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Redescription of *Tenuipalpus heveae* Baker (Acari: Tenuipalpidae) and description of a new species from rubber trees in Brazil

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ABSTRACT — *Tenuipalpus heveae* Baker, 1945 was originally described from only female specimens collected on rubber trees from Belterra, State of Pará, Brazil. The original description does not provide enough key information essential for accurate and consistent species identification, and thus, it is difficult to correctly identify this species. In this paper, we redescribe the female, male and immatures of *T. heveae*, from type and newly collected material, and include additional novel data (e.g. dorsal and ventral ornamentation, leg chaetotaxy and setal measurements) in a standardized form. In addition, we describe *Tenuipalpus vieirae* **n. sp.** based on adult females and immatures, collected on *Hevea brasiliensis* Muell. Arg. and *H. guianensis* Aubl. (Euphorbiaceae) from Manaus, State of Amazonas, Brazil. We include details of the patterns of ontogenetic setal additions for all stages (except the male of *T. vieirae* **n. sp.**) of these two species.

KEYWORDS — *Hevea*; sensu lato group; *Tenuipalpus vieirae*; red false spider mite; pest mite; ontogeny; taxonomy; systematics

ZOOBANK — 0763BBAE-D697-4E4A-89D3-C49CDAEC6265

INTRODUCTION

Some researchers have recorded a high abundance of *Tenuipalpus heveae* Baker (Acari, Tenuipalpidae) on rubber tree plantations, *Hevea brasiliensis* (Euphorbiaceae), in different regions across Brazil (Hernandes & Feres 2006; Daud & Feres 2007; Castro *et al.* 2013). According to Pontier *et al.* (2000), high infestations of *T. heveae* may cause leaf rusting followed by plant defoliation. Currently, this

mite species is considered to be a pest for this crop in several states of Brazil (Castro *et al.* 2013).

The original description of *Tenuipalpus heveae* was based only on adult female specimens collected on rubber trees in Belterra, State of Pará, Brazil (Baker 1945; Baker & Pritchard 1953). Recently, male and immatures were described by Pontier & Flechtmann (1999; 2000), respectively. However, these descriptions does not provide enough key information essential for accurate and consis-

tent species identification (e.g. dorsal and ventral ornamentation, leg chaetotaxy and setal measurements), and thus, it may be difficult to correctly identify the species. The objective of this paper is to redescribe the female, male and immatures of *T. heveae* in a standardized form, and describe a new species collected on rubber tree from Manaus, State of Amazonas, Brazil.

MATERIALS AND METHODS

Measurements of the holotype are given in micrometers (µm), with the range of measurements for the paratypes shown in parentheses. Photographs taken using differential interference contrast (DIC) microscopy are included. The terminology used follows that of Lindquist (1985) and Mesa *et al.* (2009). Leg chaetotaxy is adapted from Lindquist (1985), Xu & Fan (2010) and Seeman & Beard (2011). Tarsal setae are presented as the total number followed by the number of solenidia in parentheses.

Specimens of *T. heveae* were collected on *Hevea brasiliensis* Muell. Arg. (Euphorbiaceae) from São José do Rio Preto, State of São Paulo, Brazil. These specimens were maintained in 70% ethanol and later used for low-temperature scanning electron microscopy (LT-SEM) studies. Mites for LT-SEM studies use the methodology previously described by Castro *et al.* (2015). Non-type material of *T. heveae* was collected from rubber tree plantations of different regions of Brazil.

Type specimens and voucher of non-type material are deposited in the Collection of Acari, Departamento de Zoologia e Botânica, UNESP, São José do Rio Preto, State of São Paulo, Brazil (DZSJRP, <http://www.splink.cria.org.br>) and in the National Insect and Mite Collection, National Museum of Natural History, Smithsonian Institution, located in the Systematic Entomology Laboratory (SEL), USDA, Beltsville, Maryland, USA (NMNH).

