarsus I > 3 instead of < 2 (see Table 3).

Remarks

Parapronematus connarus De Vis & Ueckermann **n. sp.** shows great variability in relation to the number of setae on tarsus III and some setal lengths. Two specimens (112 and 113) have five setae (*ft'* absent) on tarsus III instead of six. Together with specimen 121, these have longer setae *ro*, *c2*, *f1*, *f2*, *h1*, *3d*, *ag2* and *ag3* than the other specimens of the same new species (Table 1), with specimen 122 (MZLQ 4386) showing other aberrations. Still, other characteristics of these specimens were the same as in other specimens. The bold setae of specimens 112 (MZLQ

4387), 113 (MZLQ 4388) and 121 (MZLQ 4404) do not differ from the holotype. Therefore, we do not consider these three specimens to belong to a different species. Baker (1965) and André (1980) were not clear on that, mentioning the presence of five or six setae on tarsus III in species of this genus. Additionally, although the differences in setal lengths might support the thesis that they belong to a different species, the two specimens with five setae on tarsus III were found together with three specimens with six setae on a single host plant. Seta *ft'* appears during ontogeny in the tritonymph.

The seta on trochanter I and the second dorsal seta on tarsus III also appear in the tritonymph of *Homeopronematus*, *Quasihomeopronematus* (André 1980; De Vis and Ueckermann 2024b), *Pseudopronematulus* (De Vis and Ueckermann 2024a) and *Proctotydaeus* (André 1980). This seems to be a general pattern.

Type specimens and depository

Parauapebas, Pará, J.D. Lacerda, on *Connarus* sp., July 2023, holotype female (MZLQ 4386); on *Clusia rosea*, July 2023, 5 paratype females (MZLQ 4387–4391); on *Eucalyptus* spp., July 2023, paratype female (MZLQ 4392), 2 paratype deutonymphs (MZLQ 4393 and MZLQ 4394); on *Andropogon gayanus*, July 2023, paratype female (MZLQ 4395); on *Arrabidaea chica*, July 2023, paratype female (MZLQ 4396); on *Musa paradisiaca*, July 2023, paratype male (MZLQ 4397); on *Sida rhombifolia*, July 2023, paratype tritonymph (MZLQ 4398); on *Stachytarpheta* sp., July 2023, paratype female (MZLQ 4399); on *Connarus* sp., July 2023, paratype male (MZLQ 4400); on *Syzygium malaccense*, July 2023, 2 paratype males (MZLQ 4401 and MZLQ 4402). Piracicaba, São Paulo State, R.M.J De Vis, on *Hevea brasiliensis*, July, 2002, paratype male (MZLQ 4403); on *H. brasiliensis*, April- May, 2003, 4 paratype females (MZLQ 4404, MZLQ 4405, MZLQ 4406, MZLQ 4407, MZLQ 4408), 2 paratype larvae (MZLQ 4409 and MZLQ 4410), 2 paratype protonymphs (MZLQ 4409), 3 paratype tritonymphs (MZLQ 4404, MZLQ 4411 and MZLQ 4412). Pontes e Lacerda, Mato Grosso State, N.J. Ferla, on *H. brasiliensis*, date unknown, paratype female (MZLQ 4413); *H. brasiliensis*, September-October 1999, 2 paratype females (MZLQ 5658 and MZLQ 5659), paratype male (MZLQ 5659). Itambé, Pernambuco, M.G.C. Gondim Jr., on *Acrocomia intumescens*, July 1998, paratype female (MZLQ 4414), paratype tritonymph (MZLQ 4473). All types deposited at the Mite Reference Collection, ESALQ-USP, Piracicaba, São Paulo State, Brazil.

Etymology

The species is named after *Connarus*, the genus of the host plant of the holotype.

PCA analysis

The characteristics that define the major differences between the specimens are setae *f1*, *f2*, *h1*, *3d*, *ag3*, *tc'ζ*, *tc"ζ* and *p'ζ* (Figure 12A, Table 1). Specimens 112, 113 and 121 stand out from the other specimens (Figure 12B).

Reappraisal of *Parapronematus*

Most of the descriptions of species of this group are rather incomplete. Several of them do not have measurements and none indicates the variability of measurements. Most do not provide scale bars in illustrations. Characters of doubtful value have been used to distinguish species while characters of recognizable value are not always considered. Although complementary descriptions should be done, in this work we could only redescribe *P. geminus*, as in most cases the museums in which they are deposited do not allow their shipment.

None of the descriptions mentions lyrifissures. However, in our specimens, lyrifissures could be seen in most males and all immatures, despite not always visible in adult females.

Similarly, striae are very fine and indistinct in part of the body of several species. We suppose that they are present but not always visible. In our specimens, digital augmentation shows striae in specimens where striae are not distinguishable under phase contrast microscopic

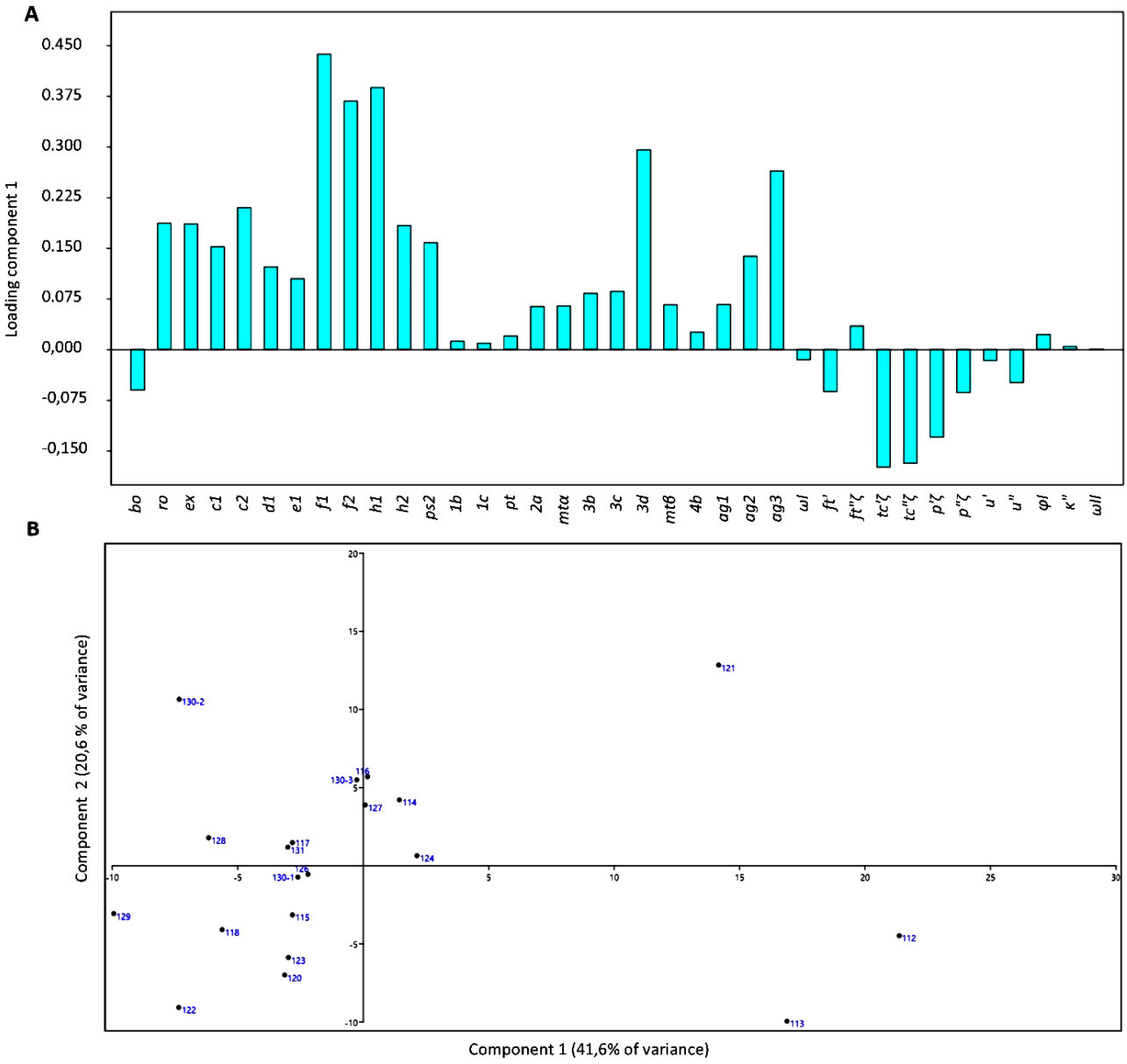

Figure 12 Principal component analysis (PCA) of measurements of *Parapronematus connarus* De Vis & Ueckermann **n. sp.** females.A. Loading of component one for different characters. B. Scatter plot of 20 individual females (including 112: MZLQ 4387, 113: MZLQ 4388, 121: MZLQ 4404).

examinations at 1000 X. It seems that this characteristic is influenced by mounting conditions. We therefore do not consider this a reliable characteristic for distinguishing species based on publications of distinct authors (as used for the characterization of *P. citri*, e.g.).

As the species are not sclerotized, distances between setae are influenced by the state of the mite when mounted, mounting conditions, as the amount of medium used and the 'pressure' on the specimens, the presence of folds, etc. These aspects will lead to inaccurate measurements of distance between setae. Thus, we also consider this characteristic inadequate to separate species.

Likewise, length of the dorsal setae on femora III and IV in relation to the width of the segment seems a characteristic of questionable value. We believe that the width or height of

Table 1 Length and distances between dorsal and ventral setae of *Parapronematus connarus* De Vis & Ueckermann **n. sp.** stages (mean, min-max). Aberrant values of specimens 112 (MZLQ 4387), 113 (MZLQ 4388) and 121 (MZLQ 4404) are given in bold. Specimen 122 (MZLQ 4386) is the holotype.

	Female					Male	Tritonymph	Deutonymph	Protonymph	Larva
	All	Spc. 112	Spc. 113	Spc. 121	Spc. 122					
bo-h1	190 (170–231)	191	198	182	188	134 (126–146)	156 (146–172)	112	108 (97–120)	89 (88–89)
width (at level *c1)*	184 (155–212)	198	194	168	196	124 (109–138)	151 (147–158)	133	110 (103–116)	102 (101–103)
bo	44 (39–50)	41	39	50	40	33 (32–35)	42 (40–44)	39	36 (35–37)	33 (33–34)
bo-bo	52 (46–62)	58	62	51	56	37 (33–45)	46 (40–50)	44	37 (37–38)	29 (29–30)
ro	18 (16–22)	**22**	**22**	**20**	16	10 (8–12)	11 (9–13)	117	9 (8–9)	9 (8–10)
ro-ro	27 (23–36)	34	36	28	28	19 (16–21)	24 (21–26)	23	21 (19–22)	16 (15–16)
ex	23 (20–27)	27	25	26	23	13 (10–15)	15 (13–17)	14	11 (10–11)	12 (11–12)
c1	21 (18–29)	21	21	**29**	19	12 (9–15)	15 (13–17)	17	13 (13–14)	14 (13–14)
c2	22 (18–26)	**26**	**24**	**26**	18	9 (8–11)	14 (13–16)	13	11 (11–12)	14 (13–16)
c1-c1	52 (39–66)	48	49	48	54	33 (31–35)	41 (36–46)	35	34 (34–35)	35 (34–37)
d1	21 (19–26)	23	22	**26**	20	13 (11–16)	15 (13–17)	15	12 (12–13)	12 (11–13)
d1-d1	51 (34–60)	55	59	53	60	32 (31–33)	40 (38–43)	34	31 (31–32)	32 (31–32)
e1	21 (19–26)	22	20	**26**	19	13 (10–15)	15 (13–19)	15	11 (10–11)	10 (10–11)
e1-e1	42 (36–63)	43	49	42	43	25 (22–27)	30 (28–34)	26	22 (21–22)	24 (24–25)
f1	30 (25–41)	**39**	**41**	**35**	30	19 (17–21)	19 (16–22)	17	13 (13–14)	11 (11–12)
f1-f1	36 (29–45)	44	45	37	34	24 (24–26)	26 (23–33)	20	17 (16–17)	12 (12–13)
f2	73 (67–81)	**81**	**77**	**79**	70	47 (45–52)	52 (49–55)	45	34 (33–344)	26 (24–28)
h1	33 (28–43)	**43**	**39**	**38**	32	22 (21–24)	22 (19–26)	19	14 (14–15)	11 (10–11)
h2	56 (51–63)	58	56	**63**	51	34 (32–37)	36 (35–37)	19	21 (20–22)	15 (14–15)
ps2	24 (21–29)	**29**	**28**	25	21	16 (14–18)	17 (15–21)	19	9 (8–9)	4 (3–4)
1b	18 (17–20)	19	17	19	18	13 (12–15)	13 (12–13)	12	9 (9–10)	9 (9–10)
1c	8 (6–10)	9	7	8	6	6 (5–7)	6 (5–9)	5	4 (4–5)	5 (4–5)
pt	11 (10–13)	11	11	13	11	9 (8–10)	8 (7– 9)	6	6 (5–6)	5 (5–6)
pt-pt	16 (11–21)	16	21	15	17	13 (11–16)	16 (15–17)	14	14 (14–15)	15 (14–15)
2a	21 (17–23)	22	21	23	21	15 (12–16)	14 (12–16)	12	11 (10–12)	10 (10–11)
mtα	9 (6–11)	9	11	10	9	7 (6–8)	6 (5–8)	5	4 (4–5)	4 (4–5)
mtα-mtα	31 (22–42)	33	37	30	22	22 (18–25)	26 (219–31)	25	23 (22–24)	24 (23–25)
3b	20 (17–22)	22	19	20	19	13 (11–14)	13 (11–15)	12	9 (9–10)	10 (9–10)
3c	32 (28–36)	33	30	35	30	18 (15–20)	22 (20–24)	22	15 (15–16)	Absent
3d	26 (21–32)	**32**	**31**	**32**	25	16 (14–17)	18 (13–21)	14	Absent	Absent
mtβ	7 (5–9)	8	9	7	6	5 (4–7)	5 (4–5)	4	Absent	Absent
mtβ-mtβ	21 (17–26)	20	-	19	22	15 (13–18)	16 (15–20)	19	Absent	Absent
4b	15 (13–18)	17	-	17	13	11 (9–14)	10 (8–12)	8	Absent	Absent
ag1	7 (6–9)	8	9	7	6	5 (5–,6)	4 (4–6)	4	Absent	Absent
ag1-ag1	17 (13–24)	18	24	15	15	9 (9–10)	11 (8–14)	11	Absent	Absent
ag2	8 (7–12)	**12**	**11**	8	7	5 (4–6)	5 (3–7)	absent	Absent	Absent
ag2-ag2	29 (14–47)	22	24	29	30	20 (18–22)	20 (18–22)	absent	Absent	Absent
ag3	15 (12–22)	**22**	**21**	14	20	8 (8–10)	7 (2–10)	absent	Absent	Absent
ag3-ag3	37 (22–65)	23	22	34	45	28 (24–32)	21 (18–24)	absent	Absent	Absent

femora are also influenced by the mounting conditions. So, any parameter comparing the length of the dorsal setae with the width of the segment may be inaccurate and should preferably not be used to separate species. This type of problem seems of lesser importance in relating the length of eupathidia and length of tarsus I. Hence, in this publication the ratio between the lengths of *tc"ζ* and of tarsus I is taken into account in the separation of species.

