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Redescription of *Tenuipalpus palosapis* Corpuz-Raros (Trombidiformes: Tenuipalpidae) from the Philippines, with comparison to related species

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ABSTRACT

Tenuipalpus palosapis Corpuz-Raros, 1978 was described based on specimens collected on *Anisoptera thurifera* Blume and *Shorea squamata* Benth. and Hook.f. (both *Dipterocarpaceae*), from Laguna, Republic of the Philippines. In this article, we redescribe *T. palosapis* based on paratype specimens deposited at the National Insect and Mite Collection, National Museum of Natural History, Smithsonian Institution (NMNH), located at Beltsville, Maryland, USA. We compare *T. palosapis* with three other morphologically similar species of *Tenuipalpus* from the Asia-Pacific region, *Tenuipalpus antipodus* Collyer (New Zealand), *Tenuipalpus guamensis* Baker (Guam), and *Tenuipalpus orilloi* Rimando (Republic of the Philippines), and we demonstrate that the females of these species share a well-developed and similarly shaped, genitoventral plate. Based on literature, the latter three species have been recorded on a broader range of host plants than has been recorded for many other species of *Tenuipalpus*, and have been intercepted at ports of entry in the United States and New Zealand. A key to these four species is provided.

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Taxonomy; flat mites; false spider mites; genitoventral plate; *Tenuipalpus antipodus*; *Tenuipalpus guamensis*; *Tenuipalpus orilloi*; Caribbean; Indonesia; Asia; biogeography

Introduction

The flat mites (Acari: Tenuipalpidae) comprise over 1200 described species in 40 genera (Mesa et al. 2009; Beard et al. 2014, 2016; Castro et al. 2015). *Tenuipalpus* Donnadieu is the largest genus of this family with more than 300 species described (Mesa et al. 2009; Castro et al. 2016a, 2017; Welbourn et al. 2017). Recently, after resurrecting *Colopalpus* (Castro et al. 2015), Castro et al. (2016b) proposed the division of *Tenuipalpus* in two groups: *sensu stricto*, a homogenous group with body projections associated with opisthosomal setae *c*₃; and *sensu lato*, a heterogenous group without the body projections associated with setae *c*₃.

T. palosapis Corpuz-Raros, 1978, a species of the *sensu lato* group, was described from specimens collected on the native tree species *Anisoptera thurifera* Blume and *Shorea squamata* Benth. and Hook.f. (Dipterocarpaceae), from Laguna, Republic of the Philippines. We compared *T. palosapis* with three other species of the *sensu lato* group from the Asia-Pacific region, *T. antipodus* Collyer, 1964; from New Zealand, *T. guamensis* Baker, 1945; from Guam and *T. orilloi* Rimando, 1962; from the Philippines. We demonstrate that these four species share a well-developed, and similarly shaped, genitoventral plate. Based on previous descriptions (Meyer 1979, 1993; Baker and Tuttle 1987), many *Tenuipalpus* species do not have a well-developed or strongly delimited genitoventral plate. Furthermore, the three species *T. antipodus*, *T. guamensis* and *T. orilloi* all occur on a wide range of host plants and have a broad distribution, including New Zealand, Taiwan, Guam, the Cook Islands, the Philippines, Indonesia, Guiana, Trinidad and China. These species have also been intercepted at ports of entry in the United States and New Zealand (Baker 1945; Collyer 1973; Corpuz-Raros 1989; Xu and Fan 2010).

Herein, we redescribe the female and male of *T. palosapis*, presenting the description in a standardized format, and we discuss character states shared by these four species of the

sensu lato group. The shared character states combined with a shared distribution (Asia-Pacific region) seem to indicate a possible biogeographic pattern.

Material and methods

All measurements are given in micrometers (μm). The terminology used follows that of Lindquist (1985) and Mesa et al. (2009). Leg chaetotaxy is adapted from Lindquist (1985), Zhang and Fan (2004), Xu and Fan (2010), and Seeman and Beard (2011). Tarsal setae are presented as the total number of phaneres followed by the number of solenidia in parentheses. The types and paratypes of the species mentioned in this study are deposited in the National Insect and Mite Collection, National Museum of Natural History (NMNH), Smithsonian Institution, located at the Systematic Entomology Laboratory (SEL), USDA, Beltsville, Maryland, USA.

Family **Tenuipalpidae** Berlese, 1913

Genus ***Tenuipalpus*** Donnadieu, 1876

Type species: ***Tenuipalpus palmatus*** Donnadieu, 1876 (= *T. caudatus* (Dugès, 1834))

Diagnosis

(Following Castro et al. 2016a)

Female. Body shape with prodorsum wider than opisthosoma or elongate-ovate; prodorsum with three pairs of setae (*v*₂, *sc*₁, *sc*₂; except *v*₂ absent in *T. elegans* (Collyer)); dorsal opisthosoma with 8–10 pairs of setae (*c*₃, *d*₃, *e*₃, *f*₃, *h*₁, *h*₂ present; *c*₂, *d*₂, *e*₂ absent; *c*₁, *d*₁, *e*₁, *f*₂ present or absent (*d*₁, *e*₁ rarely absent); setae *h*₂ elongate, flagellate. Palp one to three segmented. Venter with one to two pairs of setae *3a* (*3a* always present; *3a*₂ present or

absent) and one to four pairs of setae *4a* (*4a* always present; *4a2*, *4a3*, *4a4* present or absent); genitoventral plate developed or not, membranous genital flap present; commonly two pairs of pseudanal setae *ps2–3* present (three pairs, *ps1–ps3*, rarely present).

Male. Opisthosoma distinctly narrower than that of female; legs and dorsal setae usually similar to those of female; pseudanal setae *ps3* modified as a variously shaped accessory genital stylet.

***Tenuipalpus palosapis* Corpuz-Raros, 1978: 227**

(Figure 1–9, 10(a), 11(a))

Tenuipalpus palosapis Corpuz-Raros (1978): 227

Diagnosis

Female. Dorsum completely sculptured. Prodorsum: region lateral to setae *v2–sc1* with pair small globose projections, and central region with three large, distinctive globose projections, with strongly colliculate cuticle flanking the posterior projections; prodorsal setae *v2*, *sc1* and *sc2* strongly barbed; *v2* and *sc1* longer than *sc2*. Opisthosoma: central region anterior to setae *e1–e1* with a large single, medial, oblate projection, larger than prodorsal projections; dorsal opisthosomal setae barbed; setae *c1* and *d1* absent; setae *d3* and *e1* thick, subequal in length, longest on dorsal opisthosoma; setae *c3*, *e3*, *f2*, *f3*, *h1* short, subequal in length; setae *h2* elongate and flagelliform. Palps one-segmented. Ventral integument completely striated; with single fused genito-ventral plate, well-developed and clearly delimited; setae *1a*