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 (*v2*, *sc1*, *sc2*; except *v2* absent in *T. elegans* (Collyer)); dorsal opisthosoma with eight to ten pairs of setae (*c3*, *d3*, *e3*, *f3*, *h1*, *h2* present; *c2*, *d2*, *e2* absent; *c1*, *d1*, *e1*, *f2* present or absent (*d1*, *e1* rarely absent); setae *h2* elongate, flagellate. Palp one to three segmented. Venter with one to two pairs of setae *3a* (*3a* always present; *3a2* present or absent) and one to four pairs of setae *4a* (*4a* always present; *4a2*, *4a3*, *4a4* present or absent); ventral and genital plates not developed, 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 accessory genital stylet.

RESULTS

Tenuipalpus heveae Baker (Figures 1-17)

Tenuipalpus heveae Baker, 1945: 36; Baker & Pritchard, 1953: 319; Pontier & Flechtmann, 1999: 293; Pontier & Flechtmann, 2000: 77.

Diagnosis — Female: Dorsum completely ornamented; prodorsum with transverse to oblique striae, and pair of converging oblique ridges from *sc1* to sejugal furrow (weakly evident under DIC, strongly evident under SEM); triangular to semi-circular plate weakly evident encompassing *c3-d3*. Anterior margin of prodorsum with pair median triangular projections, forming a notch. Dorsum with setae *v2*, *c1*, *d1*, *d3*, *e1* minute; setae *sc1*, *sc2*, *c3*, *e3*, *f2*, *f3*, *h1* ovate to lanceolate, barbed; *h2* elongate, flagelliform; *f2* present. Palps three segmented. Ventral integument with regions of smooth cuticle and with regions of fine longitudinal striae; striae oblique and converging to become longitudinal striae between *3a* setae; ventral prodorsum with lateral margin longitudinally striate; striae surrounding coxae III and IV oblique; large region of smooth cuticle laterad setae *4a-ag*; broken transverse striae between setae *ag* and *g1-g2*. Coxal setae *1b* and *2b* filiform

and smooth, other coxal setae sparsely plumose. Tarsi I–IV 9(1)–9(1)–4–4 (setae *tc'* absent on tarsus III–IV); trochanters I–IV 1–1–1–1 (seta *l'* absent on trochanter III); setae *d* absent on tibia III and IV. Male and immatures: most of dorsal setae similar to those of female.

Type material examined — **Holotype:** female collected on a rubber tree, *Hevea brasiliensis* Muell. Arg. (Euphorbiaceae), Belterra, State of Pará, Brazil, 9 Aug. 1941, coll. J.A. Zilles, deposited in National Insect and Mite Collection, National Museum of Natural History, Smithsonian Institution, located at the SEL-USDA, Beltsville, Maryland, USA (USNM no. 1481a). **Paratypes:** 2 females with the same data as the holotype (USNM no. 1481b–1481c); 1 female with the same data as the holotype, deposited in Collection of Acari, Departamento de Zoologia e Botânica, UNESP, located at the São José do Rio Preto, State of São Paulo, Brazil (DZSJRP no. 10145 (donation of slide USNM no. 1481d)).

Non-type material examined — 5 females collected on *H. brasiliensis* from Igrapiúna, Bahia, Brazil, 2009; coll. E.B. Castro (DZSJRP n. 10146–10148); 2 females collected on *H. brasiliensis* from Manaus, Amazonas, Brazil, 20 Oct. 2000, coll. T.J. Izzo; 2 females collected on *H. guianensis* Aubl. (Euphorbiaceae) from Manaus, Amazonas, Brazil, Aug. 2012, coll. F.M. Nuvoloni (DZSJRP n. 10149–10151); 3 females collected on *H. brasiliensis* from Taquaritinga, São Paulo, Brazil, 14 Apr. 2000, coll. R.J.F. Feres; 2 females collected on *H. brasiliensis* from São José do Rio Preto, São Paulo, Brazil, 01 Jul. 2003, coll. R.J.F. Feres (DZSJRP n. 10152–10154); 5 females collected on *H. brasiliensis* from Goianésia, Goiás, Brazil, 05 Dec. 2000, coll. R.J.F. Feres (DZSJRP n. 10155–10157); and 1 male, 3 deutonymphs, 1 protonymph and 3 larvae collected on *H. brasiliensis* from São José do Rio Preto, São Paulo, Brazil, 09 Jul. 2015, coll. E.B. Castro (DZSJRP n. 10706–10708).