The length of individual setae, even on the same species, can differ significantly, so relative length can also vary, for practical reasons. The tips of the setae can break off and that may be overlooked. We therefore recommend measuring setae of Pronematinae at 1000 X for higher confidence on measurements.

André (1979: 204) considered the description of a new genus based on a single specimen to be unadvisable, except when the specimen exhibits very special characteristics. We propose to extend this suggestion to the description of new species. For Phytoseiidae, Tixier (2012) concluded that measurement of at least ten specimens is necessary to express variability reliably. We, therefore, suggest describing new taxa only when several specimens are available, unless the specimen exhibits special characteristics assumed to be of lower variability.

The position of the solenidion on tarsus I is used as a distinctive character in the *Paraprone-*

Table 1 Continued.

	Female					Male	Tritonymph	Deutonymph	Protonymph	Larva
	All	Spc. 112	Spc. 113	Spc. 121	Spc. 122					
eu1	Absent	absent	absent	absent	absent	3 (3–4)	Absent	absent	Absent	Absent
eu2	Absent	absent	absent	absent	absent	4 (3–5)	Absent	absent	Absent	Absent
palptarsus	23 (20–26)	24	24	26	21	16 (14–18)	20 (19–22)	13	13 (12–13)	12 (12–13)
palp *p* 'ζ	6 (4–8)	8	7	6	7	4 (4–5)	5 (5–6)	3	3 (3–4)	3 (3–4)
stylet	13 (11–15)	11	14	14	14	10 (10–11)	12 (10–12)	10	10 (10–11)	9 (8–9)
leg I	142 (129–154)	140	139	147	141	110 (100–123)	118 (106–132)	84	68 (67–70)	67 (66–68)
leg II	121 (112–134)	116	114	128	122	99 (94–112)	108 (101–118)	83	66 (65–66)	64 (64–65)
leg III	119 (109–147)	125	113	147	124	89 (82–101)	109 (100–125)	77	70 (68–71)	69 (67–70)
leg IV	123 (111–135)	127	111	131	127	95 (86–107)	108 (91–129)	76	65 (63–67)	Absent
tarsus I length	24 (23–26)	24	23	24	23	21 (18–24)	22 (20–24)	18	16 (15–16)	17(16–17)
tibia I length	22 (20–25)	22	20	24	22	18 (17–20)	19 (18–21)	14	12 (12–13)	12 (11–12)
ωI	5 (4–6)	4	4	6	4	4 (3–5)	3 (3–4)	2	2 (1–2)	2 (2–3)
ft'ζ	12 (9–16)	9	9	16	-	9 (7–11)	10 (8–11)	8	6 (6–7)	6 (6–7)
ft"ζ	69 (63–73)	69	69	-	63	539 (49–61)	44 (38–52)	29	11 (10–11)	9 (9–10)
tc'ζ	72 (67–79)	67,5	67	-	-	56 (47–63)	51 (47–59)	41	31 (31–32)	22 (21–23)
tc"ζ	70 (65–76)	66,8	65	-	-	55 (51–60)	49 (44–55)	39	32 (32–33)	30 (29–31)
p'ζ	51 (44–58)	46,7	47	-	48	39 (36–45)	34 (31–40)	26	19 (19–20)	7 (6–7)
p"ζ	42 (38–47)	39,1	40	-	38	31 (26–345)	25 (23–32)	20	16 (16–17)	6 (6–7)
u'	4 (2–5)	3	3	4	2	3 (2–5)	3 (2–3)	4	3 (2–3)	Absent
u"	4 (2–5)	3	3	3	2	3 (2–4)	2 (2–3)	3	3 (2–3)	Absent
φI	3 (2–4)	3	3	3	2	2 (2–3)	3 (2–4)		-	2 (1–2)
κ"	2 (2–3)	3	2	3	-	2 (1–2)	2 (1–2)	2	-	2 (2–3)
ωII	3 (2–4)	3	2	3	2	2 (2–3)	1 (1–2)	13	2 (1–2)	1 (1–2)
tibia II *v'*	32 (30–34)	31	30	34	31	24 (22–25)	24 (22–27)	22	18 (17–18)	16 (15–17)
tibia II *d*	19 (17–22)	18	19	22	18	12 (11–13)	13 (12–15)	10	8 (7–8)	7 (6–7)
femur II *v"*	36 (31–40)	37	39	40	33	25 (23–28)	26 (24–27)	23	17 (16–18)	17 (16–17)
femur II *d*	25 (23–29)	24	25	27	23	14 (12–17)	20 (18–23)	15	13 (12–13)	13 (12–13)
tarsus III *ft'*	10 (8–11)	-	-	10	9	8 (7–8)	7 (5–9)	absent	Absent	Absent
tarsus III *ft"*	19 (17–21)	19	17	20	17	14 (14–15)	14 (13–15)	11	9 (9–10)	10 (9–10)
tibia III *v'*	20 (18–23)	23	20	22	19	15 (13–16)	15 (15–16)	10	9 (8–9)	8 (8–9)
tibia III *d*	16 (13–17)	16	16	17	13	11 (9–13)	12 (11–13)	9	8 (8–9)	8 (8–9)
femur III *ev'*	31 (28–34)	34	32	32	28	21 (21–23)	22 (21–24)	18	15 (15–16)	13 (12–13)
femur III *d*	36 (32–40)	36	35	40	34	17 (13–20)	30 (27–32)	27	22 (22–23)	20 (20–21)
long fork	16 (10–21)	16	14	21	16	7 (3–10)	11 (8–15)	absent	Absent	Absent
short fork	12 (8–15)	9	11	15	10	5 (4–8)	2 (1–3)	absent	Absent	Absent
tibia IV *v'*	16 (14–22)	16		22	17	12 (9–13)	12 (11–14)	9	Absent	Absent
tibia IV *d*	17 (16–20)	18	19	17	16	12 (11–14)	13 (11–15)	10	Absent	Absent
femur IV *d*	39 (34–44)	38	34	44	36	15 (13–18)	33 (26–36)	24	Absent	Absent
long fork	19 (14–25)	17	15	25	15	8 (6–9)	7 (10–15)	absent	Absent	Absent
short fork	14 (10–18)	13	12	18	13	5 (4–6)	3 (6–9)	absent	Absent	Absent

matus key of Gupta (2002). However, this is not always clearly presented in illustrations of different species.

The number of setae on tarsi III and IV varies between species, so it could be considered a reliable feature to separate species. However, in *P. connarus* **n. sp.**, we found two specimens with five setae on tarsi III and IV instead of six in the majority of the specimens. This characteristic is not always clearly stated in the descriptions, and we see discrepancies between the text of descriptions and the respective illustrations (e.g. *P. acaciae* Baker, 1965) and in all descriptions but that of *P. formosanus*, leg figures are unclear or incomplete.

It is concluded that a revision of the whole genus is necessary, starting with a redescription of its type species and the creation of eventual new genera according to the generic concept of André (1980). Types of *P. acaciae* can only be studied in the museum where they are deposited. Thus, in this publication we selected characteristics that allow the separation of the species, although many uncertainties remain concerning other characteristics. A provisional re-characterization of *Paraprone matus* is subsequently provided, based on what is available in the literature, the examination of the type specimens of the new species here described (*P. connarus* **n. sp.**) and the complementary description of *P. geminus*, provided in this publication.

Additionally, a discussion about the other species placed in the genus is presented, concerning their main characteristics and the limitation of the information available in the literature.

Diagnosis of *Parapronematus*

Adult females with three pairs of setae on the aspidosoma (*la* lacking, except in one species), nine pairs on the dorsum of the opisthosoma (*ps1* and *ps3* lacking), three pairs of *ag*, three setae on tibia I and two on genu I instead of respectively four and three in all other pronematid genera. Two setae on genu II, trochanter II nude, and one seta on femur IV. Only two other genera have three *ag* setae, but they have different leg I setation. Aberrations of some species concerning the type species: one species with four setae (*la* present) on aspidosoma, three of the seven species with five setae on tarsus III instead of six (the species described below has five or six setae on tarsus III), one species with two setae on each of femora I and II instead of three.

Complementary description

Adult female. Aspidosoma procurved, with 3 –4 pairs of setae (*bo*, *ro* and *ex*; *la* absent in all but one species); opisthosoma with nine pairs of setae (*c1*, *c2*, *d1*, *e1*, *f1*, *f2*, *h1*, *h2* and *ps2*; *ps1* and *ps3* absent) and four pairs of lyrifissures (*ia*, *im*, *ip* and *ih*). Eye spots absent. Three pairs of *ag* setae. One pair of genital papillae. Leg I without pretarsus; each of other legs with ciliate empodium and two claws, without empodial hooks. Seta homologous to *s* on tarsus I absent. Femur IV undivided. Leg chaetotaxy (tarsus to trochanter; aberrations from type species in bold): leg I ($8 + \omega - 2 + \varphi + \kappa - 2 -$ **2** or $3 - 1$); leg II ($6 + \omega - 2 - 2 -$ **2** or $3 - 0$); leg III (**5** or $6 - 2 - 2 - 2 - 1$); leg IV ($5 - 2 - 1 - 1 - 0$). Epimeral formula 3-1-4-2.

Remarks

According to the concept of André (1980), new genera should be defined for: i) species having setae *la*; ii) species having two setae on each of femora I and II; and iii) species having five setae on tarsus III. However, to describe a new genus, a full description of the type species is needed. A redescription of *P. geminus* (seta *la* present) is presented underneath based on two paratypes; but more specimens are needed to determine variability. Type specimens of other species could not be studied, and the respective descriptions are sometimes ambiguous, with contradictions between the text and the illustrations, including the type species of *Parapronematus*. So, we prefer not to create new genera, given the impossibility of making a complete description of the type species, adapting the generic descriptions of Baker (1965) and André (1980). The latter author mentioned 5–6 setae on tarsus IV in his diagnosis of the genus. None of the descriptions of *Parapronematus* species mentions tarsus IV with six setae. Hence, in the complementary description of this genus in this publication, the variation of six setae on tarsus IV is not mentioned, despite being detected in some of the specimens of the new species described in this work, as this could be just a case of aberration.

We suppose that the following setae are absent in *Parapronematus* (not mentioned in original descriptions): tibia I, *d*; genu I, *v′*; tarsus II *tc″*; genu II, *v′*; trochanter II, *v′*; tarsus III, *ft ′*(shortest seta); tarsus IV, *ft′* (shortest seta); and femur IV, *ev′*.

Type species

Parapronematus acaciae Baker 1965.

Parapronematus acaciae Baker, 1965

Parapronematus acaciae Baker, 1965: 116.
Parapronematus acacia, Gupta 2002: 121.

The original description of this species is extremely basic, with no measurements or details in the illustration. In the complementary description of Gupta (2002), he used part of the original description and all drawings of the original description, with no new measurements.

The type specimens could not be studied because they could not be loaned; hence, in this publication, the length of setae of the dorsal part of opisthosoma and of tarsus I were estimated (Table 2) based on the illustrations provided in the original description.

We found the following inconsistencies between the description and the illustrations: tarsus III is depicted with five setae, instead of six in the description of the genus. Also, according to the original description, "The forked seta of femur IV is at least twice as long as the width of the segment", but in the illustration, the length of the seta and the width of the segment are similar. For the moment, we retain the genus description with six setae on tarsus III and the estimated setal lengths as distinguishing characteristics and we consider the relative length of the dorsal setae of femora III and IV to the width of the segment as an unreliable characteristic. However, we are convinced that the species needs a redescription, especially for being the type of the genus.

As distinguishing characters, we retain: *f1* **49**, *h1* **49** and *h2* **68**, which are clearly longer than in *P. camelia*, *P. formosanus*, *P. murshidabadensis* and *P. connarus* **n. sp.** Eupathidia long, *tc"ζ* /tarsus I≈**3.0** but seta *p"ζ* **34** is shorter than in *P. connarus* **n. sp.** (37.5–47.3 µm), tarsus III with six and tarsus IV with five setae, according to the text of the original description of the genus.

Parapronematus camelia Gupta, 1992

Parapronematus camelia Gupta, 1992: 126.
Parapronematus cameliae, Gupta 2002: 121.

The description of this species is basic and lacks many measurements and detailed figures. We see inconsistencies between the textual description and the illustrations: Figure 58 shows a decrease in length of setae *f2*, *h2*, *f1* and *h1*; seta *ps2* is not depicted, while in the description the lengths of these setae are *D4* (*f1*) = 31, *L2* (*f2*) 56, *D5* (*h1*) 36 and *L3* (*h2*) 23. It is unclear which setal nomenclature is followed. On basis of the figure, we would switch the length of setae mentioned in the text (*h*) to *h1* 23 and *h2* 36. Figure 59 seems to be leg I instead of palp and the limit between tarsus and tibia as well as between femur and trochanter are not depicted, nor are the solenidia. In the text, "*ωI* thick and *φI* very small", but neither of them is illustrated. We suppose that *φI* has been confounded with *κ*. So, we cannot use the form of *φI* as a distinguishing parameter.

As distinguishing characters, we retain: *f2* short (56 µm); seta *c2* stout and lanceolate, other setae thin and pointed; eupathidia intermediate, *tc"*/tarsus I≈2.2; tarsus III with six and tarsus IV with five setae, according to the illustration of the original description.

In the original description, the species was named *Pronematus camelia* (the designation *camelia* is a name in apposition). In his monograph, Gupta (2002) changed the name to *P. cameliae*. We believe that that change is not justified.

Parapronematus citri Salviejo, 1969

Parapronematus citri Salviejo, 1969: 272.

The description of this species is also basic and lacks measurements, although the illustrations are rather detailed, showing some important characteristics, as follows: setae *ro*, *ex*, *c1*, *c2*, *d1* and *e1* very short (less than half as long as *f1*), thick and lanceolate; *f1* about 2/3 as long as *h1*; *f2* slightly over twice as long as *f1*; *h2* about 1.2 times as long as *h1* (Table 1). The number of setae on tarsus IV is mentioned in the text to be "as for the genus" (five setae), whereas the illustration seems to show six setae (not totally clear). We suppose it to be five.

We consider to be distinctive characteristics of this species: setae *ro*, *ex*, *c1*, *c1*, *d1* and *e1* **11**–**13**, shorter than all other setae; eupathidia long (*tc"*/tarsus I≈3.0); tarsi III and IV respectively with six and five setae.

Parapronematus ferox Gupta, 1991

Parapronematus ferox Gupta, 1991: 231.
Parapronematus ferox, Gupta, 2002: 123.

The description of this species is very basic and lacks most measurements and detailed illustrations. The long *f1* in relation to *f2* in Figure 58 of the original description is noteworthy. Double checking it would be convenient; if correct, this characteristic would be sufficient to distinguish this from all other species. The lengths of the dorsal setae of femora III and IV were not provided, but they seem to be longer than in other species. There is a contradiction between the descriptive text and the illustration concerning the number of setae on tarsus III; in the text it is mentioned to be the same as reported for the genus, while the illustration shows both tarsi III and IV with five setae.