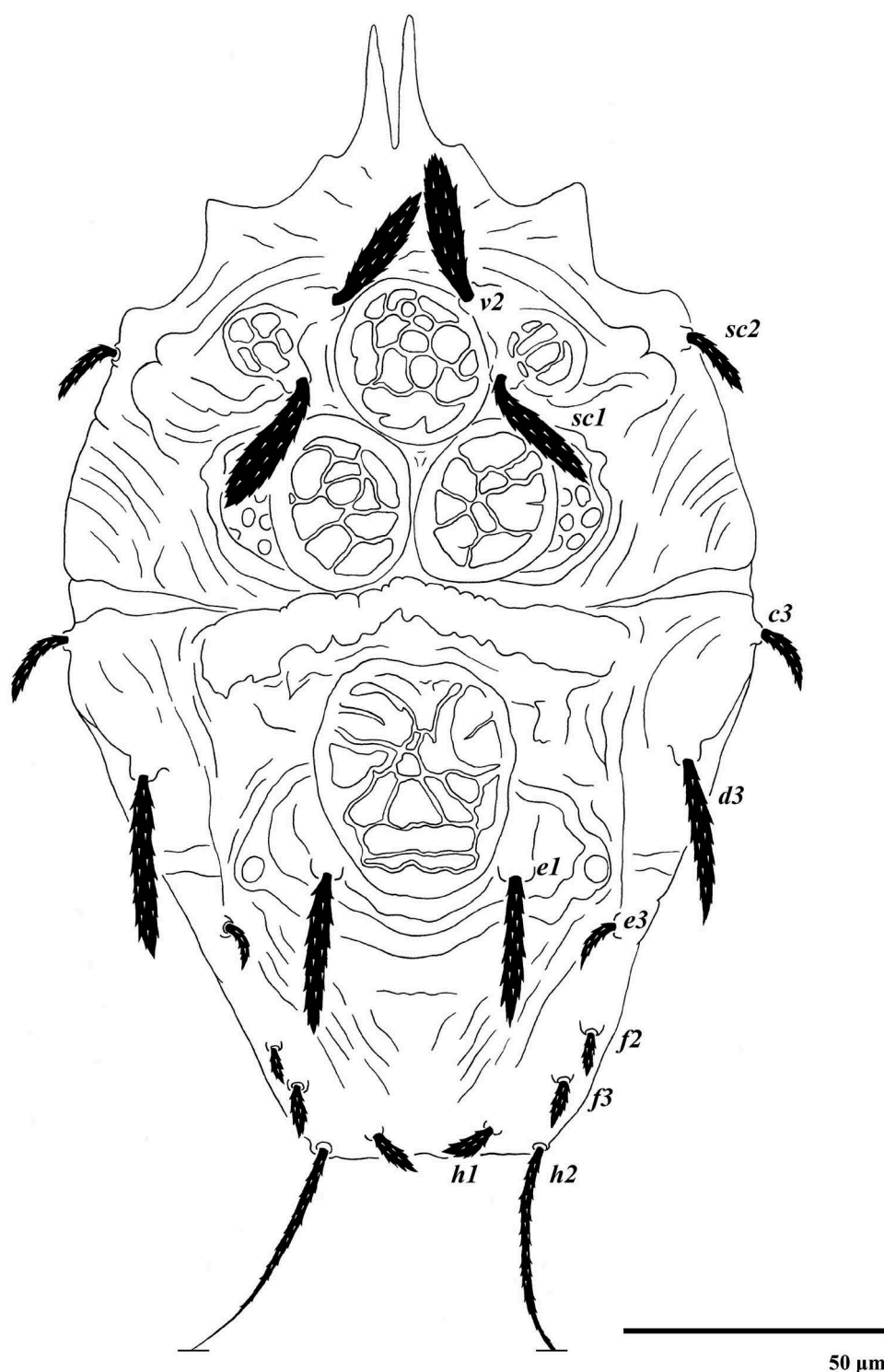


Figure 1. *Tenuipalpus palosapis* Corpuz-Raros (Female): dorsum.

elongate and flagelliform; setae *4a* short; setae *ag*, *g1–g2* and *ps2–ps3* smooth. Legs with seta *d* on femora and genua I–II thick, barbed and inserted in truly dorsal position.

Male. Prodorsum with projections similar to those of the female, and setae *v2*, *sc1* shorter than those of female. Opisthosomal projection smaller than prodorsal projections and weakly developed to almost absent; dorsal opisthosomal setae *c1*, *d1* absent; setae *e1*, *e3*, *f2*, *f3*, *h1* short, subequal in length; setae *c3*, *d3* thick; setae *d3* the longest on dorsal opisthosoma; tarsi I–II each with one additional solenidion in proximal ventrolateral position; other leg setae similar to those of the female.

Material examined

Paratypes: Three females and one male collected on *A. thurifera* Blume (Dipterocarpaceae), from Makiling Botanic Garden, Mount Makiling, Laguna, the Republic of the Philippines; 27 November 1976, coll. J.M. Sooto and R.C. Garcia. (USNM, DNR 331).

Redescription

Female (*n* = 3) (Figure 1–5, 10(a), 11(a)). Body measurements: distance between setae *v2–h1* 147–152, *sc2–sc2* 100–102; other measurements: *v2–v2* 23–25, *sc1–sc1* 35–38, *c3–c3* 119–128, *d3–d3* 102–104, *e1–e1* 31–34, *e3–e3* 68–71, *f2–f2* 57–59, *f3–f3* 48, *h1–h1* 18–22, *h2–h2* 38–40.

Dorsum (Figure 1–2, 10(a)). Anterior margin of prodorsum with median-forked projection forming a notch, reaching middle of femur of leg I. Dorsum completely sculptured, strongly sclerotized; with pair small globose projections lateral to setae *v2–sc1*; central region of prodorsum with three large, distinctive globose projections; with colliculate cuticle laterally flanking the posterial projections; prodorsal setae *v2*, *sc1* and *sc2* strongly barbed; *v2* and *sc1* broad, lanceolate to oblanceolate, subequal in length, longer than *sc2*. Central region of opisthosoma with a single large, medial, oblate projection; setae *c1*, *d1* absent; *d3* and *e1* thick, narrowly lanceolate, longest on dorsal opisthosoma; setae *c3*, *e3*, *f2*, *f3*, *h1* short, subequal in length; setae *h2* elongate and flagelliform. Setal lengths: *v2* 23–25, *sc1* 24–27, *sc2* 13–15, *c3*



Figure 2. Differential interference contrast (DIC) image of *Tenuipalpus palosapis* Corpuz-Raros (Female): dorsal habitus.