Remarks — Baker (1945) and Baker & Pritchard (1953) did not mention the number of specimens used in the description and redescription of the species. Four type specimens were located, and these were remounted by USNM staff due to their poor condition. Now there are four slides, each with 1 female specimen (see above for deposition

details). One of the paratypes was donated to Collection of Acari DZSJRP.

Redescription

Female (Figures 1–10; n=4) — Body measurements: distance between setae *v2-h1* 240 (230 – 250), *sc2-sc2* 150 (145 – 150); other measurements: *v2-v2* 32 (30 – 31), *sc1-sc1* 100 (95 – 105), *c1-c1* 25 (20 – 25), *c3-c3* 175 (165 – 175), *d1-d1* 7 (5 – 10), *d3-d3* 135 (130 – 145), *e1-e1* 6 (3 – 7), *e3-e3* 100 (85 – 112), *f2-f2* 82 (80 – 97), *f3-f3* 75 (72 – 75), *h2-h2* 60 (50 – 62), *h1-h1* 27 (22 – 27).

Dorsum (Figures 1–4) — Anterior margin of prodorsum with a pair of median triangular projections forming a notch. Dorsum completely ornamented; under SEM appears as fine narrow bands of elongate cells and fine reticulation (Fig. 2a); under DIC appears as: prodorsum – a series of fine oblique bands laterally, separated by small fine irregular unjoined cells; opisthosoma – a series of fine transverse bands centrally, separated by small fine irregular open cells (Fig. 1); triangular to semicircular plate weakly evident encompassing *c3-d3*. Dorsal setae *v2*, *c1*, *d1*, *d3* and *e1* short to minute; *sc1*, *sc2*, *c3*, *e3*, *f2*, *f3*, *h1* ovate to lanceolate, barbed; *h2* elongate and flagelliform. Setal lengths: *v2* 5 (4 – 5), *sc1* 10 (9 – 10), *sc2* 20 (20 – 23), *c1* 4 (3 – 4), *c3* 19 (16 – 19), *d1* 4 (3 – 4), *d3* 4 (4), *e1* 4 (4), *e3* 16 (17 – 20), *f2* 16 (13 – 18), *f3* 15 (14 – 17), *h1* 14 (10 – 14), *h2* 120 (100 – 125). Microplates: microplate layer consisting of a smooth base layer of tiny rounded wax-like crystals forming an even coating over the body, interspersed with large, individual, globular, conglomerate masses (Fig. 3).

Venter (Figures 5 and 7) — Ventral integument with fine, mostly longitudinal striae; with oblique striations becoming longitudinal near *3a* setae; prodorsum with lateral margin longitudinally striate; with narrow band of transverse striae between setae *4a-4a* and longitudinal striae *4a-ag*; with broken transverse striae between *ag* and *g1-g2*; large region of smooth cuticle laterad setae *4a-ag*. Striae surrounding coxae I and II longitudinal; striae surrounding coxae III and IV oblique to longitudinal. Coxal setae *1b* and *2b* smooth, other coxal setae sparsely plumose; setae *1a* and *4a* setae elon-

FIGURE 1: *Tenuipalpus heveae* Baker (Female): dorsum.

FIGURE 2: Low-Temperature Scanning Electron Microscopy (LT-SEM) image of *Tenuipalpus heveae* Baker (Female): a – dorsal view; b – lateral view.

FIGURE 3: LT-SEM image of *Tenuipalpus heveae* Baker (Female): detail of microplates on integument of dorsum (15,000X magnification).