Distinguishing characteristics: *f1* almost twice as long as *f2* (the opposite in all other species); setae *ro*, *ex*, *c1*, *c2*, *d1* stout and lanceolate; other dorsal setae on opisthosoma, thin and pointed; eupathidia short (*tc"*/tarsus I≈1.5); tarsi III and IV each with five setae (based on the illustration of the original description).

Parapronematus formosanus Tseng, 1985

Parapronematus formosanus Tseng, 1985: 85.

The description of this species is detailed, missing few measurements, although information on variability was not provided. The illustrations are detailed, though without scale bars. Striae are shown on dorsum and venter of the idiosoma. The ventral setae are illustrated in detail, varying from the very broad and leaflike *pt* to the lanceolate *mtβ*.

Calls attention the statement "legs strongly sclerotized, brown in colour". As far as we know no other sclerotised species have been reported in Iolinidae. Two inconsistencies were detected between the descriptive text and the illustrations: in the differential diagnosis with *P. acaciae*, femora III and IV are mentioned to have two pairs of setae each. We suppose that this should refer to femora I and II, as described in the table with the number of setae on the legs and the depicted number of setae in the illustrations. Secondly, the text mentions the presence of striae in a diamond pattern anteriad *ag1*, which seems to be correct, while the pattern is illustrated in Figure 130 anteriad *mtβ*.

As distinguishing characteristics, we retain: setae *ro*, *ex*, *c1*, *c2*, *d1* and *e1* stout and lanceolate, other dorsal setae on opisthosoma long, thin and pointed; eupathidia of intermediate length (*tc"*/tarsus I≈2.2); two setae on each of femora I and II (instead of the usual three); tarsi III and IV each with five setae; setae *pt*, *mtα* and *mtβ* barbed, from leaflike to lanceolate.

Parapronematus geminus Meyer & Rodrigues, 1966

Parapronematus geminus Meyer & Rodrigues, 1966: 21.

(Figures 8g-h, 13–15)

Adult female (n = 2)

Measurements — Measurements of different structures are shown in Table 2.

Idiosoma — (Figure 13). Ovaloid, tapering posteriorly. Completely covered with fine striae with tiny tubercles, not clearly visible. Aspidosoma with four pair of setae (*bo, ro, la* and *ex*), of which *la* very short, and opisthosoma with nine pairs of setae (*c1, c2, d1, e1, f1, f2, h1, h2* and *ps2*; *ps1* and *ps3* absent).

Dorsum — (Figures 8e-f, 13). Striae barely visible, in parts of the dorsum. Aspidosoma with striae longitudinal medially, progressively more divergent towards *das* furrow laterally. Opisthosoma with median longitudinal striation, divergent towards *das* furrow, but only patches of striae visible, divergent between levels of *d1* and e*1*, transverse between setae *e1* and *h1* and then divergent towards posterior margin.

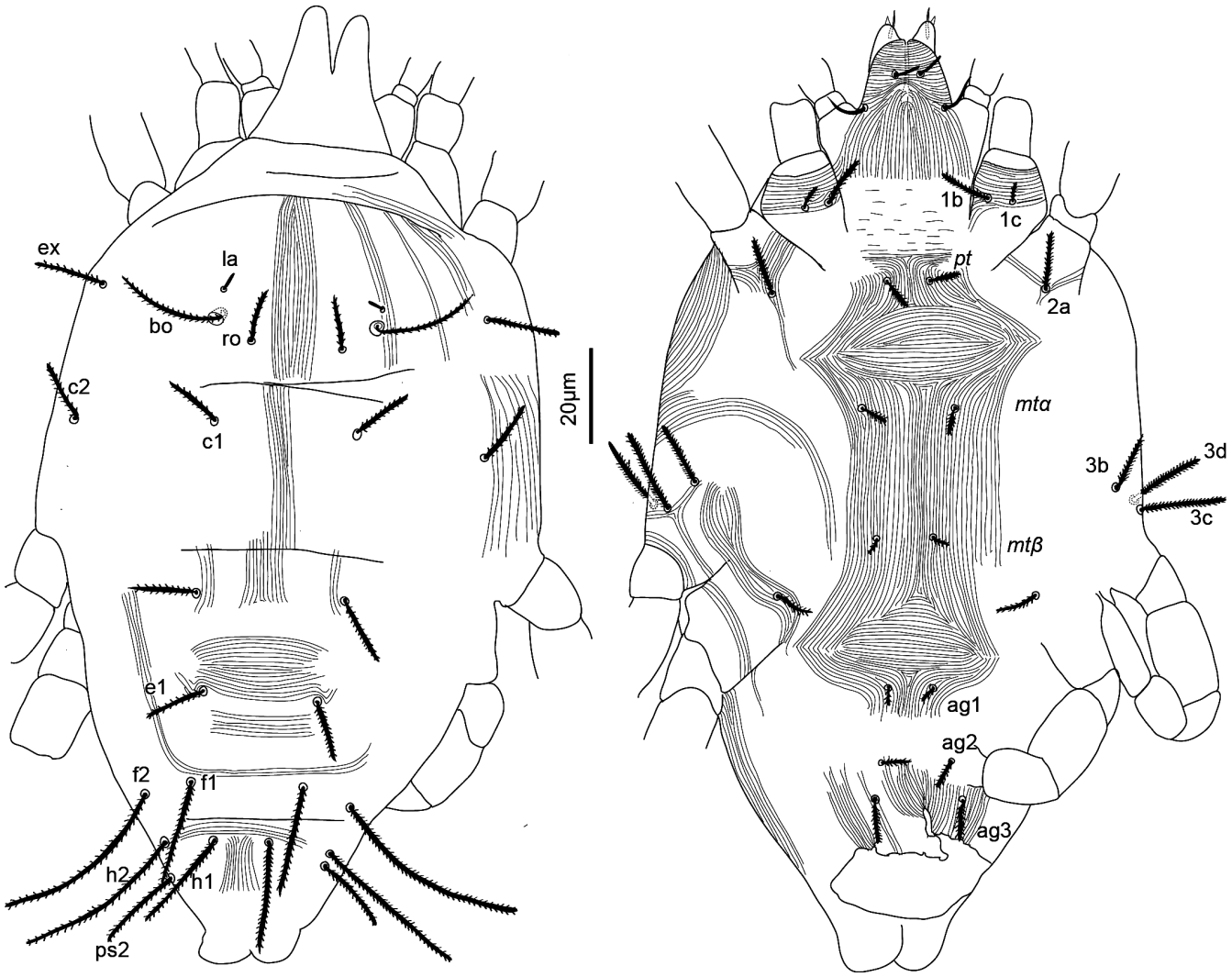

Figure 13 *Parapronematus geminus* Meyer & Rodrigues 1966: dorsum (left) and venter (right) of paratype female.

Idiosomal setae acute and clearly serrate (Figures 8e-f, 9g-h, 13); trichobothrial seta (*bo*) longer than *ex*, which is in turn longer than *ro*; *bo* barbed (Figures 8e, 9b, 13); seta *la* very short and smooth. Setae *f2* (Figures 9h, 13) and *h2* longest followed by *f1* (Figures 9g, 13) and *h2*, and then *ps2, d1* and *c1*, with *c2* shortest. Setae *c1, d1* and *e1* not reaching bases of *d1*, *e1* and *f1*, but *f1* longer than distance between its base and the base of *h1*. Seta *ps1* absent.

Venter — (Figures 8g-h, 13). Area immediately posteriad gnathosoma with transverse striation; striation longitudinal between setae *pt* and between setae *mtα* and *mtβ*; two areas of spindle-shaped striation pattern between *pt* and *mtα* and immediately anteriad *ag1*.

With three pairs of *ag* setae anterolaterad anal opening; genital papillae not distinguishable. Seta *ps3* absent. Lyrifissure *ih* not distinguishable.

Gnathosoma — (Figure 14).

With two pairs of scapular setae, *sc1* 8 (8) and *sc2* 10 (12), both serrate and slender; setae *or1* and *or2* not distinguishable; striae in section anteriad *sc1* almost transverse; in section between *sc1* and *sc2* converging anteromedially. Palptarsus elongate, with a distal forked eupathidium *pζ*; setae *l′* and *l″* curved towards eupathidium; seta *d* forked at tip; *l′* the most proximal, followed by seta *d*; setae *l″* and *v* at about same levels; all setae smooth and of similar thickness; solenidia *ω* and *ba* not distinguishable, chaetotaxy (5-1-2). Femorogenu length 20

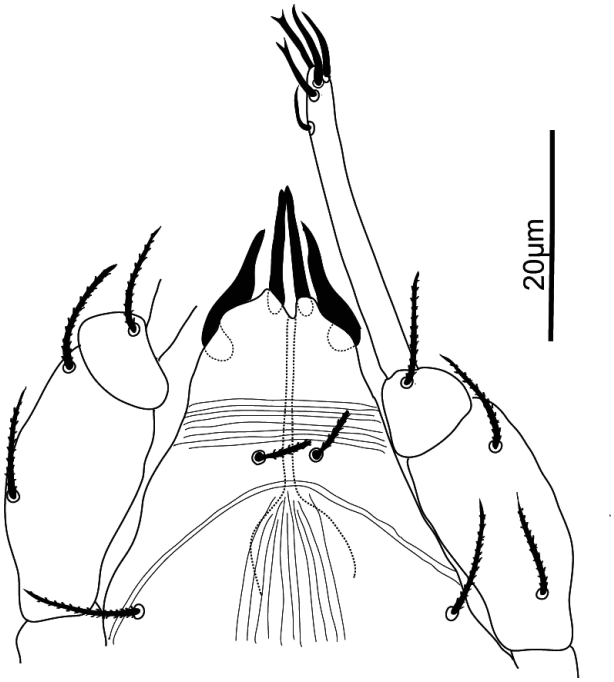

Figure 14 *Parapronematus geminus* Meyer & Rodrigues 1966. Female: ventral view of gnathosoma with palp of paratype female.

(23), width 11 (11).

Legs — (Figure 15). Chaetotaxy: leg I (8 +*ω*–2+*φ*+k – 2 – 3 – 1); leg II (6+ *ω* – 2 – 2 – 3 – 0); leg III (5 – 2 – 2 – 2 – 1); leg IV (5 – 2 – 1 – 1 – 0). Epimeral formula: 3 – 1–4 – 2. All non-solenidion leg setae acute, serrate and stout. Leg I with solenidion *ω* not reaching tip of tarsus, eupathidia *ft"ζ*, *tc'ζ*, *tc"ζ* (Figure 9a), *p'ζ* and *p"ζ* barbed for the entire length, tectals subequal, shorter prorals not as long, with *p"ζ* the shortest; with a pair of small forked unguinal setae proximal to prorals on ventral side; seta homologous to *s* between prorals absent (see Ueckermann and De Vis *et al.* 2024). Tibia I with bifurcated famulus *κ* but this is not always visible, about same length as solenidion *φ*. Seta *d* on femur III forked. Femur IV undivided and with seta *d* also forked.

Adult male (n = 2 paratypes, in poor condition)

Idiosoma — Most characters same as in female. Dorsal setae shorter. Distance *bo-h1* 140, width at level *c1* 134, *bo* 30; *bo-bo* 43; *ro* 12; *ro-ro* 21; *la* 4; *la-la* 38; *ex* 16; *c1* 16; *c1-c1* 36; *c2* 10; *d1* 14; *d1-d1* 31; *e1* 12; *e1-e1* 30; *f1* 21; *f1-f1* 24; *f2* 40; *h1* 23; *h2* 37; *ps2* 17, *1b* 12; *1c* 5; *pt* 9; *pt-pt* not possible to measure; *2a* 16; *mtα* 6; *mtα-mtα* 24, remaining setae cannot be measured.

Legs — Femora III and IV with forked setae. Femur IV with a dorso-distal, adaxial pointed spur (Figure 15e). Other measurements: leg I 102; tarsus I 19; tibia I 16; tarsus I setae: *ft'* 8; *ft"ζ* 42; *tc'ζ* 53; *tc"ζ* 48 *p'ζ* 37; *p"ζ* 31.

Differential diagnosis

This species closely resembles *P. connarus* **n. sp.**, by having similar setal lengths and shapes. It can be distinguished from *P. connarus* **n. sp.** and other species of the same genus by having seta *la* and five setae on each of tarsi III and IV.

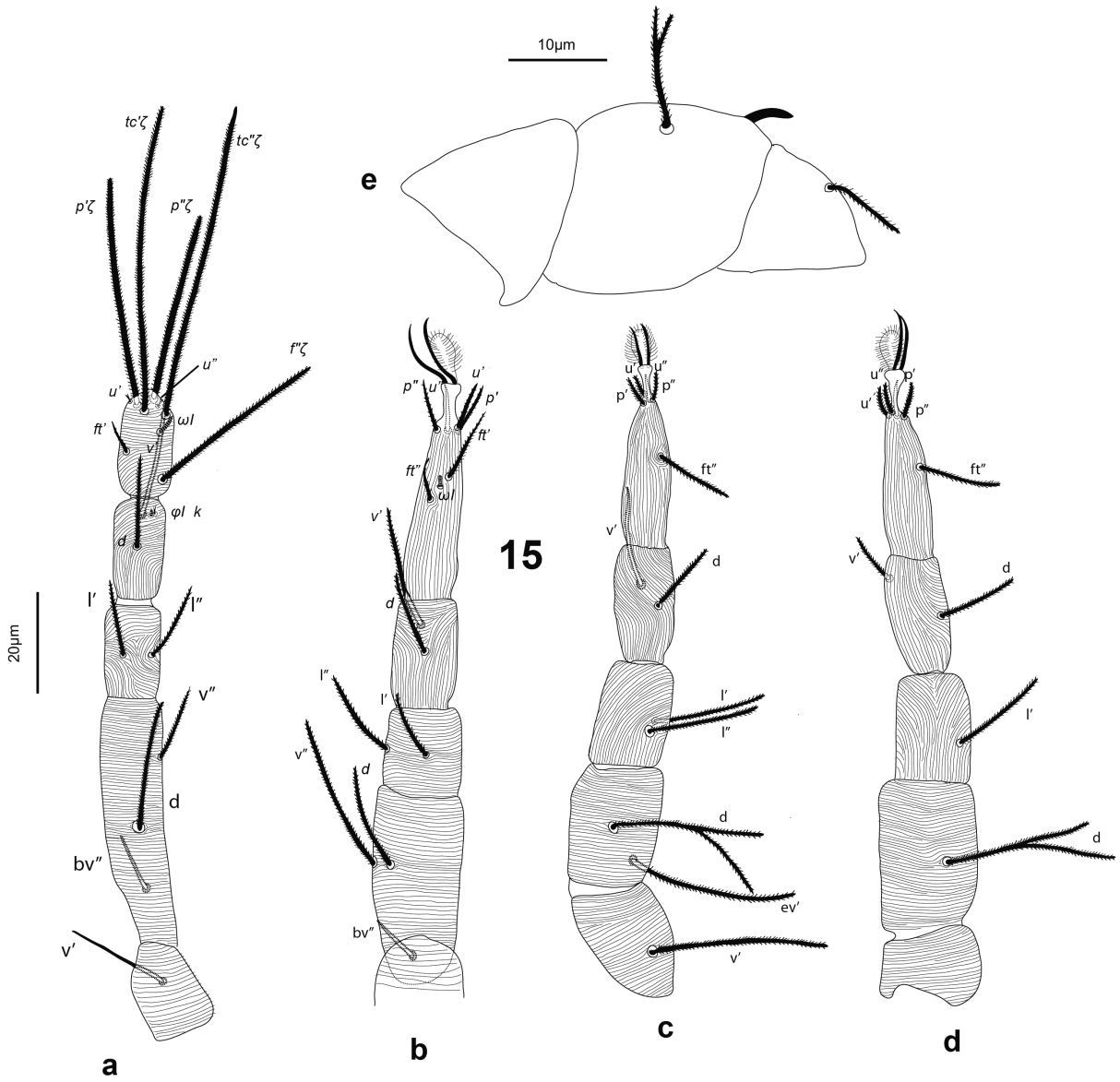

Figure 15 *Parapronematus geminus* Meyer & Rodrigues, 1966: a–d, legs of female; a – Combination of holotype and paratype leg I; b – Holotype leg II; c – Holotype leg III; d – Holotype leg IV; e – Paratype male leg IV.