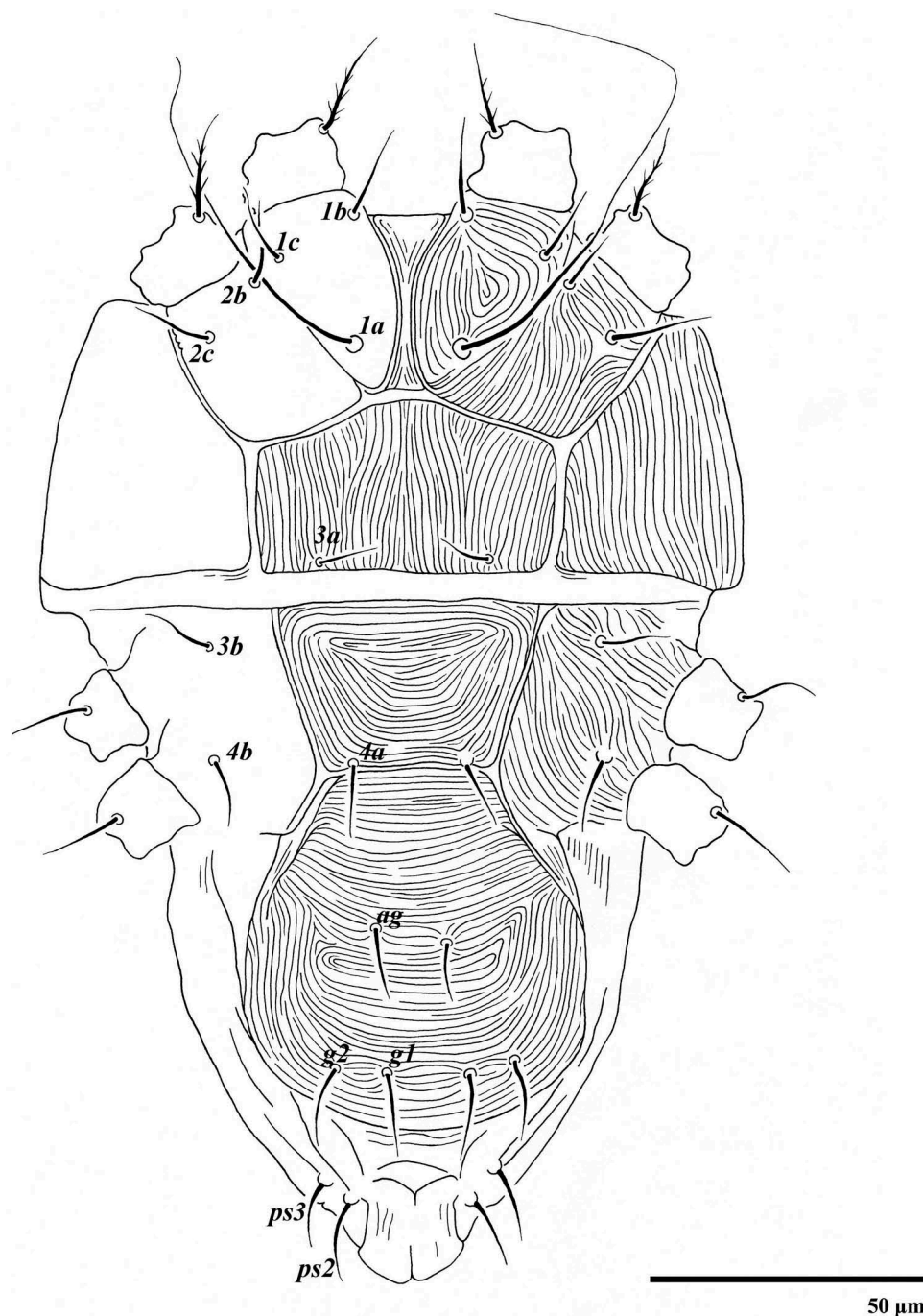


Figure 3. *Tenuipalpus palosapis* Corpuz-Raros (Female): venter.

12–15, *d3* 27–31, *e1* 28–29, *e3* 6–9, *f2* 6–7, *f3* 7–8, *h1* 8–9, *h2* 150–170.

Venter (Figure 3, 11(a)). Ventral integument completely striated; with single fused genitoventral plate, well-developed and clearly delimited; setae *1a* elongate and flagelliform; setae *4a* short; setae *ag*, *g1*–*g2* and *ps2*–*ps3* fine and smooth. Setal lengths: *1a* 71–74, *1b* 11–12, *1c* 6–7, *2b* 9–10, *2c* 11–13, *3a* 6–7, *3b* 9–10, *4a* 9–11, *4b* 8–10, *ag* 8–10, *g1* 9–10, *g2* 8–10, *ps2* 7–11, *ps3* 4–6.

Gnathosoma (Figure 4). Palps one-segmented, with one smooth distal seta *d* 8–10; eupathidium and solenidion absent. Ventral setae *m* 6–7, barbed; distance between setae *m*–*m* 11–12.

Legs (Figure 5). Chaetotaxy (from coxae to tarsi): I 2–1–4–2–5–8 (1), II 2–1–4–2–5–8(1), III 1–1–2–0–3–5, IV 1–1–1–0–3–5. Seta *d* on femora I–III short, broad, barbed; seta *d* on genu I–II short, thick,

barbed. Tarsi I–II each with one solenidion ω'' 7–8 and 8–9, respectively, longer than associated setae *ft''* short, lanceolate; two distal eupathidia, $p\zeta''$ – $p\zeta'''$ (4–5 for both tarsi).

Male (*n* = 1) (Figure 6–9). Body measurements: distance between setae *v2*–*h1* 138, *sc2*–*sc2* 82; other measurements: *v2*–*v2* 20, *sc1*–*sc1* 36, *c3*–*c3* 90, *d3*–*d3* 62, *e1*–*e1* 15, *e3*–*e3* 42, *f2*–*f2* 39, *f3*–*f3* 34, *h1*–*h1* 11, *h2*–*h2* 29.

Dorsum (Figure 6–7). Anterior margin of prodorsum with median-forked projection forming a notch, reaching middle of femur of leg I. Dorsum completely sculptured and sclerotized; central region of prodorsum with three large, distinctive globose projections. Setae *v2*, *sc1* and *sc2* broad, strongly barbed; *sc1* longer than *v2* and *sc2*. Opisthosoma with mostly longitudinal striation, medial globose projection weakly developed to almost absent (Figure 7); setae *c1*, *d1* absent; setae *d3* subequal in length to *sc1*,

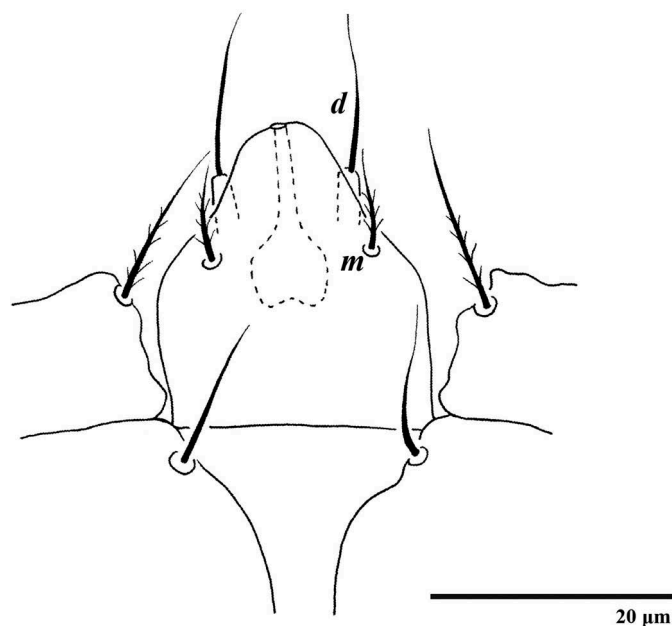


Figure 4. *Tenuipalpus palosapis* Corpez-Raros (Female): ventral infracapitulum.

thick and strongly barbed; setae *e1*, *e3*, *f2*, *f3*, *h1* short, subequal in length, barbed. Setal lengths: *v2* 15, *sc1* 20, *sc2* 14, *c3* 12, *d3* 21, *e1* 4, *e3* 9, *f2* 6, *f3* 7, *h1* 8, *h2* 150.