FIGURE 4: Differential interference contrast (DIC) image of *Tenuipalpus heveae* Baker (female paratype): dorsum.

FIGURE 5: *Tenuipalpus heveae* Baker (Female): venter.

FIGURE 6: *Tenuipalpus heveae* Baker (Female): ventral infracapitulum.

FIGURE 7: LT-SEM image of *Tenuipalpus heveae* Baker (Female): a – anterior ventral opisthosoma; b – posterior ventral opisthosoma.

gate and flagelliform; setae *3a* smooth; setae *ag*, *g1-2* and *ps2-3* sparsely plumose. Setal lengths: *1a* 70 (40 – 70), *1b* 10 (10 – 11), *1c* 14 (12 – 15), *2b* 16 (12 – 20), *2c* 21 (18 – 24), *3a* 12 (10 – 12), *3b* 20 (15 – 20), *4a* 70 (70 – 75), *4b* 17 (17 – 21), *ag* 17 (16 – 18), *g1* 16 (16 – 19), *g2* 19 (17 – 20), *ps2* 13 (12 – 16), *ps3* 14 (12 – 16).

Gnathosoma (Figures 6, 8–9) — Palps 3-segmented, second segment elongate bearing 1 long, barbed seta *d* 10 (9 – 13); third segment small with 1 eupathidium *ul'* 8 (7 – 8). Ventral setae *m* 11 (10 – 12), sparsely plumose; distance between setae *m-m* 15 (12 – 14). Tips of cheliceral stylets laterally serrated (Figure 9).

Legs (Figure 10) — Setal counts (from coxae to tarsi): I 2-1-4-1-5-9(1), II 2-1-4-1-5-9(1), III 1-1-2-0-2-4, IV 1-1-1-0-2-4. Setae *d* on femora I and II in dorsal position, not lateral; setae *l'* on trochanter III absent; setae *d* absent on tibiae III and IV; setae *tc'* absent on tarsi III – IV; seta *ft''* on tarsi I and II short, broadly lanceolate, barbed; tarsi I and II each with 1 short solenidion ω'' [tarsi I 4 (4 – 5) and tarsi II 3 (3 – 4) respectively] and 2 eupathidia *p'* and *p''* (7 – 8, 7 – 8 for both tarsi I and tarsi II). Ventral setae on trochanters, femora, and tibiae I – IV sparsely plumose. See details of the development of leg chaetotaxy in Table 1.

Color (Figure 2a) — The body is reddish with the margin of prodorsum and opisthosoma darker red. The legs and dorsal setae are orange. Due to its color, this species is known in Brazil as the rubber tree red false spider mite or "falso-ácaro-vermelhoda-seringueira".

Male (Figures 11–13; *n*=1) — Body measurements: distance between setae *v2-h1* 180, *sc2-sc2* 125; other measurements: *v2-v2* 33, *sc1-sc1* 80, *c1-c1* 25, *c3-c3* 125, *d1-d1* 13, *d3-d3* 100, *e1-e1* 8, *e3-e3* 70, *f2-f2* 70, *f3-f3* 60, *h2-h2* 50, *h1-h1* 20.

Dorsum (Figures 11–12) — Anterior margin of prodorsum with a pair of median triangular projections forming a notch. Dorsal cuticle mostly smooth. Prodorsum with weak oblique striae converging from *sc1* to median sejugal furrow; semi-circular plate weakly evident encompassing *c3-d3*. Dorsal setae *v2*, *c1*, *d1*, *d3* and *e1* short to minute; *sc1*, *sc2*, *c3*, *e3*, *f2*, *f3*, *h1* lanceolate, barbed; *h2* elongate and flagelliform. Setal lengths: *v2* 5, *sc1* 10, *sc2*

14, *c1* 6, *c3* 9, *d1* 6, *d3* 5, *e1* 5, *e3* 11, *f2* 12, *f3* 12, *h1* 10, *h2* 65.