Type specimens and depository

Holotype female, from *Gossypium* sp., R. Quetxoaio, Mozambique, April 16, 1964, M.C. Rodrigues; paratype female, from *Mangifera indica*, Morrumbala, Mozambique, March 25, 1964, M.K. P. Meyer; paratype male, from *Gossypium* sp., Kaidundjua, Mozambique, April 17, 1964, M.C. Rodrigues; paratype male, from shrub, Raraga, Mozambique, March 18, 1964, M.K.P. Meyer.

Holotype female (accession number Acy 65/30) and paratype female (accession number Acy 65/137), paratype male (accession number Acy 65/37), paratype male (accession number Acy 65/142) at Mite Collection, ARC-Plant Health Protection, Pretoria, South Africa, NCA (Zhang 2018).

Parapronematus murshidabadensis Gupta, 1992

Parapronematus murshidabadensis Gupta, 1992: 126.
Parapronematus murshidabadensis, Gupta, 2002: 123.

The description of this species is basic, missing many measurements and detailed illustrations. In contrast with the description of *P. camelia*, in the description of *P. murshidabadensis* the relative lengths of the setae in the description coincide with what is shown in the illustration: *D4* (*f1*) 44, *L2* (*f2*)78, *D5* (*h1*) = 40, *L3* (*h2*) 56. The used nomenclature does not coincide with that of Baker (1965). Solenidion *ωI* stout, *φI* extremely small and blunt. We suppose that in this case *φ1* is confused with *κ*. As an inconsistency within the text of the original description, it is stated in the key to species that the solenidion on tarsus I is placed in the middle of the segment, whereas in Figure 65 of Gupta (1992) it appears in the distal half.

Distinguishing characteristics: seta *f1* nearly twice as long as *e1* (44 and 21). Setae *f1*, *f2*, *h1* and *h2* (44, 78, 40, 56) longer than in other species and *ft"ζ* relative short, less than half length of *p"ζ* (figure 65 of Gupta, 1992). Setae *ro*, *ex*, *c1*, *d1* and *e1* thick and lanceolate; other dorsal setae of opisthosoma long, thin and pointed (*c2* unclear); eupathidia intermediate; *tc"*/tarsus I≈1.7, but tarsus I seems long; tarsi III and IV each with five setae.

Key to the *Parapronematus* species

Based on the previous considerations, a key is subsequently provided to separate the species of this genus. This should be considered provisional, until a thorough re-examination of type specimens or newly collected specimens is done.

1. Aspidosomal seta *la* present (despite very short, ≈5–7 µm) . . . . . *P. geminus*
— Aspidosomal seta *la* absent 2

2 (1). Two setae on each of femora I and II; setae *ro*, *ex*, *c1*, *c2*, *d1* and *e1* (narrowly) lanceolate and serrate; setae *pt mtα* and *mtβ* barbed, from leaflike to lanceolate . . . . . *P. formosanus*
— Three setae on each of femora I and II; dorsal and ventral setae thinner 3

3 (2). Dorsal setae *ro*, *ex*, *c1*, *c2*, *d1* and *e2* short (11–13 µm) . . . . . *P. citri*
— Dorsal setae *ro*, *ex*, *c1*, *c2*, *d1* and *e2* longer than 13 µm 4

4 (3). Ratio *tc"*/tarsus I at least 2.9 5
— Ratio *tc"*/tarsus I at most 2.2 6

5 (4). Setae *f1* 30 ± 0,9 (25–41) 19, *h1* 33 ± 0,7 (28–43), *h2* 56 ± 0,6 (51–63), and *p"ζ* 42 ± 0,6 (38–47) . . . . . *P. connarus* De Vis & Ueckermann **n. sp.**
— Setae *f1*≈**49**, *h1*≈**49**, *h2*≈**68** longer and *p"ζ*≈**34** shorter . . . . . *P. acaciae*

6 (4). Seta *bo*≈31, *f1*≈31 and *h1*≈23; six setae on tarsus III . . . . . *P. camelia*
— Seta *bo*, *f1* and *h1* at least 40% longer than above; five setae on tarsus III 7

7 (6). Seta *f1* twice as long as *f2*; seta *h1*≈**31** . . . . . *P. ferox*
— Seta *f1* slightly shorter than *f2*; seta *h1*≈40 . . . . . *P. murshidabadensis*

In addition to the key provided, Table 3 brings an overview of selected characteristics to separate the *Parapronematus* species.

Reappraisal of Pronematinae

As presently conceived, Pronematinae is composed of 19 genera, depending upon a definition of the validity of the synonymy of *Pausia* Kuznetsov & Livshitz, 1972 under *Naudea* Meyer

Table 2 Comparison of *Parapronematus* species female characteristics as described by the respective author(s). Bold-italic values are estimated based on converting factors calculated from the given values of the length and width of the idiosoma of those species and the given lengths of illustrated structures (see Materials & Methods).

Characteristic	*P. acaciae* Baker (1965)	*P. camelia* Gupta (1992, 2002)	*P. citri* Salviejo (1969)	*P. ferox* Gupta (1991, 2002)	*P. formosanus* Tseng (1985)	*P. geminus** This paper	*P. murshidabadensis* Gupta (1992, 2002)	*P. connarus* **n. sp.** This paper
body length	280	224	265	266	326		278	
bo-h1						192 (180)		190 (170–231)
width at level *c1*	97	145	152	156	179	172 (165)	168	184 (155–212)
bo	***41***	31	***30***	49	35	40 (39)	47	44 (39–50)
bo-bo	***51***		***48***	***40***		56 (52)		52 (46–62)
ro	***20***	25	***12***	24	18	19 (19)	22	18 (16–22)
ro-ro	***33***		***22***	***21***		33(31)		27 (23–36)
la	Absent	Absent	Absent	Absent	Absent	7 (5)	Absent	Absent
la-la	Absent	Absent	Absent	Absent	Absent	55 (55)	Absent	Absent
ex	***27***	22	***13***	***20***	24	23 (26)	24	23 (20–27)
c1	***23***	22	***13***	***16***	19	23 (23)	22	21 (18–29)
c2	***23***	22	***11***			63 (48)	24	22 (19–26)
c1-c1	***56***		***47***	***47***		22 (21)		52 (39–66)
d1	***23***		***13***	***19***	19	25 (25)	21	21 (19–26)
d1-d1	***51***		***38***	***53***		62(51)		51 (34–60)
e1	***26***	22	***13***	***23***	16	23 (22)	21	21 (19–26)
e1-e1	***44***		***32***	***62***		42 (39)		42 (36–63)
f1	***49***	31	***27***	***82***	40	34 (38)	44	30 (25–41)
f1-f1	***44***		***29***	***36***		41 (38)		36 (29–45)
f2	***77***		***59***	***45***	70	69 (68)	78	73 (67–81)
h1	***49***	23	***35***	***31***	26	35 (39)	40	33 (28–43)
h2	***68***		***42***	***54***	54	57 (58)	56	56 (51–63)
ps2	***26***		***24***	***24***	26	27 (29)		25 (21–29)
1b						18 (19)		18 (17–20)
1c						6 (7)		8 (6–10)
pt					11	11 (12)		11 (10–13)
pt-pt					16	16 (14)		16 (11–21)
2a						19 (21)		21 (17–23)
mtα					13	9 (10)		9 (6–11)
mtα-mtα					34	34 (32)		31 (22–42)
3b						20 (23)		20 (17–22)
3c						29 (29)		32 (28–36)
3d						26 (24)		26 (21–32)
mtβ					7	7 (7)		7 (5–9)
mtβ-mtβ					22	27 (19)		21 (17–26)
4b						13 (15)		15 (13–18)
ag1					7	6 (7)		7 (6–9)
ag1-ag1						19 (16)		17 (13–24)
ag2					7	8 (8)		8 (7–12)
ag2-ag2						26 (24)		29 (14–47)
ag3						14 (16)		15 (12–22)
ag3-ag3					18	32 (31)		37 (22–65)

& Rodrigues, 1966. The latter two genera were synonymized by Baker and Delfinado (1976), who considered them to differ only in the number of opisthosomal setae (ten pairs in *Pausia* and nine in *Naudea*). André (1980) considered both valid, without referring to Baker and Delfinado (1976) and providing a brief characterization of each.

Thus, the structure of this section starts with a characterization of the sole species included in *Naudea*, followed by a comparative characterization of the genera, subgenera (of *Proctotydaeus* Berlese, 1911) and species of this subfamily, ending with the presentation of a key to separate the genera and subgenera.

Our examination of the holotype female, one paratype female and the paratype male of the single known species of *Naudea* led to the following characterization.

Naudea richinda Meyer & Rodrigues, 1966

Naudea richinda Meyer & Rodrigues, 1966: 23.
Pausia richinda, Baker & Delfinado, 1976: 35.

Table 2 Continued.

Characteristic	*P. acaciae* Baker (1965)	*P. camelia* Gupta (1992, 2002)	*P. citri* Salviejo (1969)	*P. ferox* Gupta (1991, 2002)	*P. formosanus* Tseng (1985)	*P. geminus** This paper	*P. murshidabadensis* Gupta (1992, 2002)	*P. connarus* **n. sp.** This paper
palptarsus					29	29 (28)		23 (20–26)
palp *p* ′ζ						4 (5)		6 (4–8)
stylet						10 (11)		13 (11–15)
leg I						120 (141)		142 (129–154)
leg III						118 (120)		121 (112–134)
leg III						121 (126)		119 (109–147)
leg IV						127 (131)		123(111–135)
tarsus I length	***23***		***18***		29	23 (24)		24 (23–26)
tibia I length	***22***		***15***		26	19 (21)		22 (20–25)
ωI	***5***	Stout				7 (6)		5 (4–6)
ft′ζ	***12***		***20***			9 (12)		12 (9–16)
ft″ζ	***69***		***54***			73 (72)		69 (63–73)
tc′ζ	***71***		***67***			75 (absent)		72 (67–79)
tc″ζ	***70***		***59***			71(absent)		70 (65–76)
p′ζ	***43***		***47***			49 (51)		51 (44–58)
p″ζ	***34***		***31***			40 (39)		42 (38–47)
u′						0 (3)		4 (2–5)
u″						2 (3)		4 (2–5)
φI						2 (2)		3 (2– 4)
κ″						2 (2)		2 (2–3)
ωII						3 (3)		3 (2–4)
tibia II *v*′						24 (31)		32 (30–34)
tibia II *d*						16 (18)		19 (17–22)
femur II *v*″						39 (37)		36 (31–40)
femur II *d*						25 (24)		25 (23–29)
tarsus III *ft*′	Present	Present	Present	Absent	Absent	Absent	Absent	10 (8–11)
tarsus III *ft*″						17 (18)		19 (17–21)
tibia III *v*′						18 (18)		20 (18–23)
tibia III *d*						12 (15)		16 (13–17)
femur III *ev*′						29 (31)		31 (28–34)
femur III *d*						33 (26)		36 (32–40)
long part						17–20		16 (10–21)
short part						13–15		12 (8–15)
tibia IV *v*′						13 (15)		16 (14–22)
tibia IV *d*						13 (17)		17 (16–20)
femur IV *d*						32 (37)		39 (34–44)
long part						17–20		19 (14–25)
short part						13–14		14 (10–18)

* Holotype, paratype between brackets

Adult female

(Figures 18, 19)

Measurements — (Holotype followed by paratype, the latter in brackets).

Idiosoma — (Figure 16). Elongate-oval. Distance *bo-h1* 137 (140), width at level *c1* 113 (112). Completely covered with fine striae with tiny tubercles, not clearly visible. Aspidosoma with four pairs of setae (*bo*, *ro*, *la* and *ex*) and opisthosoma with ten pairs of setae (*c1*, *c2*, *d1*, *e1*, *f1*, *f2*, *h1*, *h2*, *ps2* and *ps3*); *ps1* absent.

Dorsum — Aspidosoma with striae longitudinal centrally, diverging toward *das* furrow laterally; dorsal part of opisthosoma with median longitudinal striation, diverging toward *das* furrow, about transverse from the level between *d1* and *im* to the level of *f1* and then diverging toward posterior margin.

Eye spots absent. Idiosomal setae aciculate and smooth; seta *bo* about as long as *ex*, which in turn is longer than *ro* and *la*, the latter two subequal. Setae *f2* and *h2* subequal to *bo* and *ex,* longer than other dorsal idiosomal setae; *ro*, *f2* and *h2* the shortest. Setae *c1*, *d1*, *e1* and *f1* not reaching bases of respectively *d1*, *e1*, *f1* and *h1*.

Setal lengths and distances between setae: *bo* 27 (27), *bo-bo* 33 (33), *ro* 15 (15), *ro-ro* 18 (14), *la* 17 (18), *la-la* 30 (31), *ex* 25 (27), *c1* 21 (17), *c1-c1* 25 (27), *c2* 17 (16), *d1* 17 (17), *d1-d1* 25 (26), *e1* 19 (18), *e1-e1* 45 (44), *f1* 14 (13), *f1-f1* 15 (15), *f2* 25 (21), *h1* 14 (14), *h2* 25

(29), *ps2* 16 (15) and *ps3* 6 (7). Lyrifissures *ia* located between setae *c1* and *d1*, *im* immediately anteriad *e1* and *ip* immediately anteriad *f2*.

Venter — Striation mostly longitudinal, except for transverse region immediately behind gnathosoma, between *pt* and *mtα* and immediately anteriad *ag1*; in the latter two regions, striation forming a spindle-shaped pattern, respectively wider than the distance between setae *mtα* and wider than the distance between setae *ag1*.

With four pairs of *ag* setae anterolaterad anogenital area; genital papillae and lyrifissure *ih* not visible.

Setal lengths and distances between setae: *1b* 19 (16), *1c* 13 (11), *pt* 13 (13), 2a 17 (20), *mtα* 11 (13), *3b* 16 (15), *3c* 15 (16), *3d* 17 (16), *mtβ* 11 (11), *4b* 16 (14), *ag1* 9 (10), *ag2* 8 (8), *ag3* 9 (0), *ag4* 12 (0), *pt–pt* 19 (18), *mtα–mtα* 37 (31), *mtβ–mtβ* 29 (24), *ag1-ag1* 25 (22), *ag2-ag2* 12 (12). Anogenital area in both holotype and paratype ruptured, hence distances *ag3-ag3* and *ag4-ag4* are not possible to measure.