Venter (Figure 8(a)). Ventral integument completely striated, ventral propodosoma with mostly longitudinal striae, ventral opisthosoma with mostly transverse striae. Coxal, genital and pseudanal setae fine and smooth; setae *1a* elongate and flagelli-form; setae *4a* short; setae *ps3* modified into genital accessory stylets, short thickened setae with blunt tip. Setal lengths: *1a* 83, *1b* 8, *1c* 7, *2b* 9, *2c* 11, *3a* 6, *3b* 10, *4a* 7, *4b* 8, *ag* 7, *g1* 9, *g2* 10, *ps2* 7, *ps3* 7.

Aedeagus (Figure 8(b)). As figured; 70 long, finely tapered.

Gnathosoma. Palps similar to that of female, with one smooth seta *d* 10; eupathidium and solenidium absent. Ventral setae *m* 7; distance between setae *m-m* 11.

Legs (Figure 9). Chaetotaxy (from coxae to tarsi): I 2-1-4-2-5-8 (2), II 2-1-4-2-5-8(2), III 1-1-2-0-3-5, IV 1-1-1-0-3-5. Tarsi I-II each with two solenidium, tarsi I $\omega'1$ 5, ω'' 9, tarsi II $\omega'1$ 4, ω'' 9, and two eupathidia $p\zeta'$ - $p\zeta''$ (all 4); solenidium $\omega'1$ on tarsi I-II in proximal ventrolateral position; tarsi I-II with solenidium ω'' much longer than associated setae *ft''*, short and lanceolate; other leg setae similar to those of the female.

Discussion

The female of *T. palosapis* is easily differentiated from *T. antipodus*, *T. guamensis* and *T. orilloi* by the completely sculptured dorsum (Figure 10) which is only weakly sculptured in the latter

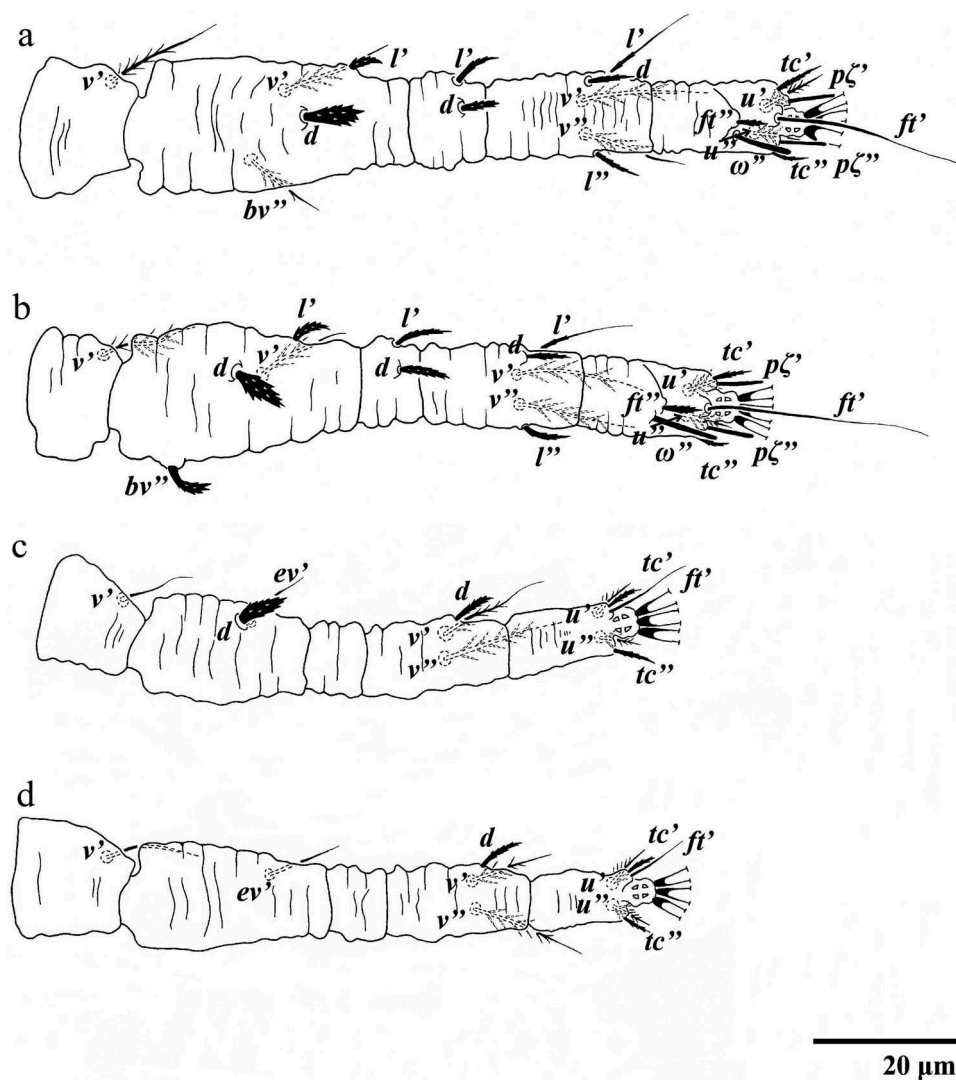


Figure 5. *Tenuipalpus palosapis* Corpez-Raros (Female), dorsal aspect, right side, of: a leg I; b leg II; c leg III; d leg IV.

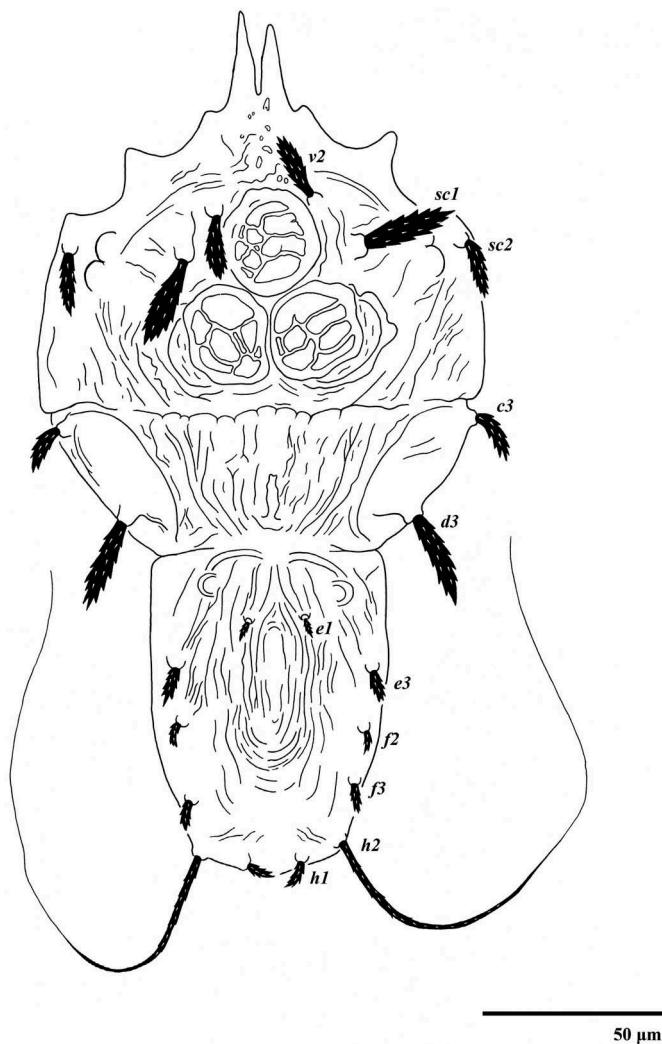


Figure 6. *Tenuipalpus palosapis* Corpuz-Raros (Male): dorsum.