Venter (Figure 13a) — Ventral integument with fine striae; prodorsum with lateral margin longitudinally striate and with converging oblique striations surrounding *3a* setae; with broken transverse striae between setae *4a* and *g1-g2*. Striae on coxae I–IV oblique to longitudinal. Coxal setae *1b* and *2b* smooth, other coxal setae sparsely plumose; setae *1a* and *4a* setae elongate and flagelliform; setae *3a*, *ag* and *ps2* smooth; setae *g1-2* sparsely plumose. Setae *ps3* modified and inserted in a distal position in the anal valves. Setal lengths: *1a* 65, *1b* 10, *1c* 12, *2b* 13, *2c* 16, *3a* 11, *3b* 16, *4a* 65, *4b* 14, *ag* 13, *g1* 14, *g2* 15, *ps2* 12, *ps3* 11.

Gnathosoma — Palps similar to those of female. Tibial seta *d* 8, tarsal eupathidium *ul'* 7. Ventral setae *m* 9; distance between setae *m-m* 12.

Legs — Same setal distribution as female; tarsi I and II each with 1 solenidion ω'' [tarsi I 5 and tarsi II 6, respectively], ω' absent, and 2 eupathidia *p'* and *p''* (tarsi I 6 and tarsi II 7, respectively).

Aedeagus (Figure 13b) — As figured; 82 long.

Deutonymph (*n*=3) — Body size measurements: distance between setae *v2-h1* 220 – 235, *sc2-sc2* 122 – 125; other measurements: *v2-v2* 25 – 28, *sc1-sc1* 82 – 90, *c1-c1* 23, *c3-c3* 145 – 150, *d1-d1* 10 – 13, *d3-d3* 115 – 120, *e1-e1* 5 – 8, *e3-e3* 82 – 85, *f2-f2* 72 – 78, *f3-f3* 65 – 70, *h2-h2* 35 – 38, *h1-h1* 12 – 15.

Dorsum (Figures 14–15a) — Anterior margin of prodorsum with a pair of small triangular projections forming a short, broad notch. Prodorsum with anterior central region smooth; region between setae *sc2* and *d1* with widely spaced transverse folds becoming oblique laterally; region posterior to *d1-c3* smooth. Dorsal setae mostly similar in shape to adults, except narrower and setae *sc2* longer – *v2*, *c1*, *d1*, *d3*, and *e1* minute; *sc2* long, narrow; *sc1*, *c3*, *e3*, *f2*, *f3*, *h1* lanceolate to weakly falcate; *h2* elongate, flagelliform. Setal lengths: *v2* 3 – 4, *sc1* 13 – 15, *sc2* 30 – 31, *c1* 3 – 4, *c3* 15 – 17, *d1* 2 – 3, *d3* 3, *e1* 3 – 4, *e3* 17 – 19, *f2* 15 – 17, *f3* 14 – 15, *h1* 9 – 11, *h2* 55 – 80.

Venter — Ventral integument covered with fine transverse striae, weak between setae *3a* and *4a*. Setal lengths: *1a* 55 – 60, *1b* 7 – 8, *1c* 7 – 9, *2b* 8 – 9, *2c*

FIGURE 8: LT-SEM image of *Tenuipalpus heveae* Baker (Female): a – view of ventral infracapitulum, detail of protracted paired cheliceral stylets; b – detail of palp.

FIGURE 9: LT-SEM image of *Tenuipalpus heveae* Baker (Female): view of apex of chelicerae.

FIGURE 10: *Tenuipalpus heveae* Baker (Female), dorsal aspect, right side, of: a – leg I; b – leg II; c – leg III; d – leg IV.

FIGURE 11: *Tenuipalpus heveae* Baker (Male): dorsum.

FIGURE 12: Differential interference contrast (DIC) image of *Tenuipalpus heveae* Baker (Male): dorsum.

FIGURE 13: *Tenuipalpus heveae* Baker (Male): a – venter. Note seta g2 missing on the right side; b – aedeagus.

FIGURE 14: *Tenuipalpus heveae* Baker (Deutonymph): dorsal habitus.