Gnathosoma — (Figure 17). Chelicera, with short stylets 14 (17). Subcapitulum with striae almost transverse in section anteriad *sc2* and diverging posteriorly; with two pairs of smooth scapular setae, *sc1* 11 (11) and *sc2* 13 (13); orals *or1* and *or2* not distinguishable. Palptarsus elongate, with a distal eupathidium *pζ* 6 (8), setae *l′*, *l″*, *v* and *d* long and smooth, *l′* inserted more proximal than *d* and *l″* (both at about same level); solenidion *ω* and *ba* not distinguishable, chaetotaxy (5-1-2). Femorogenu length 18 (17), width 8 (9).

Legs — (Figure 18). Chaetotaxy: leg I (8 +*ω*–3+*φ*+k – 3 – 3 – 1); leg II (7+ *ω* – 2 – 3 – 3 – 1); leg III (7 – 2 – 2 – 2 – 1); leg IV (7 – 2 – 1 – 1 + 1– 0). Epimeral formula: 3 – 1 – 4 – 2. All leg setae aciculate and smooth, some ventral setae stouter. Tarsus I without claws, but with empodium; *ft″ζ*, *tc′ζ* and *tc″ζ* the longest setae. Tibia I with bifurcated famulus *κ*, 2(2), which is not always visible, about half length of solenidion *φI,* 2 (3); and seta *v′* very long and stout. Leg II with *ωI* 5(5), tibia with ventral seta *v′* very long 25(24) and stout, seta *d* 16 (16); femur seta *v″* 23(21) and *d* 20(18). Leg III with setae *v′* and *d* of tibia 25(24) and 19(19), respectively, and *ev′* and *d* of femur 17(17) and 16(17), respectively. Leg IV with femur divided, with setae *ev′* 22(18) and *d* 18(16), tibia with setae *v′* and *d* 23(25) and 19(19), respectively. Legs II to IV each with an empodium and two claws distally.

Table 3 Distinguishing characteristics of *Parapronematus* species.

Characteristic		*Parapronematus* species							
		acaciae	*camelia*	*citri*	*ferox*	*formosanus*	*geminus*	*murshidabadensis*	*connarus* **n. sp.**
Presence/absence setae	*la*	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
	# setae on femora I and II	3	3	3	3	2	3	3	3
	# setae on tarsus III	6	6	6	5	5	5	5	6 (5 in few specimens)
Shape of setae	*ro* , *ex* , *c1* , *c2* , *d1* , *e1*	Stout, serrate lanceolate	Stout, lanceolate	Stout, lanceolate	Stout, barbed	Narrow, lanceolate, barbed	Narrow, setose	Stout, lanceolate	Aciculate, broader at base, barbed
	pt mtα mtβ			Barbed, stout to very thin		Barbed, leaflike to lanceolate	Barbed, stout to very thin		Barbed, stout to very thin
Length of setae	*ro* , *ex* , *c1* , *c2* , *d1* , *e1*	23–27	22–25	Short (11–13)	***≈16***–24	16–24	19–26	21–24	16–25
	bo	***≈41****	31	***≈30***	≈49	35	39–40	47	44 (38–50)
	e1	***≈26***	22	***≈13***	***≈23***	16	22–23	21	21 (19–26)
	f1	***≈49***	31	***≈27***	***≈82***	40	34–38	44	30 (25–41)
	f2	***≈77***		***≈59***	***≈45***	70	68–69	78	73 (67–81)
	h1	***≈49***	23	***≈35***	***≈31***	26	35–39	40	33 (28–43)
	h2	***≈68***		***≈42***	***≈54***	54	54	56	56 (51–63)
	p″ζ	***≈34***		***≈31***			39–40		42 (38–47)
	tc″/tarsus I	***≈3.0***	***≈2.2***	***≈3.0***	***≈1.5***	***≈2.2***	≈3.0	***≈1.7***	≈2.9

*The italic bold values are estimated from the respective illustrations (see Material & Methods)

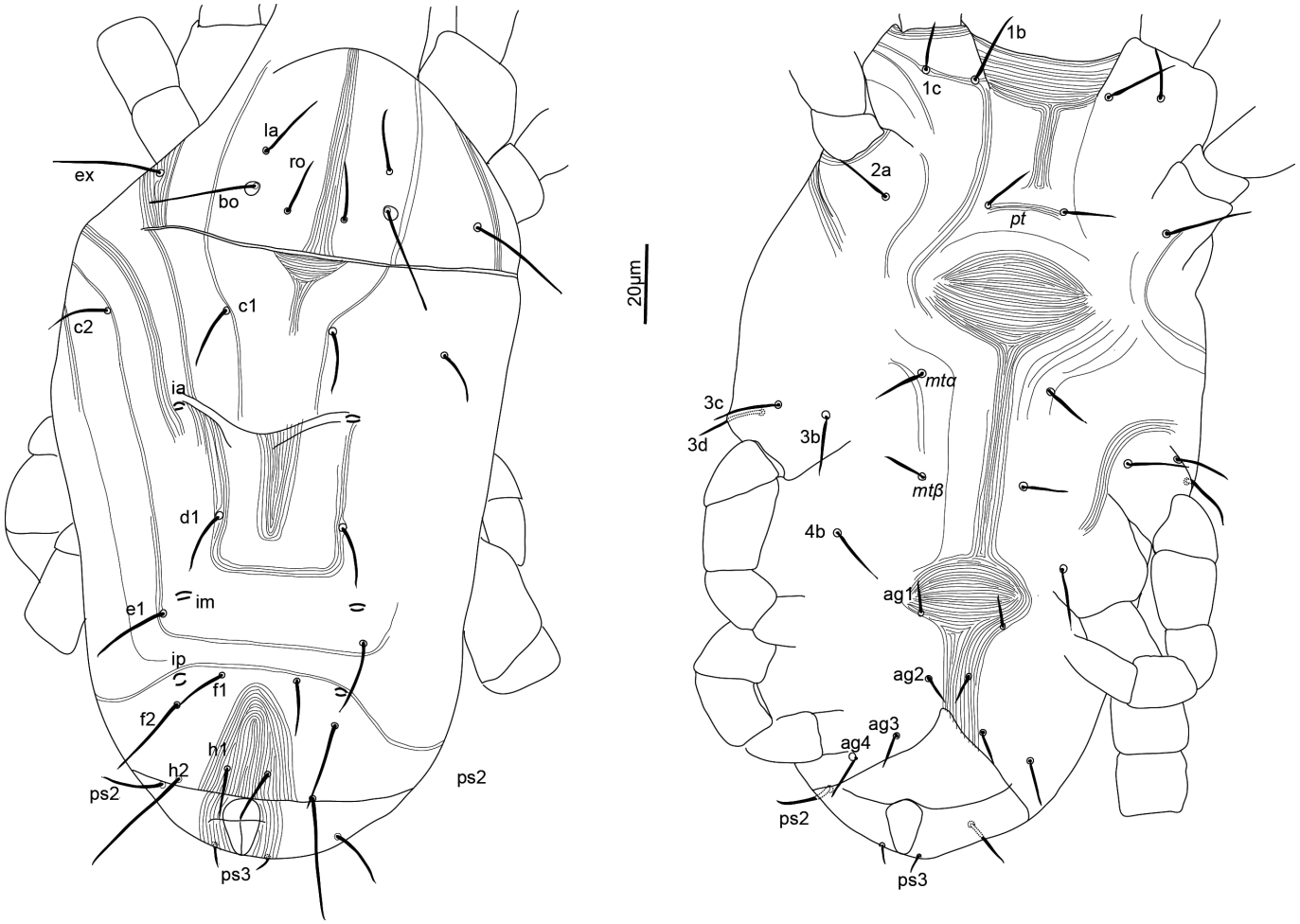

Figure 16 *Naudea richinda* Meyer & Rodrigues, 1966. Dorsum (left) and venter (right) of holotype female.

Adult male

(Figure 19)

Idiosoma: most characters same as in female with the following exceptions: dorsal setae subequal and some even longer than those of female; dorsal part of opisthosoma medially covered with broken striae. Femur IV with a dorso-distal adaxial spur (Figure 18e). Measurements: distance *bo-h1* 117, width at level *c1* 88, *bo* 26, *bo-bo* 25, *ro* 14, *ro-ro* 13, *la* 16, *la-la* 25, *ex* 28, *c1* 23, *c1-c1* 25, *c2* 20, *d1* 24, *d1-d1* 14, *e1* 23, *e1-e1* 29, *f1* 15, *f1-f1* 10, *f2* 24, *h1* 16, *h2* 26, *ps2* 17, *ps3* 5, *1b* 17, *1c* 12, *pt* 12, *pt-pt* 16, *2a* 17, *mtα* 12, *mtα-mtα* 29, *3b* 16, *3c* 18, *3d* 18, *mtβ* 10, *mtβ-mtβ* 23, *4b* 13, *ag1* 8, *ag1-ag1* 18, *ag2* 8, *ag2-ag2* 13, *ag3* 7, *ag3-ag3* 11, *ag4* 11, *ag4-ag4* 20, palptarsus 7, *pζ* 5, stylet 13, *sc1* 11, *sc2* 12, femorogenu length 16, femorogenu width 7, leg I 104, leg II 78, leg III 82, leg IV 93, tarsus I 28, tibia I 20, leg I *ωI* 17, leg I *φI* 3, leg I *k* 2, leg II *ωII* 4, leg II tibia *v′* 21 and *d* 15, leg IV femur *v″* 24 and *d* 18, leg III tibia *v′* 23 and *d* 20, leg III femur *ev″* 16 and *d* 17, leg IV tibia *v′* 20 and *d* 22 femur *ev″* 18 and *d* 13.

Type specimens and depository

Holotype female, paratype female and paratype male from *Gossypium herbaceum*, Tshipise, Limpopo Province, South Africa, 24 March 1965, M.K.P. Smith-Meyer and M. Rodrigues.

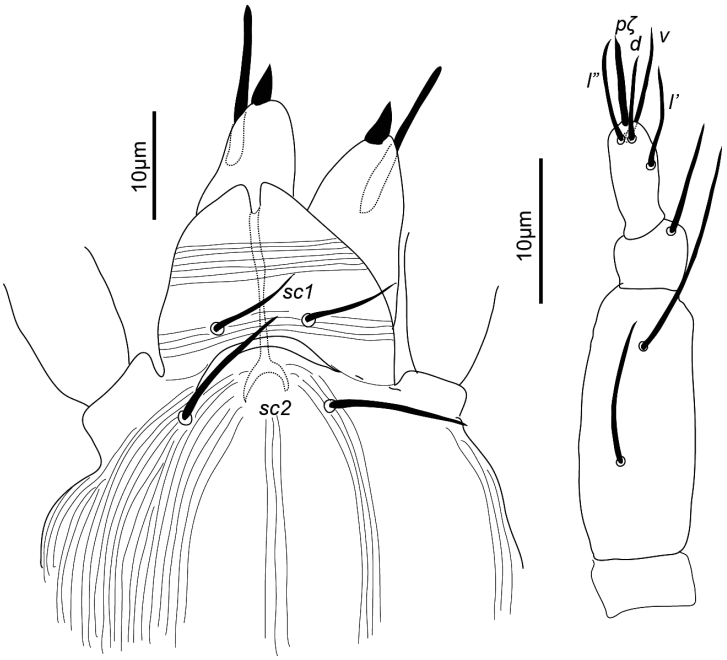

Figure 17 *Naudea richinda* Meyer & Rodrigues, 1966. Female. Ventral view of gnathosoma (left) and palp (right).

Holotype female, paratype female and paratype male (all under the same accession number Acy 65/123), at Mite Collection, ARC-Plant Health Protection, Pretoria South Africa, NCA (Zhang 2018).

Remarks

The characteristics of the type specimens examined led to the conclusion that the types of the only species of this genus differ from the four described *Pausia* species by the number of setae on tarsus II (seven, instead of six), tarsus III (seven, instead of six), the number of setae on tarsus IV (seven, instead of 5–6) and the number of opisthosomal setae (ten instead of 10–11). Moreover, *Pausia* shows several variations in number of setae on different leg segments and on the opisthosoma among species. *Pausia litchiae* Silva, Da-Costa & Ferla is the only species with 10 pairs of setae on the opisthosoma, five setae on tarsus III (instead of six) and two setae on genu IV (instead of one). *Pausia magdalenae* Baker & Definado has only two setae on tibia I (*l'* ? absent) and femur II (*bv"* absent) instead of three in the type species (Baker and Delfinado 1976, Da Silva *et al.* 2017). We recommend studying and/or redescribing, if necessary, *P. litchiae* and *P. magdalenae*, to confirm their aberrant leg chaetotaxy and eventually to transfer them to new genera. Hence, in this publication *Naudea* and *Pausia* are considered different genera. As a result, Pronematinae presently congregates 19 genera, one of which is composed of four subgenera (Kazmierski 1998a), based on Baker (1968b, 1969), Kaźmierski (1998a) and André (2004).

Characterization of genera of Pronematinae

Table 4 shows the diagnostic characteristics of the taxa presently included in Pronematinae, mostly based on an evaluation of the literature, but also including our examination of the specimens collected in this study as well as of type specimens of two previously described species that are redescribed in this publication.