species, and by the dorsal posterior lateral setae not being thick and long as they are in the latter species. The central region of the prodorsum of *T. palosapis* has three globose projections and the central region of the opisthosoma has a large single median oblate projection, while in the others three species, the dorsum is weakly sculptured and most posterior lateral setae are lanceolate. Despite these differences, these four species all share a single well-developed genitoventral plate, which is not present in other known *Tenuipalpus* species. The plate in *T. palosapis* is somewhat ovate being tapered anteriorly and broadly rounded posteriorly (Figure 3, 11(a)), whereas in *T. antipodus*, *T. guamensis* and *T. orilloi* the plate is octagonal in shape (Figure 11(b–d)); however, the genitoventral plate of *T. palosapis* appears to be weakly octagonal with three anterior and two lateral sides of an octagon weakly developed.

Besides the well-developed genitoventral plate shared by these species, *T. palosapis*, *T. antipodus*, *T. guamensis* and *T. orilloi* were all described from the Asia-Pacific region, indicating a biogeographic pattern. *T. palosapis* was described from specimens collected from native tree species in the Philippines, *A. thurifera* and *S. squamata* (Dipterocarpaceae), and has not been recorded since the original description. However, in contrast to what we know of other species of *Tenuipalpus* based on the literature, *T. antipodus*, *T. guamensis* and *T. orilloi*, have all been recorded from a wide range of host plants in several different countries, including New Zealand, Taiwan, Guam, the Cook Islands, the Philippines, Indonesia, Guiana, Trinidad and China, and have been intercepted at ports of entry in the United States and New Zealand.



Figure 7. Differential interference contrast (DIC) image of *Tenuipalpus palosapis* Corpuz-Raros (Male): dorsal habitus.

Collyer (1964) lists the type material of *T. antipodus* as being collected from *Melicytus ramiflorus* J.R. Forst. and G. Forst. (Violaceae), from New Zealand, but states that the species is also commonly collected from other bush plants, including *Coprosma* spp. (Rubiaceae) and *Nothopanax* sp. (Araliaceae). This species was later recorded infesting tea *Camellia sinensis* (L.) Kuntze (Theaceae) and *Beilschmiedia erythrophloia* Hayata (Lauraceae) in Taiwan (Lo 1969, 1986; Tseng 1977), and Collyer (1973) herself later recorded *T. antipodus* on *Hedycarya arborea* J.R. Forst. and G. Forst. (Monimiaceae), *Dysoxylum spectabile* (G. Forst.) Hook.f. (Meliaceae), *Beilschmiedia tawa* (A.Cunn.) Kirk (Lauraceae) and *Pseudowintera axillaris* (J.R. Forst. and G. Forst.) Dandy (Winteraceae) in New Zealand. Collyer (1973) also noted that *T. antipodus* and *T. orilloi* are known to occur on a wide range of host plants.

Tenuipalpus guamensis was described from bird's nest fern, *Asplenium nidus* L. (Aspleniaceae), from Sumay, Guam, intercepted in quarantine by USA (Baker 1945; De Leon 1966). Later, Collyer (1973) recorded this mite species in flower "head-bands" from Tahiti intercepted in quarantine by New Zealand, from an unnamed fern frond (Polypodiaceae) woven into the bands. Gerson and Collyer (1984) recorded *T. guamensis* from ferns *Dicranopteris linearis* (Burm. f.) Underw. (Gleicheniaceae) and *Nephrolepis hirsutula* (G. Forst.) C. Presl (Nephrolepidaceae) from the Cook Islands. These authors also describe and illustrate damage caused by this species on *N. hirsutula*. The records from three different localities, Guam, Tahiti and the Cook Islands, indicate that *T. guamensis* is widespread in the Pacific region. All previous host records are species of ferns, but it could potentially also occur on additional host plant species throughout the region.

Rimando (1962) described *T. orilloi* from coconut, *Cocos nucifera* L. (Arecaceae) and *Citrus* sp. (Rutaceae), from the Philippines.

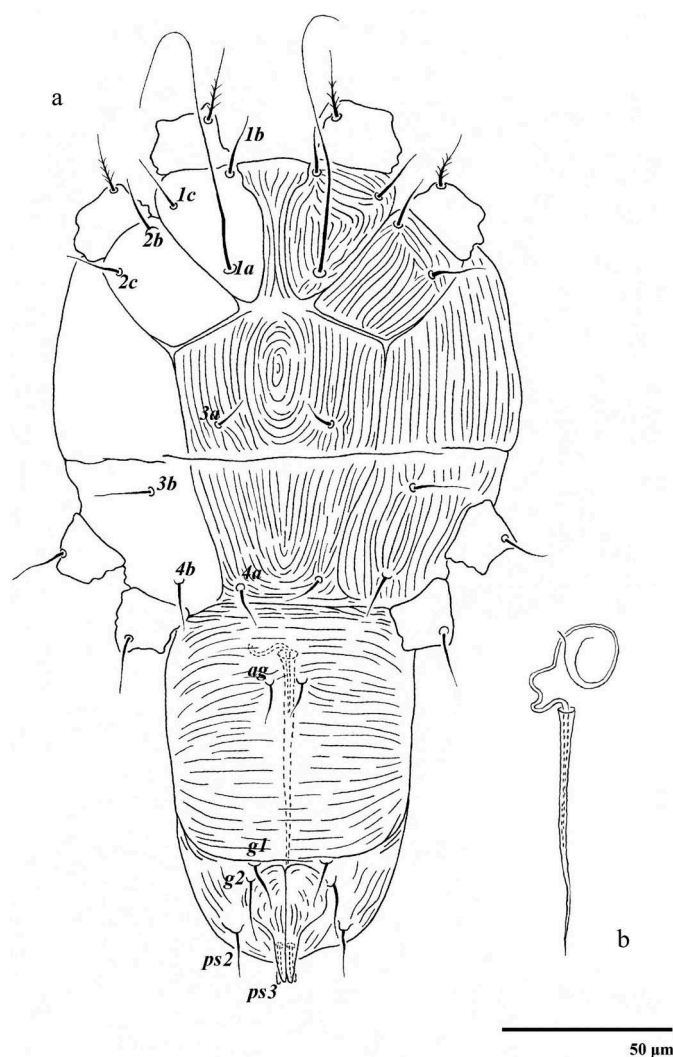


Figure 8. *Tenuipalpus palosapis* Corpuz-Raros (Male): a venter; b aedeagus.