FIGURE 15: LT-SEM image of *Tenuipalpus heveae* Baker (Deutonymph): a – dorsal view; b – lateral view of legs I and II.

10 – 12, *3a* 9 – 10, *3b* 9 – 11, *4a* 35 – 50, *4b* 7 – 8, *ag* 7 – 8, *g1* 7 – 8, *ps2* 5 – 6, *ps3* 6 – 7. Setae *g2* absent.

Gnathosoma — Palps similar to those of adults. Tibial seta *d* 6 – 7, tarsal eupathidium *ul'* 6 – 7. Ventral seta *m* 6 – 7; distance between setae *m-m* 11 – 12.

Legs (Figure 15b) — Setal counts (from coxae to tarsi): I 2-1-4-1-5-9(1), II 2-1-4-1-5-9(1), III 1-1-2-0-2-4, IV 1-0-1-0-2-3. Setal additions: setae *v'* added to trochanters I-III; setae *l'* added to femora I-II; setae *d* added to genua I and II; setae *tc'-tc''* added to tarsi I-II; setae *tc''* added to tarsus III. Seta *ft''* on tarsi I and II short, broadly lanceolate, barbed; tarsi I and II each with 1 short solenidion ω'' 3 (for both tarsi I and tarsi II) and 2 eupathidia *p'* and *p''* (all 6 long). See details of the development of leg chaetotaxy in Table 1.

Protonymph (n=1) — Body size measurements: distance between setae *v2-h1* 178, *sc2-sc2* 98; other measurements: *v2-v2* 23, *sc1-sc1* 68, *c1-c1* 23, *c3-c3* 105, *d1-d1* 13, *d3-d3* 78, *e1-e1* 5, *e3-e3* 58, *f2-f2* 55, *f3-f3* 43, *h2-h2* 25, *h1-h1* 10.

Dorsum (Figure 16) — Anterior margin of prodorsum with a pair of small rounded projections, forming a shallow notch. Prodorsum with anterior central region smooth; region between setae *sc2* and *d1* with widely spaced transverse folds becoming oblique laterally; region posterior to setae *d1-c3* smooth. Dorsal setae mostly similar in shape to deutonymph, except *sc1*, *sc2*, *c3*, *c3*, *f2* and *f3* slightly smaller. Setal lengths: *v2* 3, *sc1* 10, *sc2* 27, *c1* 2, *c3* 12, *d1* 2, *d3* 2, *e1* 3, *e3* 15, *f2* 12, *f3* 11, *h1* 8, *h2* 50.

Venter — Ventral integument covered with fine transverse striae. Setal lengths: *1a* 40, *1b* 7, *1c* 7, *2c* 7, *3a* 8, *3b* 7, *ag* 8, *ps2* 5, *ps3* 6. Setae *2b*, *4a*, *4b*, *g1* and *g2* absent.

Gnathosoma — Palps similar to those of adults. Tibial seta *d* 5, tarsal eupathidium *ul'* 6. Ventral seta *m* 6; distance between setae *m-m* 10.

Legs — Setal counts (from coxae to tarsi): I 2-0-3-0-5-7(1), II 1-0-3-0-5-7(1), III 1-0-2-0-2-3, IV 0-0-1-0-2-3. Setal additions: *1c* added to coxae I; *2c* added to coxae II; *3b* added to coxae III; setae *l'* absent on trochanter III. Tarsi I and II each with 1 solenidion

ω'' 3 (for both tarsi I and tarsi II) and 2 eupathidia *p'* and *p''* (5, 6, for both tarsi I and II).

Larva (n=3) — Body measurements: distance between setae *v2-h1* 145 – 157, *sc2-sc2* 70 – 85; other measurements: *v2-v2* 17 – 20, *sc1-sc1* 52 – 60, *c1-c1* 17 – 22, *c3-c3* 82 – 95, *d1-d1* 13, *d3-d3* 59 – 65, *e1-e1* 8, *e3-e3* 50 – 57, *f2-f2* 45 – 50, *f3-f3* 35 – 38, *h2-h2* 20 – 23, *h1-h1* 7 – 10.