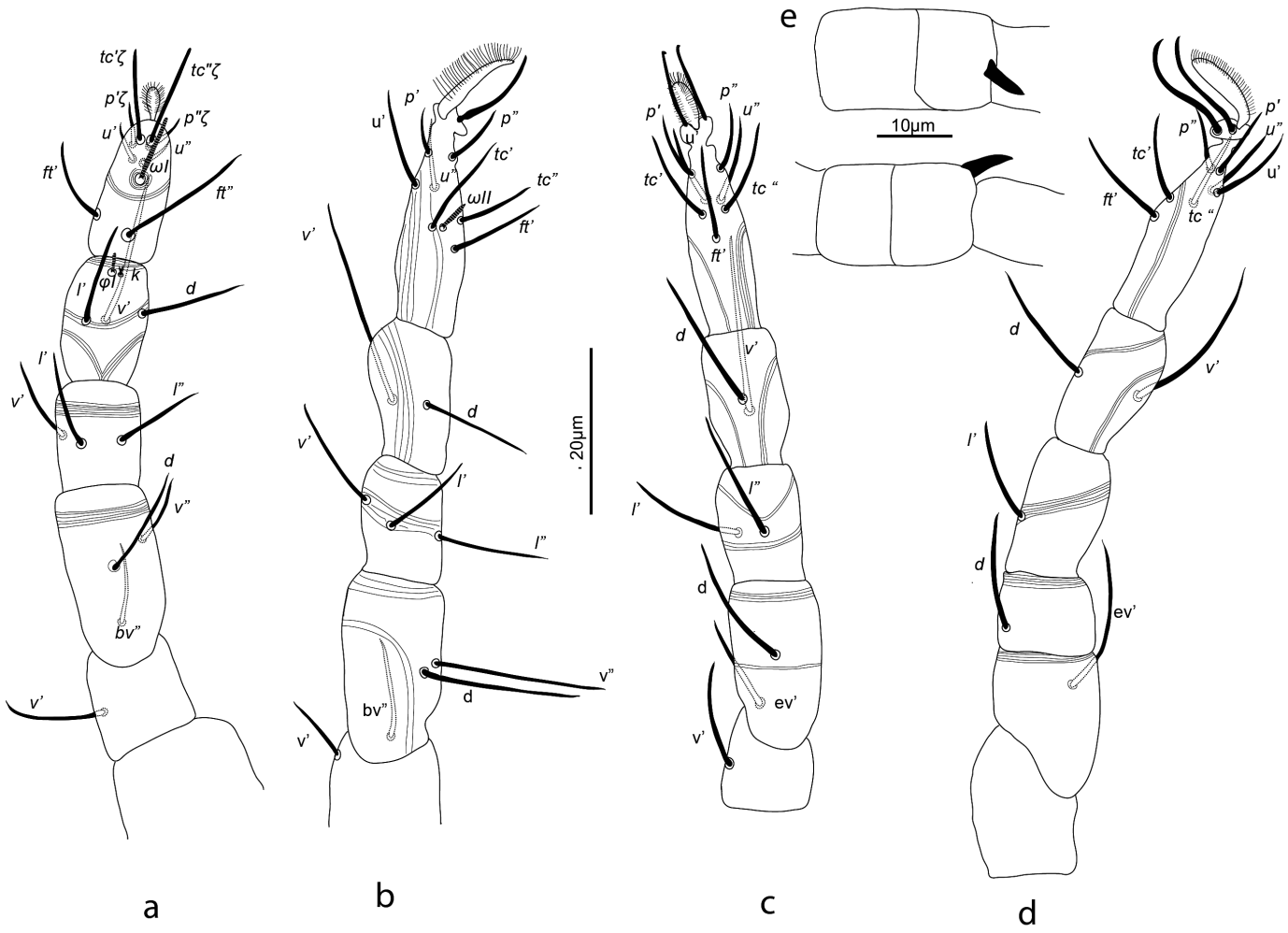

Figure 18 *Naudea richinda* Meyer & Rodrigues, 1966. A-D, legs of holotype female: A – Leg I, B – Leg II, C – Leg III, D – Leg IV; E – Leg IV of male.

Key to the genera and subgenera of Pronematinae

The Pronematinae contains several monotypic genera; for those, the name of the corresponding species is shown immediately after reaching the name of the genus. For genera consisting of more than one species, the number of species is presented in Table 4. The distribution of the genera is based on type localities of the type species except for *Pronematus* and *Homeopronematus*, for which we refer to Ueckermann and De Vis *et al.* (2024) and De Vis *et al.* (2024b).

1. Apotele I with vestigial claws or with no claws (empodium usually present); femur IV divided 2
— Apotele I absent 5

2 (1). Tarsi II–IV each with seven setae; South Africa . . . . . *Naudea* Meyer & Rodrigues, 1966
— Tarsus II with seven or less setae; tarsi III and IV each with at most six setae 3

3 (2). Tarsus II with seven setae; Egypt . . . . . *Neonaudea* El Bagoury & Abou Awad, 1966
— Tarsus II with 5–6 setae 4

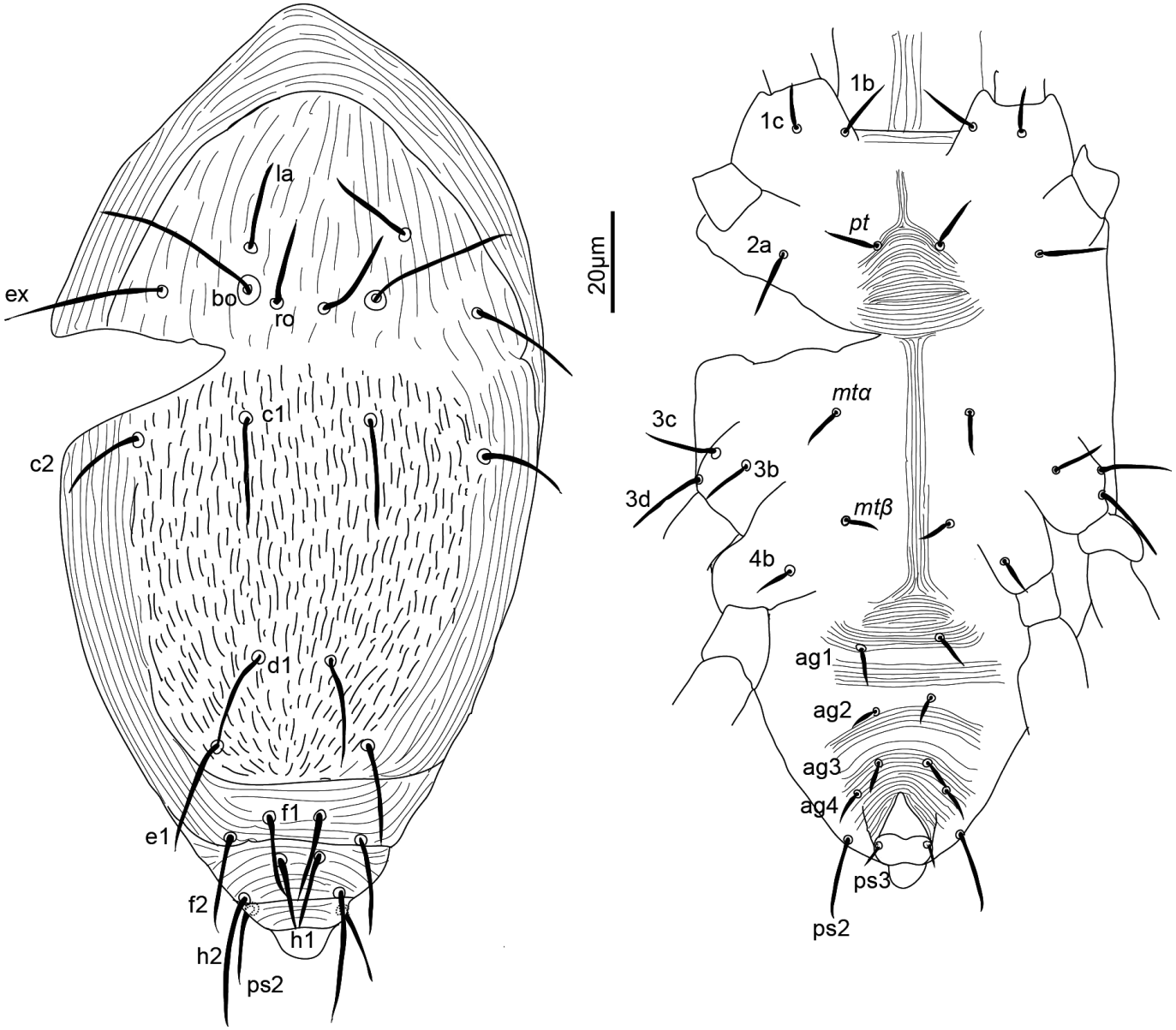

Figure 19 *Naudea richinda* Meyer & Rodrigues, 1966. Dorsum (left) and venter (right) of male.

4 (3). Genu II with three setae; genu III with two and tarsus III with 5–6 setae, Brazil, Crimea, Greece, South Africa . . . . . *Pausia* Kuznetsov & Livshitz, 1972
— Genua II and III each with only one seta; tarsus III with five setae; Mexico . . . . . *Pronecupulatus* Baker, 1944

5 (1). One pair of aggenital setae (known only from males) 6
— More than one pair of aggenital setae (known from males and females) 7

6 (5). Ten pairs of opisthosomal setae (*ps1* absent); Brazil . . . . . *Quasihomeopronematus* De Vis & Ueckermann, 2024b (*Q. nordestinus* male)
— Eleven pairs of opisthosomal setae; worldwide except Africa and Oceania . . . . . *Homeopronematus* André, 1980 (*Homeopronematus anconai* (Baker, 1943) male)

Table 4 Differential characteristics of pronematid genera: number of species within a genus (Sp. #), number of setae on aspidosoma (Asp. #), opisthosoma, number of *ag* setae (*ag* #), presence of apotele on tarsus I (1 = present, 0 = absent), number of setae on leg segments tarsus (ta), tibia (ti), genu (ge), femur (fe) and trochanter (tr), total number of setae on leg segments (total #, excl. ω, κ, φ) and division of femur IV (1 = divided, 0 = undivided). For variable genera (*Parapronematus*, *Pausia* and *Proctotydaeus*), characteristics are given per groups of species within each.

Genus/ species	Sp.	Asp.	Opisthosoma	*ag*	Leg I*					Leg II				Leg III		Leg IV				Total
	#	#	#	#	apotele	ta	Ti	ge	tr	ta	ge	fe	tr	ta	ge	ta	ge	fe	te div.	#
Naudea richinda	1	4	10–*ps1*	4	1	8+ω	3+κ+φ	3	1	7+ω	3	3	1	7	2	7	1	2	1	60
Neonaudea gossypii	1	4	11	4	1	8+ω	3+κ+φ	3	1	7+ω	3	3	1	5	2	5	1	2	1	56
*Pausia****	4	4	10 or 11	4	1	8+ω	or3+κ+φ	3	1	6+ω	3	2or3	1	5 or 6	2	5	1or2	2	1	56
taurica, colonus	2		11				3+κ+φ					3		6			1			56
magdalenae	1		11				2+κ+φ					2		6			1			54
litchiae	1		10–*ps3*				3+κ+φ					3		5			2			56
Pronecupulatus anahuacensis	1	4	11	?	1	8+ω	3+κ+φ	3	1	6+ω	1	3		5	1	5	1	2	0	52
Duoparus hyeresensis	1	4	11	2	0	9+ω	3+κ+φ	3	1	7+ω	3	3	1	6	2	6	1	2	1	59
Metapronematus leucohippeus	1	4	10–*ps1*	3	0	8+ω	3+κ+φ	3	1	6+ω	3	3	1	6	2	5	1	1	0	55
Parapronematus	8	3 or 4	9–*ps1*–*ps3*	3	0	8+ω	2+κ+φ	2	1	6+ω	2	2 or3	0	5 or 6	2	6	1	1	0	49-52
acaciae, camelia, citri	3	3										3		6						52
connarus **n. sp.**	1	3										3		6 (5)						52(51)
geminus	1	4										3		5						52
ferox, murshidabadensis	2	3										3		5						51
*formosanus***	1	3										2**		5						49
Apopronematus bakeri	1	4	11	3	0	8+ω	3+κ+φ	2	1	6+ω	2	3	1	5	1	5	1	1	1 ?	51
Proctotydaeus	22	4	10 or 11	4	0	8+ω	3+κ+φ	3	1	7+ω	3	3	1	7	2	7	1	2	1/0	60
P. (*Proctotydaeus*)	5		11																0	60
P. (*Oriola*)	6		11																0	60
P. (*Neotydeolus*)	4		10–*ps2*																0	60
P. (*Proctotydulus*)	7		11																1	60
Pronematulus	3	4	11	4	0	8+ω	3+κ+φ	3	1	7+ω	2	3	1	6	2	6	1	2	1 ?	57
Pseudopronematulus	5	4	11	4	0	9+ω	3+κ+φ	3	1	7+ω	3	3	1	6	2	6	1	2	1	59
Ueckermanniella cataracta	1	4	11	4	0	8+ω	3+κ+φ	3	1	6+ω	3	3	1	6	2	5	1	1	1	55
Homeopronematus anconai	1	4	11	1 or 4	0	9+ω	3+κ+φ	3	1	6+ω	3	3	1	6	2	6	1	2	0	58
Quasihomeopronematus nordestinus	1	4	10–*ps1*	4	0	9+ω	3+κ+φ	3	1	6+ω	3	3	1	6	2	6	1	2	0	58
Pronematus	8	4	10–*ps2*	4	0	9+ω	3+κ+φ	3	0	6+ω	3	3	0	5	2	5	1	2	0	54
Lourus	2	4	11	4	0	8+ω	3+κ+φ	3	1	6+ω	3	2	1	5	2	5	1	2	0	54
Neopronematus	8	4	9–*ps1*, *ps2*	4	0	8+ω	3+κ+φ	3	1	6+ω	3	3	1	5	2	5	1	2	0	55
Dasilcoferla nadirae	1	4	10–*ps1*	4	0	8+ω	3+κ+φ	3	1	6+ω	3	3	1	5	2	5	1	2	0	55
Peridasilcoferla paraensis **n. gen. n**	1	4	11	4	0	8+ω	3+κ+φ	3	1	6+ω	3	3	1	5	2	5	1	2	0	55
Total 20 genera	71 species																			

*Do not vary among genera: tibiae II, III and IV, each with two setae, femur I and III with respectively three (except **) and two setae and trochanters III and IV respectively with one seta and nude, totalling 12 setae on these segments.
***Parapronematus formosanus* has two setae on each femur I and II instead of three.
***We include the species of *Pausia* in this table because the chaetotaxy of the species belonging to that genus differs from each other.

7 (5). Two pairs of aggenital setae, France ..... *Duoparus* De Vis & Ueckermann, 2024a
— More than two pairs of aggenital setae 8

8 (7). Three pairs of aggenital setae 9
— Four pairs of aggenital setae 11

9 (8). Genua I and II each with three setae; USA ..... *Metapronematus* André, 1980
— Genua I and II each with two setae 10

10 (9). Seta *la* reduced or absent; tibia II with two setae + φ + κ; genu III with two setae; Brazil, Democratic Republic of Congo, India, Mozambique, Philippines, Taiwan ..... *Parapronematus* Baker, 1965
— Seta *la* normal; tibia II with three setae + φ + κ; genu III with one seta; USA ..... *Apopronematus* André, 1980 (*A. bakeri* André, 1980)

11 (8). Tarsi III and IV each with seven setae; in general insect associates ..... *Proctotydaeus* Berlese, 1911 12
— Tarsi III and IV each with at most six setae, in general not associated with insect 15

12 (11). Seta *bo* club-shaped; ten pairs of opisthosomal setae (*ps2* absent); femur IV not divided; Brazil . . . . . *Proctotydaeus* (*Neotydeolus*) Flechtmann & Camargo, 1979
— Seta *bo* whip-shaped; 11 pairs of opisthosomal setae (*ps2* present), femur IV divided or not 13

13 (12). Paraproctal suckers distinctly developed (especially in females); anus terminally surrounded by sucker-like papillae; tectal setae (*tc*) not longer than tarsus; unguinal setae (*u*) on tarsus I normal; femur IV not divided; Galapagos Islands, Indonesia . . . . . *Proctotydaeus* (*Proctotydaeus*) Berlese, 1911
— Paraproctal suckers weakly developed; setae (*tc*) longer than tarsus; unguinal setae (*u*) on tarsus I shorter than other setae; femur IV divided or not 14

14 (13). Femur IV not divided; males with some bifurcate setae; Brazil, Canada, Poland, USA . . . . . *Proctotydaeus* (*Oriola*) (Baker, 1968b)
— Femur IV divided; males without bifurcate setae; Crimea, Iran, Mozambique, South Africa, Ukraine, US . . . . . *Proctotydaeus* (*Proctotydulus*) Kaźmierski, 1998a

15 (11). Tarsus II with seven setae 16
— Tarsus II with six setae 17

16 (15). Genu II with two setae; Crimea, Taiwan, USA, Uzbekistan . . . . . *Pronematulus* Baker, 1965
— Genu II with three setae; Belgium, Brazil, China, Mozambique, South Africa . . . . . *Pseudopronematulus* Fan & Li, 1992

17 (15). Tarsus III and femur IV respectively with six and one seta; South Africa . . . . . *Ueckermanniella* Beron, 2012
— Tarsus III and femur IV respectively with five and two setae 18

18 (17). Trochanters I and II each with one seta 19
— Trochanters I and II nude; worldwide . . . . . *Pronematus* Canestrini, 1886

19 (18). Femur II with two setae; opisthosoma with 11 pairs of setae; Crimea, Mozambique . . . . . *Lourus* Ueckermann and Grout 2007
— Femur II with three setae; opisthosoma with 9–11 pairs of setae 20

20 (19). Nine pairs of opisthosomal setae (*ps1* and *ps2* absent); Greece, Hungary, Crimea, Iran . . . . . *Neopronematus* (Panou, Emmanouel & Kaźmierski, 2000)
— More than nine pairs of opisthosomal setae 21

20 (21). Ten pairs of opisthosomal setae (*ps1* absent); Brazil . . . . . *Dasilcoferla* De Vis & Ueckermann, 2024a
— Eleven pairs of opisthosomal setae; Brazil . . . . . *Peridasilcoferla* De Vis & Ueckermann **n. gen.** (This paper)

For the following genera, keys to the species have been developed (reference in brackets): *Neopronematus* (Darbemamieh *et al.* 2015), *Parapronematus* (this work), *Proctotydaeus* (Kaźmierski 1998a); *Pronematus* (Ueckermann *et al.* 2024) and *Pseudopronematulus* (De Vis *et al.* 2024a).