The association with citrus indicated by Rimando (1962) is probably accidental because only one specimen was collected on this host. Manson (1963) described *Tenuipalpus spathiphyllus* based on specimens intercepted in quarantine on peace lily *Spathiphyllum* sp. (Araceae) from Indonesia at Washington D.C., USA. Two years later, De Leon (1965) collected *T. orilloi* on golden cane palm *Chrysalidocarpus lutescens* H. Wendl. (sic) (currently *Dypsis lutescens* (H. Wendl.) Beentje and J. Dransf.) (Arecaceae) and on an unknown broad-leaved tree from Guiana. He synonymized *T. spathiphyllus* with *T. orilloi* and mentioned that this species was less restricted in host preference than were most *Tenuipalpus* known in that time.

Later, De Leon (1967) reported an association between *T. orilloi* and the predatory mite groups Phytoseiidae and Camerobiidae in Trinidad. These associations were as follows, *T. orilloi* with: *Typhlodromina conspicua* (Garman) (Phytoseiidae) on *Hura crepitans* L. (Euphorbiaceae); *Amblyseius largoensis* (Muma) (Phytoseiidae) on *C. nucifera* and *Corypha umbraculifera* L. (Arecaceae); and *Neophyllobius fissus* De Leon (Camerobiidae) on *C. nucifera* and *Caryota urens* L. (Arecaceae). De Leon (1967) also reported *T. orilloi* on *Saraca indica* L. (Fabaceae), *Stylogyne lateriflora* (Sw.) Mez (Primulaceae) and *Citharexylum fruticosum* L. (sic.) (currently *C. spinosum* L.), (Verbenaceae) in Trinidad.

Corpuz-Raros (1989) reported associations between Phytoseiidae and Bdellidae and *T. orilloi* in the Philippines. This association occurred as follows, *T. orilloi* with: *Amblyseius cinctus* Corpuz and Rimando (Phytoseiidae) on *Citrus mitis* Blanco, *Citrus nobilis* Lour. (Rutaceae) and *Gmelina arborea* Roxb. (Lamiaceae); *A. largoensis* on *Chrysophyllum cainito* L. (Sapotaceae); *Proprioseiopsis lenis* (Corpuz and Rimando) (Phytoseiidae) on *C. nobilis*; *Paraphytoseius multidentalis* Swirski and Schechter (Phytoseiidae) on *Ch. cainito*; *Phytoseius glareosus* Corpuz (Phytoseiidae) on *Ch. cainito*; *Ph. rasilis* Corpuz on *G. arborea*; *Chanteius contiguus* (Chant) (Phytoseiidae) on *Bambusa vulgaris* Schrad. (Poaceae), *C. nobilis* and *Tagetes foetidissima* Hort. ex DC. (Asteraceae); and *Bdellodes harpax* Atyeo (Bdellidae) on *Bischofia javanica* Blume (Phyllanthaceae) and *Caryota cumingii* Lodd. ex Mart. (Arecaceae).

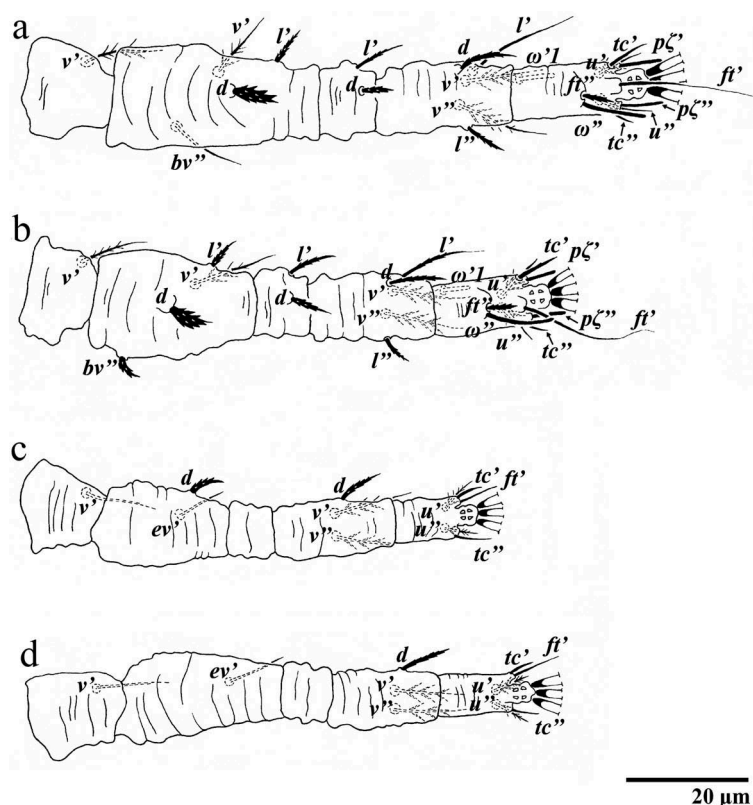


Figure 9. *Tenuipalpus palosapis* Corpuz-Raros (Male), dorsal aspect, right side, of: a leg I; b leg II; c leg III; d leg IV.