Discussion

Presence/ absence of one or more setae is a key feature in the taxonomy of Pronematinae. Thus, an important aspect is to decide which dorsal seta/setae is/are absent: *ps1, ps2* and/or *h2*?

In his diagnoses of the genera *Naudea*, *Pronematus*, *Metapronematus* and *Parapronematus*, André (1980) found it difficult to believe the missing seta to be *ps1* in one species and *ps2* in another. Without specifying the species and the genus he referred to, Kaźmierski (1998a: 44) expressed the same idea. However, in our understanding, the loss of setae on the body or legs does not merely follow a straight line and might occur at different times in evolution on different continents and ecosystems. More recently, Panou *et al.* (2000) described the genus *Neopronematus*, with two missing opisthosomal setae, stating that these were *h1* and *ps1*, while the most logic would be *ps1* and *ps2*, with *h2* (which is long) present. Authors of other new *Neopronematus* species (Sadeghi *et al.* 2012; Ripka *et al.* 2013; Darbemamieh *et al.* 2015; Ahmad-Hosseini *et al.* 2017) agreed with Panou *et al.* (2000). However, we do not agree with this point of view and think that both *ps1* and *ps2* setae are lost in *Neopronematus* following thereby André (1981a), who stated that the distal setae likely to be lost are all *ps* and that the only seta that tends to move laterally is *e1*. So, in our opinion the missing setae in the different genera might be: *ps1* (*Naudea*, *Metapronematus*, *Quasihomeopronematus*, *Dasilcoferla*); *ps2* (*Proctotydaeus* (*Neotydeolus*), *Pronematus*); both *ps1* and *ps2* (and not *h2* and *ps2*) (*Neopronematus*), *ps3* [in *Pausia litchiae* Da Silva *et al.* (2017), but this should be confirmed] or *ps1* and *ps3* (*Parapronematus*), according to Table 4. Unstable setae may either become very small or disappear (Coineau 1974; André 1981a). Examples can be found in seta *la*. In several genera, this seta is thinner than other setae of the aspidosoma (De Vis *et al.* 2024a). In *P. geminus*, it is reduced, tiny, while absent in all other *Parapronematus* species. A second example refers to *ps1*, very small in *Peridasilcoferla* **n. gen.** and *Homeopronematus*, and absent in the closely related *Dasilcoferla* (De Vis *et al.* 2024a) and *Quasihomeopronematus* (De Vis *et al.* 2024b).

It would not seem plausible that instead, *ps2* was lost, *ps1* moved to the usual position of *ps2* and in parallel became as large as *ps2*. *Dasilcoferla* has the same chaetotaxy as *Neopronematus*, but with one less dorsal seta, which would be logically the loss of *ps2*, although *Neopronematus* is not comparable in the same way; it has many differences and stands probably far away from *Dasilcoferla* or *Peridasilcoferla* **n. gen.**

It has been considered that the loss of opisthosomal *ag* or leg setae justifies the description of a new genus of Pronematinae (André 1980; Kaźmierski 1998b; Khaustov 2022). The adoption of this concept could explain the existence of several monotypic genera. Alternatively, the existence of many monotypic genera in Pronematinae could be due to the insufficient effort dedicated to the study of these mites, in comparison with other groups, e.g. the Phytoseiidae, which are used broadly in biocontrol programs (Van Lenteren *et al.* 2018). The interest in using Pronematinae in biocontrol has recently increased (Vervaet *et al.* 2022; Pijnakker *et al.* 2022a; Pijnakker *et al.* 2022b; Marcossi *et al.* 2024). So, the number of monotypic genera might diminish as more species are discovered.

Related to that, studies are necessary to define the ecological and evolutionary importance of the loss of body or leg setae, to strengthen this generic concept. In the meantime, we consider it important to maintain the actual concept to avoid confusion, although not all authors followed it in the past (see also De Vis *et al.* 2024a). This concept may also lead to the believe that different species within a genus can be defined based on differential lengths of setae. This is a characteristic not well defined in early descriptions, but it could support the need for redescriptions of the early described species, to ensure their validity. Baker was the first to introduce leg chaetotaxy in the description of genera (Baker 1965). However, the lack of leg chaetotaxy in his species descriptions (Baker 1968a) led to the presently high number of *species inquirendae* (Kaźmierski 1998b; Ueckermann *et al.* 2024).

Naudea has the same leg chaetotaxy as *Proctotydaeus,* but the latter lacks empodium on leg I (Table 4). However, two *Pausia* species have aberrant chaetotaxy; *P. magdalenae* has only two setae on tibia I (*l'* ? absent) and femur II (*bv"* absent) (!) instead of three in the type species (Baker and Delfinado 1976). *Proctotydaeus litchiae* has five setae on tarsus III (*ft'* absent) instead of six, two setae on genu IV instead of one and it lacks *ps3* (ten opisthosomals) when compared to the type species of the genus (Da Silva *et al.* 2017). These findings need

confirmation, and new genera should be described within the current generic concept if these characteristics are confirmed. If the presence of two setae on genu IV is confirmed, that would be the first species within the Pronematinae to show that characteristic (André 1980).

We think that other aspects of the morphology could be introduced in the genus descriptions and might even have priority over the presence or absence of setae. The difficulty in this is that early described genera and species have been poorly defined and redescriptions of those are therefore needed before these characters can be used. An additional problem is that the types of at least some species are in inadequate condition to be further studied. We have recently described new species in the following genera of Pronematinae: *Pronematus* (Ueckermann *et al.* 2024), *Duoparus*, *Pseudopronematulus* and *Dasilcoferla* (De Vis *et al.* 2024a), *Homeopronematus* and *Quasihomeopronematus* (De Vis *et al.* 2024b), *Peridasilcoferla* **n. gen.** and *Parapronematus* (this paper). While doing so, we were convinced that the following characteristics seemed of generic value:

a) in the idiosoma:

• Presence or absence of tubercles on the striae: this seems to be fixed within at least two genera: absent in *Pseudopronematulus* (five species examined) and present in *Pronematus* (eight species examined).

• Presence/absence of spindle-shaped pattern of striation anteriad *e1*: present in *Parapronematus*, absent in all other genera (compare Figures 1 and 5 of this publication).

• Extent of the spindled pattern of striae anteriad *mtα*: in *Peridasilcoferla* **n. gen.** it extends anteriorly to level of *pt*; in others (*Pronematus*, *Homeopronematus*; *Quasihomeopronematus, Dasilcoferla, Parapronematus*) it almost reach level of *pt*; in still others (*Duoparus*, *Pseudopronematulus*) it is much smaller. Unfortunately, this characteristic is not pointed out in the description of many species.

• Extent of the spindled pattern of striae anteriad *ag1*: Smaller than distance between setae *ag1* (*Duoparus*), a bit wider than the distance between those setae (*Pseudopronematulus*, *Peridasilcoferla* **n. gen**, *Parapronematus*) or much broader, about twice the distance between those setae (*Pronematus*, *Homeopronematus*). Also in this case, the characteristic is not properly detailed in the description of many species.

• Presence and form of *la*: Somewhat thinner than *bo* and *ex* (most genera), thin and small (*Parapronematus geminus*) or absent (all other *Parapronematus* spp.). In the generic concept of André (1980), a new genus should be described for species with *la* absent.

• Forked *ag3*: present in *Homeopronematus*, *Quasihomeopronematus* and *Neopronematus* (except *N. aegeae,* Panou *et al.* 2000; in fact, the generic placement of *N. aegeae* should be reevaluated based on that characteristic).

• Positioning of *ag* setae: *Pseudopronematulus*-type, positioned in two eccentric lines (*Pseudopronematulus*, *Duoparus*); or *Pronematus*-type with distances *ag2-ag2* and *ag3-ag3* short and near base of the longitudinal part of the genital opening (*Neopronematus* (Panou *et al.* 2000), *Pronematus*, *Homeopronematus*, *Quasihomeopronematus*); or *Dasilcoferla*-type with *ag1* and *ag3* close to each other while *ag2* and *ag4* widely separated (*Dasilcoferla* and *Peridasilcoferla* **n. gen.**).

• The (relative) lengths of setae *3b, 3c* and *3d*: *3c* longer than the other two subequal setae (*Pseudopronematulus*), *3d* longer than the other two subequal setae (*Homeopronematus*, *Quasihomeopronematus*); subequal *3c* and *3d* and these longer than *3b* (*Pronematus, Dasilcoferla)*; *3d* longer than *3c* which is longer than *3b* (*Duoparus*, *Peridasilcoferla* **n. gen.**). As differences may not be much, measurement of several specimens seems necessary.

b) in the gnathosoma:

• Status of seta *v* on palptarsus: smooth (*Pronematus*, *Homeopronematus*, *Quasihomeopronematus, Pseudopronematulus, Dasilcoferla*), finely barbed (*Peridasilcoferla* **n. gen.**) or heavily barbed (*Duoparus*). This characteristic is very clear in *Duoparus* but not in other genera under phase microscopy.

c) in the legs:

• Presence of seta homologous to *s* (Ueckermann *et al.* 2024), present in *Pronematus*, *Homepronematus* and *Quasihomeopronematus* (De Vis *et al.* 2024b); vestigial or absent in *Pseudopronematulus* and *Duoparus* (De Vis *et al.* 2024a); absent in *Dasilcoferla*, *Peridasilcoferla* **n. gen.**, and *Parapronematus* (De Vis *et al.* 2024a and this paper); unknown for other genera.

• Length of *ωI*. We prefer to use the absolute length as the width of leg is dependent on mounting conditions. In most species, the relative length of the eupathidia: (*tc*) subequal (most species) or not (*Dasilcoferla*); (*p*) subequal (*Duoparus*, *Pseudopronematulus*), *p"ζ* shorter (*Pronematus, Homeopronematus Quasihomeopronematus*, *Peridasilcoferla* **n. gen.**, *Parapronematus*) or longer than *p'ζ*. (*Dasilcoferla, Neopronematus*).

• The status of the eupathidia on tarsus I: smooth (*Duoparus,* some *Pseudopronematulus*), partially barbed (*Homeopronematus*, *Quasihomeopronematus*, *Peridasilcoferla* **n. gen.**, *Neopronematus,* some *Pseudopronematulus*,) or completely barbed (*Dasilcoferla, Pronematus* (but not tip), *Parapronematus,* some *Pseudopronematulus*); the type of barbs on the eupathidia also differ.

• Presence of forked dorsal setae: present on femur III only (at least some *Pseudopronematulus*; to be confirmed in others); present on femora III and IV (*Parapronematus*); or absence (all other genera).

• Pending upon confirmation of studies to be conducted, other characteristics seemingly important to consider in generic characterization include: the ornamentation of eupathidia of tarsus I, as well as the distance along the main axis of the two most distal setae of tarsus IV. Still, given the small dimensions of those setae, their usefulness as diagnostic features remains to be determined.

Summarizing our vision of the important characteristics in the definition of taxa of Pronematinae, we retain the listed characteristics as of generic importance and recommend them to be part of genus descriptions and not of species description (although further study of described species should confirm this). For body characteristics: the presence or absence of tubercles on the striae, the presence/absence of spindle form striae anterior to setae *e1* on the dorsum; the form of spindle form striae anterior to setae *mtα*; the form of spindle form striae anterior to setae *ag1* on the venter; the presence and form of seta *la*; the form of *ag3* (forked or not). For gnathosoma characteristics: the status of seta *v* on palptarsus. For leg characteristics: the relative length of the eupathidia.

Acknowledgements

The seed of this work was planted during the post-doctoral fellowship nr 01/13725-6 at ESALQ provided by FAPESP (State of São Paulo Research Foundation) to the first author in 2002. The Biodiversity Virtual Institute Program (BIOTA) of FAPESP (http://www.biotasp.org.br); it was in part supported by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), grant No. 88887.827149/2023-00, awarded to J. Lacerda; Universidade Federal Rural da Amazônia Campus Parauapebas provided logistic support; and Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) issued collection authorization (nr.89189-2) and provided logistical assistance in expeditions.

Arne Jansen and Irene Cardoso were so kind to transport slides of Brazilian mites to the first author and Christine Muggler was our postal hub in Rio de Janeiro.

Distribution of work

Raf M.J. De Vis collected samples in 2002–2003, made the description of *P. connarus* **n. sp.**, developed keys and wrote the text. José P. Lacerda collected samples and mounted the mites

in Brazil; Gilberto de Moraes supervised the work of José P. Lacerda and this work as senior acarologist. Edward A. Ueckermann redescribed *P. geminus* and *N. richinda* and supervised the work as senior acarologist and Pronematinae specialist. We want to acknowledge explicitly Henri André for his initiative to build the Tydeoidea database in the wikispecies platform (André 2021). It was an invaluable tool during the preparation of this manuscript and all previous ones.

ORCID

Raf M. J. De Vis https://orcid.org/0009-0000-6954-5824
José Dantas Araujo Lacerda https://orcid.org/0000-0003-4438-2322
Gilberto J. de Moraes https://orcid.org/0000-0002-5587-1781
Edward A. Ueckermann https://orcid.org/0000-0003-4213-4309

References

Ahmad-Hosseini M., Khanjani M., Karamian R. 2017. A new species of *Neopronematus* and a redescription of *Pronematus rykei* Meyer & Rodrigues (Acari: Iolinidae) from Iran. Zootaxa, 4337(4): 493-508. https://doi.org/10.11646/zootaxa.4337.4.2

André H.M. 1979. A generic revision of the family Tydeidae (Acari : Actinedida) I. Introduction, paradigms and general classification. Ann. Soc. R. Zool. Belg., 3-4(1978): 189-208.