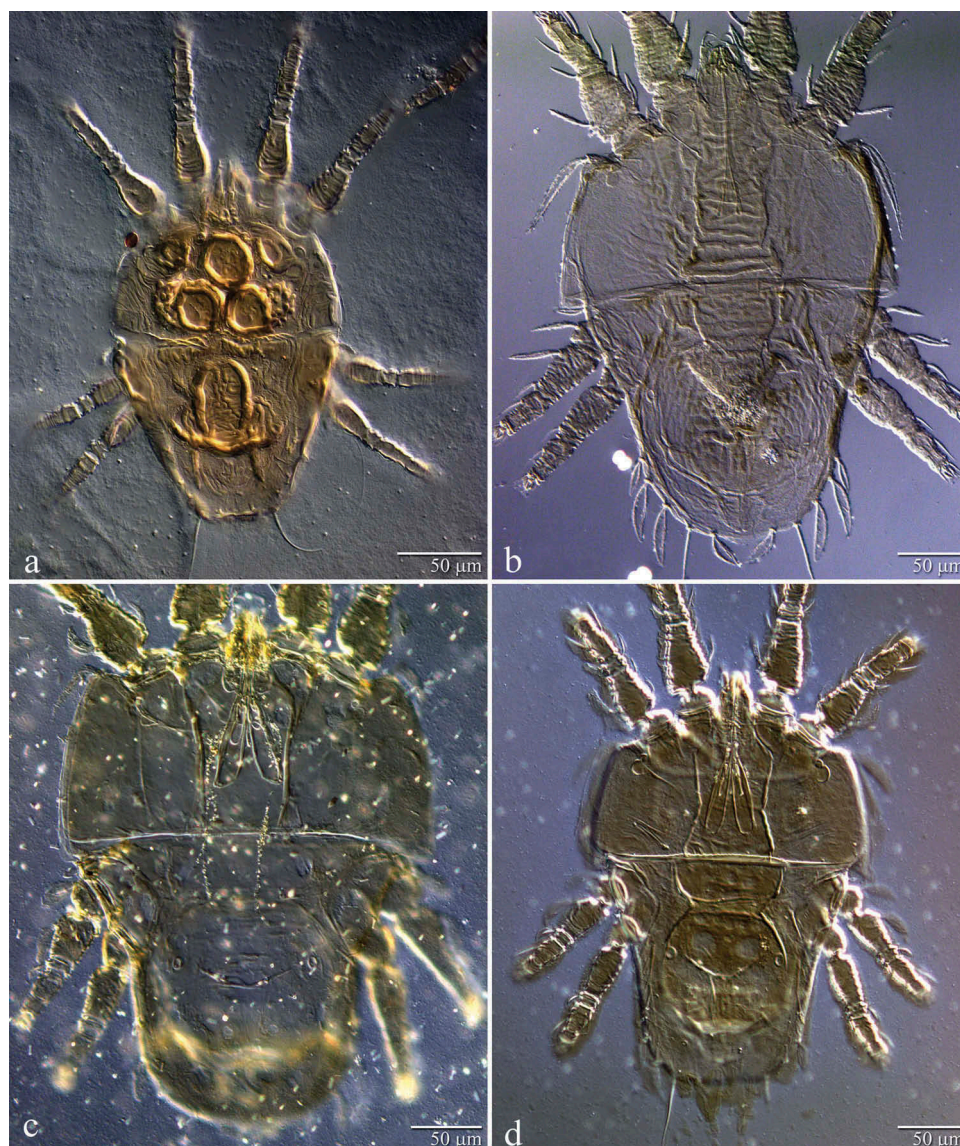


Figure 10. Female dorsal habitus: a *Tenuipalpus palosapis* Corpuz-Raros; b *Tenuipalpus antipodus* Collyer; c *Tenuipalpus guamensis* Baker; d *Tenuipalpus orilloi* Rimando.

Corpuz-Raros (1989) also reported *T. orilloi* for the first time on *Acalypha hispida* Burm.f. (Euphorbiaceae); *Astronia cumingiana* S. Vidal (Melastomataceae), *Beaumontia pandacqui* (sic) (*Tabernaemontana pandacqui* Lam., Apocynaceae), *Casearia fuliginosa* (Blanco) Blanco (Salicaceae), *Citrus grandis* (L.) Osbeck (sic) (syn. of *Citrus maxima* (Burm.) Merr), (Rutaceae), *Coffea excelsa* A. Chev. (sic) (syn. of *Coffea liberica* var. *dewevrei* (De Wild. and T. Durand) Lebrun, Rubiaceae), *Cratogeomys celebicum* Blume (Hypericaceae), *Ficus septica* Burm.f. (Moraceae), *Leea philippinensis* Merr. (Vitaceae), *Livistona rotundifolia* (Lam.) Mart. (sic) (syn. of *Saribus rotundifolius* (Lam.) Blume), (Arecaceae), *Psychotria luzoniensis* (Cham. and Schltdl.) Fern.-Vill. (Rubiaceae), *Rubia* sp. (Rubiaceae), *Spathodea campanulata* P. Beauv. (Bignoniaceae), *Strombosia philippinensis* S. Vidal (Strombosiaceae), *Terminalia citrina* Roxb. ex Fleming (Combretaceae) and *Theobroma cacao* L. (Malvaceae).

Recently, Xu and Fan (2010) provided a detailed redescription of *T. orilloi* female based on specimens collected on the palm *Phoenix roebelenii* O'Brien (Arecaceae) from China. These authors also mentioned the broad host range and potentially wide distribution of this species. To date, *T. orilloi* has been reported on 36 different host plants belonging to 22 families, from five different countries, the Philippines, Indonesia, Guiana, Trinidad and China. Based on reports and comments on the host associations of this mite species (De Leon 1965; Corpuz-Raros 1989; Xu and Fan 2010), *T. orilloi* appears strongly associated with two monocot

plant families, the palm family Arecaceae and perhaps the lily family Araceae (monocotyledons), while other dicot plant families that have been recorded as host plants may need reevaluating, as neither substantial populations nor immatures were recorded on these hosts.

The wide range of host plants, including several economic palms and ornamentals, that are affected by the mite species *T. antipodus*, *T. orilloi* and *T. guamensis*, and the quarantine interception records from different countries, together indicate the importance of these three tenuipalpid species as potential invasive species. The damage caused, life cycles, host associations and natural enemies of these species are in need of additional research.

Key to species of *Tenuipalpus* with a well-developed genitoventral plate (based on females)

1. Dorsal opisthosomal setae *c1* and *d1* absent; prodorsum completely sculptured; central region of prodorsum with three distinctive globose projections..... *T. palosapis* Corpuz-Raros
- Dorsal opisthosomal setae *c1* and *d1* present; prodorsum not as mentioned above..... 2
2. Dorsal opisthosomal setae *e3* half to three quarters the length to setae *f2* and *f3*..... *T. antipodus* Collyer

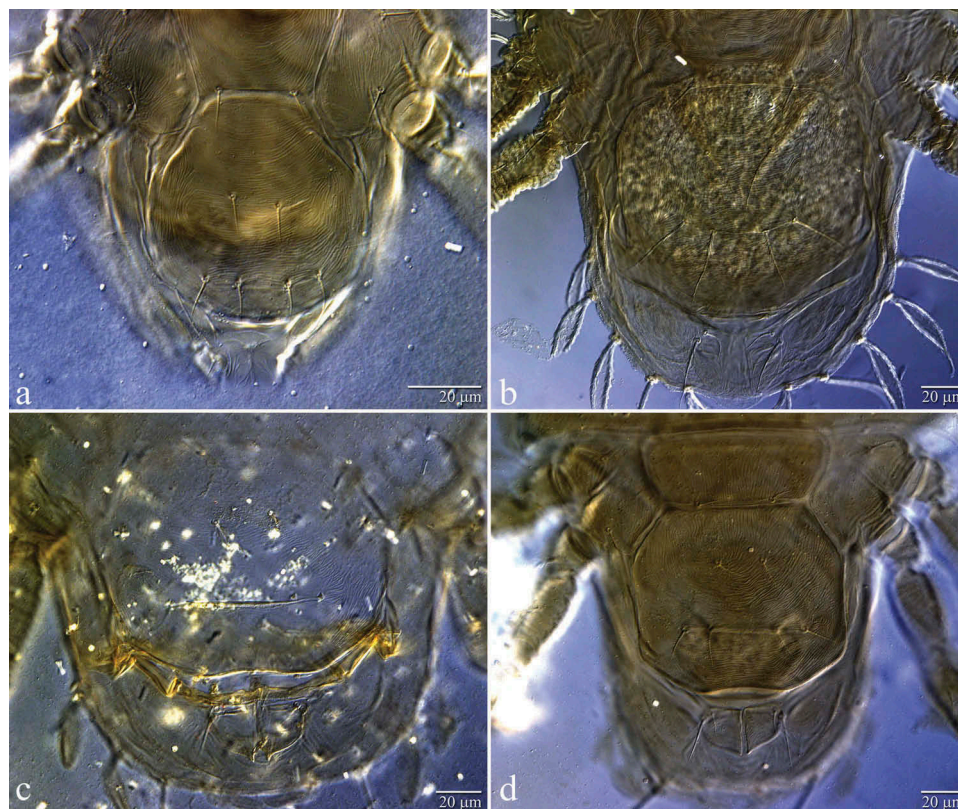


Figure 11. Posterior venter with detail of genitoventral and anal plates (female): a *Tenuipalpus palosapis* Corpuz-Raros; b *Tenuipalpus antipodus* Collyer; c *Tenuipalpus guamensis* Baker; d *Tenuipalpus orilloi* Rimando.