André H.M. 1980. A generic revision of the family Tydeidae (Acari: Actinedida) IV. Generic descriptions, keys and conclusions. Bull. Ann. Soc. R. Belge Ent., 116(7-9): 103-168.

André H.M. 1981a. A generic revision of the family Tydeidae (Acari, Actinedida) II. Organotaxy of the idiosoma and gnathosoma. Acarologia, 22(1): 31-46.

André H.M. 1981b. A generic revision of the family Tydeidae (Acari, Actinedida) III. Organotaxy of the legs. Acarologia, 22(2): 165-178.

André H.M. 2004. Revalidation of *Oriola* and replacement name for *Meyerella* (Acari: Tydeoidea). Int. J. Acarol., 30(3): 279-280. https://doi.org/10.1080/01647950408684395

André H.M. 2021. The Tydeoidea (Ereynetidae, Iolinidae, Triophtydeidae and Tydeidae)-An online database in the Wikispecies platform. Acarologia, 61(4): 1023-1035. https://doi.org/10.24349/6yc5-1lxw

André H.M., Fain A. 2000. Phylogeny, ontogeny and adaptive radiation in the superfamily Tydeoidea (Acari: Actinedida), with a reappraisal of morphological characters. Zool. J. Linn., 130(3): 405-448. https://doi.org/10.1111/j.1096-3642.2000.tb01636.x

Baker E.W. 1943. Nuevos tydeidos mexicanos (Acarina). Rev. Soc. Mex. Hist. Natur., 4(3-4): 181-189.

Baker E.W. 1944. *Pronecupulatus*, a new genus of Tydeidae (Acarina) from Mexico. J. Kans. Entomol. Soc., (17): 72-73.

Baker E.W. 1965. A review of the genera of the family Tydeidae (Acarina). Adv. Acarol., 2: 95-133.

Baker E.W. 1968a. The genus *Pronematus* Canestrini. Ann. Entomol. Soc. Am., 61(5): 1091-1097. https://doi.org/10.1093/aesa/61.5.1091

Baker E.W. 1968b. Two new genera of Tydeidae (Acarina). Ann. Entomol. Soc. Am., 61(4): 968-970. https://doi.org/10.1093/aesa/61.4.968

Baker E.W. 1969. *Oriolella*, a new name for *Oriola* (Acarina: Tydeidae). Entomol. Soc. Wash. Proc., 71(2): 204.

Baker E.W., Delfinado M.D. 1976. Notes on the genus *Naudea* Meyer and Rodrigues, with description of a new species (Acarina: Tydeidae). Int. J. Acarol., 2(1): 35-38. https://doi.org/10.1080/01647957608683754

Berlese A. 1911. Acarorum species novae quindecim. Gen. *Proctotydaeus* n. gen. Redia, (7): 430-431.

Berlese A. 1914. Acari nuovi. Manipulus IX. Redia, (10): 113-150.

Beron P. 2012. *Ueckermanniella* nom. nov. pro *Kakamasia* Ueckermann et Grout, 2007 (Acari, Iolinidae) nec *Kakamasia* Lawrence, 1944 (Acari, Erythraeidae). Hist. Nat. Bulg., (20): 67-68.

Canestrini G. 1886. Prospetto dell′ Acarofauna italiana (Continuazione). Famiglia degli Eupodini. Atti del R. Istituto Veneto di Scienze, Lettere ed Arti (ser. 6), 4(5): 693-734.

Carrillo D., De Moraes G.J., Peña J.E. eds. 2015 . Prospects for Biological Control of Plant Feeding Mites and Other Harmful Organisms. Cham: Springer International Publishing. pp. https://doi.org/10.1007/978-3-319-15042-0

Coineau Y. 1974. Éléments pour une monographie morphologique, écologique et biologique des Caeculidae (Acariens). Mem. Mus. Natl. Hist.Nat., A(81): 330.

Da Silva G.L., Da-Costa T., Ferraz C.S., Pallini A., Ferla N.J. 2017. First description of iolinid mites (Acari: Tydeoidea) from Brazil. Syst. Appl. Acarol., 22(5): 694–701. https://doi.org/10.11158/saa.22.5.8

Darbemamieh M., Hajiqanbar H., Khanjani M., Kaźmierski A. 2015. New species and records of *Neopronematus* (Acari: Iolinidae) from Iran with a key to world species. Zootaxa, 3990(2): 235–246. https://doi.org/10.11646/zootaxa.3990.2.4

De Leon D. 1966. Phytoseiidae of British Guyana with keys to species. Studies on the Fauna of Suriname and other Guyanas, 8(1): 81-102.

De Vis R.M.J., de Moraes G.J., Bellini M.R. 2006a. Initial screening of little known predatory mites in Brazil as potential pest control agents. Exp. Appl. Acarol., 39(2): 115-125. https://doi.org/10.1007/s10493-006-9004-7
De Vis R.M.J., Moraes G.J. de, Bellini M.R. 2006b. Mites (Acari) of rubber trees (*Hevea brasiliensis* Muell. Arg., Euphorbiaceae) in Piracicaba, state of São Paulo, Brazil. Neotrop. Entomol., 35(1): 112-120. https://doi.org/10.1590/S1519-566X2006000100015
De Vis R.M.J., Vervaet L., Van Leeuwen T., Braga A.D.F., Castilho R.D.C., Ueckermann E.A. 2024a. Description of two new genera, three new species, and redescription of two species of Pronematinae (Acari: Iolinidae). Acarologia, 64(4): 1063-1099. https://doi.org/10.24349/z0vq-ji83
De Vis R.M.J., Vervaet L., Reybroeck E., Vanlommel W., Van Havermaet R., Foque, D., Marcossi, I., Pallini, A., Binda de Assis, C. H., Van Leeuwen, T., Ueckermann E.A. 2024b. Rescription of *Homeopronematus anconai* (Baker), and description of *Quasihomeopronematus nordestinus* n. gen. n. sp. (Acari: Iolinidae). Acarologia, 64(4): 1283-1311. https://doi.org/10.24349/cu4t-4h6v
El-Bagoury M.E., Abou-Awad B.A. 1966. *Neonaudea* gen. n. of the family Tydeidae from Egypt (Acari, Tydeoidea). Acarologia, 27(2): 121-123.
Fan Q.-H., Li L.-S. 1992. A new genus and three new species of Tydeidae (Acari: Actinedida) from China. J. Fujian. Agric. Coll., 21: 396-400.
Flechtmann C.H.W., Camargo C. de 1979. Acari associated with stingless bees (Meliponidae, Hymenoptera) from Brazil. In: Proc. 4th Int. Congr. Acarol., Budapest: Akademiai Kiado. pp. 315-319.
Gupta S.K. 1991. Studies on predatory prostigmatid mites of North East India with descriptions of new dpecies and dew records from India. Records of the Zoological Survey of India, 88(2): 207-239. https://doi.org/10.26515/rzsi/v88/i2/1991/161345
Gupta S.K. 1992. Arachnida: Plant mites (Acari). In: Fauna of West Bengal, Part 3. State fauna Series 3, Calcutta: Zoological Survey of India. pp. 61-211.
Gupta S.K. 2002. A monograph on plant inhabiting predatory mites of India. Part 1: Orders: Prostigmata, Astigmata and Cryptostigmata. A monograph on plant inhabiting predatory mites of India. Part 1: Orders: Prostigmata, Astigmata and Cryptostigmata., 19(2): 1-183.
Hernandes F.A., De Castro T.M.M.G., Venancio R. 2015. Prostigmata (Acari: Trombidiformes) as Biological Control Agents. In: Carrillo D., De Moraes G. J., Peña J. E. (Eds) Prospects for Biological Control of Plant Feeding Mites and Other Harmful Organisms, Cham: Springer International Publishing. pp. 151-184. https://doi.org/10.1007/978-3-319-15042-0_6
Kaźmierski A. 1989. Morphological studies on Tydeidae (Actinedida, Acari). I: Remarks about the segmentation, chaetotaxy and poroidotaxy of idiosoma. Acta zool. Cracov, 32(4): 69-83.
Kaźmierski A. 1998a. A review of the genus *Proctotydaeus* Berlèse (Actinedida: Tydeidae: Pronematinae). Acarologia, 39(1): 33-47.
Kaźmierski A. 1998b. Tydeinae of the world: generic relationships, new and redescribed taxa and keys to all species. A revision of the subfamilies Pretydeinae and Tydeinae [Acari: Actinedida: Tydeidae]-part IV. Acta Zoologica Cracoviensia, 41(2): 283-455.
Khaustov A.A. 2022. A new genus and species of Tydeidae (Acari: Prostigmata) from Western Siberia, Russia. https://doi.org/10.24349/1dwx-x5h2
Khaustov A.A., Hugo-Coetzee E., Ermilov S.G. 2020. A new species of *Lorryia* (Acari: Tydeidae) from a termite nest in South Africa. Acarina, 28(1): 47-53. https://doi.org/10.21684/0132-8077-2020-28-1-47-53
Kramer P. 1877. Tydeidae. Arch. Naturgesch., (43): 232-246.
Krantz G.W., Walter D.E. eds. 2009. A manual of acarology. 3rd ed. Lubbock, Texas: Texas Tech University Press. pp. 807.
Kuznetsov N.N. 1972. Mites of the genus *Pronematus* Canestrini (Acarina, Tydeidae) from Crimea. Nauch Dokl Vyssh Shk, Biol Nauk, (5): 11-16.
Kuznetsov N.N., Livshits I.Z. 1972. A new genus and species of Tydeidae (Acariformes) from Crimea (In Russian). Zool. Zhurnal, 51(11): 1738-1740.
Lofego A.C., Barbosa M.F.D.C., Demite P.R., Moraes G.J.D. 2024. Phytoseiidae (Acari: Mesostigmata) of the subfamily Amblyseiinae from Brazil. Zootaxa, 5439(1): 1-306. https://doi.org/10.11646/zootaxa.5439.1.1
Marcossi Í., Francesco L.S., Fonseca M.M., Pallini A., Groot T., De Vis R., Janssen A. 2024. Predatory mites as potential biological control agents for tomato russet mite and powdery mildew on tomato. J. Pest. Sci., 251-263. https://doi.org/10.1007/s10340-024-01802-0
McGregor E.A. 1914. Four new tetranychids. Ann. Entomol. Soc. America, 7(4): 354-360. https://doi.org/10.1093/aesa/7.4.354
Meyer M.K.P., Rodrigues M.C. 1966. Acari associated with cotton in Southern Africa (with reference to other plants). Garcia de Orta, Ser. Bot., 13(2): 195-226.
Panou H.N., Emmanouel N.G., Kaźmierski A. 2000. *Neopronematus*, a new genus of the subfamily Pronematinae (Acari: Prostigmata: Tydeidae) and a new species from Greece. Acarologia, 41(3): 321-325.
Pijnakker J., Hürriyet A., Petit C., Vangansbeke D., Duarte M.V.A., Arijs Y., Moerkens R., Sutter L., Maret D., Wäckers F. 2022a. Evaluation of phytoseiid and iolinid mites for biological control of the tomato russet mite *Aculops lycopersici* (Acari: Eriophyidae). Insects, 13(12): 1146. https://doi.org/10.3390/insects13121146
Pijnakker J., Moerkens R., Vangansbeke D., Duarte M., Bellinkx S., Benavente A., Merckx J., Stevens I., Wäckers F. 2022b. Dual protection: a tydeoid mite effectively controls both a problem pest and a key pathogen in tomato. Pest Manag. Sci., 78(1): 355-361. https://doi.org/10.1002/ps.6647
Pritchard A.E. 1956. A New superfamily of trombidiform mites with the description of a new family, Genus, and Species (Acarina: Iolinoidea: Iolinidae: *Iolina nana*). An. Esc. Nac. Cienc. Biol., 49(3): 204-206. https://doi.org/10.1093/aesa/49.3.204

Ripka G., Laniecka I., Kazmierski A. 2013. On the arboreal acarofauna of Hungary: Some new and rare species of prostigmatic mites (Acari: Prostigmata: Tydeidae, Iolinidae and Stigmaeidae). Zootaxa, 3702(1): 1–50. https://doi.org/10.11646/zootaxa.3702.1.1

Sadeghi H., Łaniecka I., Kaźmierski A. 2012. Tydeoid mites (Acari: Triophtydeidae, Iolinidae, Tydeidae) of Razavi Khorasan Province, Iran, with description of three new species. Ann. Zool., 62(1): 99-114. https://doi.org/10.3161/000345412X633685

Salviejo P.B. 1969. Some Philippine tydeid mites (Tydeidae: Acarina). Philippine Entomologist, 1(4): 261-276. https://doi.org/10.59852/TPE-A27V1I4

Tixier M. 2012. Statistical approaches to assess intraspecific variations of morphological continuous characters: the case study of the family Phytoseiidae (Acari: Mesostigmata). Cladistics, 28(5): 489-502. https://doi.org/10.1111/j.1096-0031.2012.00394.x

Treat A.E. 1970. Two tydeid mites from the ears of noctuid moths. American Museum Novitates, 2426: 1-14.

Tseng Y.-H. 1985. A Taxonomic Study of the Tydeidae from Taiwan (Acarina: Trombidiformes) (Part II). J. Taiwan Mus., 38(2): 65-93.

Ueckermann E.A., De Vis R.M.J., Reybroeck E., Vervaet L., Vanlommel W., Dewitte J., Foqué D., Gautam S., Ouyangh Y., Vangansbeke D., De Clercq P., Van Leeuwen T. 2024. Redescription of *Pronematus ubiquitus* (McGregor, 1932) (Acari, Iolinidae), description of two new species and redescription of two additional species with a review of and key to all *Pronematus* species. Acarologia, 64(1): 277-311. https://doi.org/10.24349/tyki-9xlp

Ueckermann E.A., Grout T.G. 2007. Tydeoid mites (Acari: Tydeidae, Edbakerellidae, Iolinidae) occurring on *Citrus* in southern Africa. J. Nat. Hist., 41(37-40): 2351-2378. https://doi.org/10.1080/00222930701589921

Van Lenteren J.C., Bolckmans K., Köhl J., Ravensberg W.J., Urbaneja A. 2018. Biological control using invertebrates and microorganisms: plenty of new opportunities. BioControl, 63(1): 39-59. https://doi.org/10.1007/s10526-017-9801-4

Vervaet L., Parapurath G., De Vis R., Van Leeuwen T., De Clercq P. 2022. Potential of two omnivorous iolinid mites as predators of the tomato russet mite, *Aculops lycopersici*. J. Pest. Sci., 95(4): 1671-1680. https://doi.org/10.1007/s10340-022-01544-x

Wainstein B.A. 1962. Révision du genre *Typhlodromus* Scheuten, 1857 et systématique de la famille des Phytoseiidae (Berlese, 1916)(Acarina: Parasitiformes). Acarologia, 4: 5-30.

Zhang Z.-Q. 2018. Repositories for mite and tick specimens: acronyms and their nomenclature. Syst. Appl. Acarol., 23(12): 2432-2446. https://doi.org/10.11158/saa.23.12.12