- Dorsal opisthosomal setae *e3* minute, distinctly much smaller than setae *f2* and *f3* 3
- 3. Prodorsal setae *sc2* of similar length to *v2*; dorsal opisthosomal setae *c1*, *d1* and *e1* short (4–8 long) *T. orilloi* Rimando
- Prodorsal setae *sc2* distinctly smaller than *v2*; dorsal opisthosomal setae *c1*, *d1* and *e1* minute (3 long) *T. guamensis* Baker

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References

- Baker EW. 1945. Mites of the genus *Tenuipalpus* (Acarina: Trichadenidae). Proceedings of the Entomological Society of Washington. 47:33–38.
- Baker EW, Tuttle DM. 1987. The false spider mites of Mexico (Tenuipalpidae: Acari). United States Department of Agriculture, Agricultural Research Service, Technical Bulletin. 1706:1–236.
- Beard JJ, Otley J, Seeman OD. 2016. A review of *Ultratenuipalpus* (Trombidiformes: Tenuipalpidae) and related genera, with a new species from forest oak *Allocasuarina torulosa* (Aiton) (Casuarinaceae). International Journal of Acarology. 42:285–302.
- Beard JJ, Seeman OD, Bauchan GR. 2014. Tenuipalpidae (Acari: Trombidiformes) from Casuarinaceae (Fagales). Zootaxa. 3778:1–157.
- Castro EB, Feres RJF, Ochoa R, Bauchan GR. 2016a. A new species of *Tenuipalpus* sensu stricto (Acari: Tenuipalpidae) from Brazil, with ontogeny and a key to the known species. Zootaxa. 4088:355–378.
- Castro EB, Kane EC, Feres RJF, Ochoa R, Bauchan GR. 2016b. Definition of *Tenuipalpus* sensu stricto (Acari, Tenuipalpidae), with redescription of *Tenuipalpus caudatus* (Dugès) and description of a new species from Costa Rica. International Journal of Acarology. 42:106–126.
- Castro EB, Ochoa R, Feres RJF, Beard JJ, Bauchan GR. 2015. Reinstatement of the genus *Colopalpus* Pritchard and Baker (1958) and re-description of *Colopalpus matthysei* Pritchard and Baker (1958), the type species of the genus (Acari, Tenuipalpidae). International Journal of Acarology. 41:310–328.
- Castro EB, Ramos FAM, Feres RJF, Ochoa R, Bauchan GR. 2017. Redescription of *Tenuipalpus heveae* Baker (Acari: Tenuipalpidae) and description of a new species from rubber trees in Brazil. Acarologia. 57:421–458.
- Collyer E. 1964. New species of *Tenuipalpus* (Acarina: Tenuipalpidae) from New Zealand. Acarologia. 6:432–440.
- Collyer E. 1973. New species of the genus *Tenuipalpus* (Acari: Tenuipalpidae) from New Zealand, with a key to the world fauna. New Zealand Journal of Science. 16:915–955.

- Corpuz-Raros LA. 1978. New Philippine Tetranychoida (Acarina). Kalikasan, Philippines Journal of Biology. 7:211–230.
- Corpuz-Raros LA. 1989. Hosts, geographic distribution and predatory mite associations of Philippines phytophagous mites (Acari). The Philippine Agriculturist. 72:303–322.
- De Leon D. 1965. New Tenuipalpidae (false spider mites) from British Guiana with notes on four described species. Florida Entomologist. 48:65–75.
- De Leon D. 1966. A new fern mite from Trinidad, West Indies (Acarina: tarsonemidae). Florida Entomologist. 49:127–129.
- De Leon D. 1967. Some Mites of the Caribbean Area. Lawrence (Kansas): Allen Press, Inc. p. 1–46.
- Gerson U, Collyer E. 1984. Two false spider mites (Acari: Tenuipalpidae) from Cook Islands and New Zealand ferns. New Zealand Journal of Zoology. 11:141–144.
- Lindquist EE. 1985. External anatomy. In: Helle W, Sabelis MW, editors. Spider Mites: their biology, natural enemies and control. Vol. 1A. Amsterdam: Elsevier. p. 3–28.
- Lo PKC. 1969. Tetranychoid mites infesting special crops in Taiwan. Bulletin Sun Yat-Sem Cultural Foundation. 4:43–82.
- Lo PKC. 1986. Tetranychoid mites infesting tea in Taiwan. Chung-San Academic Cultural Affairs Serie. 1:275–286.
- Manson DC. 1963. Seven new species of false spider mites (Tenuipalpidae: Acarina). Acarologia. 5:213–224.
- Mesa NC, Ochoa R, Welbourn WC, Evans GA, de Moraes GJ. 2009. A catalog of the Tenuipalpidae (Acari) of the World with a key to genera. Zootaxa. 2098:1–185.
- Meyer MKP. 1979. The Tenuipalpidae (Acari) of Africa with keys to the world fauna. Entomology Memoir, Department of Agriculture Republic South Africa, Pretoria. 50:1–133.
- Meyer MKP. 1993. A revision of the genus *Tenuipalpus* Donnadieu (Acari: Tenuipalpidae) in the Afrotropical region. Entomology Memoir of the Department of Agriculture Republic South Africa. 88:1–84.
- Rimando LC. 1962. The tetranychoid mites of the Philippines. University of Philippines, College Agricultural. Laguna, Technical Bulletin. 11:1–52.
- Seeman OD, Beard JJ. 2011. A new species of *Aegyptobia* (Acari: Tenuipalpidae) from Myrtaceae in Australia. Systematic & Applied Acarology. 16:73–89.
- Tseng Y-H. 1977. Systematic and distribution on phytophagous Mites in Taiwan, Part II. Tenuipalpidae. Bureau of Commodity Inspection and Quarantine, Ministry of Economic Affairs, Tainan Branch, 80pp.
- Welbourn WC, Beard JJ, Baughan GR, Ochoa R. 2017. Description of a new species of *Tenuipalpus* (Acari: Trombidiformes) from succulent plants in Florida, USA, and a redescription of *T. crassulus* Baker and Tuttle. International Journal of Acarology. 43:112–136.
- Xu Y, Fan Q-H. 2010. *Tenuipalpus orilloi* Rimando, a new record to the Chinese fauna (Acari: Tenuipalpidae). Systematic & Applied Acarology. 15:135–138.
- Zhang Z-Q, Fan Q-H. 2004. Redescription of *Dolichotetranychus ancistrus* Baker & Pritchard (Acari: Tenuipalpidae) from New Zealand. Systematic & Applied Acarology. 9:111–131.