Dorsum (Figure 17) — Anterior margin of prodorsum smoothly rounded, without median projections. Prodorsum with anterior margin colliculate; region between *sc2* and *d1-c3* with few transverse to oblique folds becoming oblique laterally; region posterior to setae *d1* with broken longitudinal to oblique striations. Dorsal setae mostly similar in shape to protonymph, except *sc1* and *sc2* slightly smaller. Setal lengths: *v2* 2 – 3, *sc1* 6 – 7, *sc2* 19 – 20, *c1* 2, *c3* 11 – 12, *d1* 2 – 3, *d3* 2, *e1* 2 – 3, *e3* 13 – 16, *f2* 14, *f3* 12 – 13, *h1* 9 – 10, *h2* 45 – 55.

Venter — Ventral integument with fine irregular striae. Setal lengths: *1a* 35 – 50, *1b* 5 – 6, *3a* 6 – 9, *ps2* 5 – 6, *ps3* 4 – 6. As is normal for tenuipalpids, setae *1c*, *2b*, *2c*, *3b*, *4a*, *4b*, *ag*, *g1* and *g2* absent.

Gnathosoma — Palps similar to that of adults. Tibial seta *d* 5 – 6, tarsal eupathidium *ul'* 4 – 5. Ventral setae *m* absent.

Legs — Setal counts (from coxae to tarsi): I 1-0-3-0-5-7(1), II 0-0-3-0-5-7(1), III 0-0-2-0-2-3; setae *d* absent on tibia III. Tarsi I and II each with 1 solenidion ω'' 2 (for both tarsi I and tarsi II) and eupathidia *p'* and *p''* (4, 5; 4, 5 respectively). All legs covered with colliculate sculpturing.

Hosts and distribution — This species has been collected on rubber trees from several Brazilian states, and occurs mainly on the lower surface of the leaflets.

Remarks — The non-type specimens examined in this study have similar body and setal measurements to those of the type specimens (Table 2). In addition, the pattern of dorsal ornamentation and the leg chaetotaxy of those specimens match those of the type specimens.

TABLE 1: Ontogenetic development of leg setae of *Tenuipalpus heveae* (Th) and *Tenuipalpus vieirae* (Tv). Setae are indicated in the stage in which they first appear. Setae in parentheses represent pairs.

	Coxa	Troch.	Femur	Genu	Tibia	Tarsi
Leg I						
Larva–Th	1b	-	d, v', bv''	-	$d, (v), (l)$	$(u), (p), (ft), \omega''$
Tv	1b	-	d, v', bv''	-	$d, (v), (l)$	$(u), (p), (ft), \omega''$
Protonymph–Th	1c	-	-	-	-	-
Tv	1c	-	-	-	-	-
Deutonymph–Th	-	v'	l'	d	-	(tc)
Tv	-	v'	l'	d	-	(tc)
Female/Male–Th	-	-	-	-	-	-
Female–Tv	-	-	-	-	-	-
Leg II						
Larva–Th	-	-	d, v', bv''	-	$d, (v), (l)$	$(u), (p), (ft), \omega''$
Tv	-	-	d, v', bv''	-	$d, (v), (l)$	$(u), (p), (ft), \omega''$
Protonymph – Th	2c	-	-	-	-	-
Tv	2c	-	-	-	-	-
Deutonymph - Th	2b	v'	l'	d	-	(tc)
Tv	2b	v'	l'	d	-	(tc)
Female/Male–Th	-	-	-	-	-	-
Female–Tv	-	-	-	-	-	-
Leg III						
Larva - Th	-	-	d, ev'	-	(v)	$(u), ft'$
Tv	-	-	d, ev'	-	$d, (v)$	$(u), ft'$
Protonymph - Th	3b	-	-	-	-	-
Tv	3b	l'	-	-	-	-
Deutonymph – Th	-	v'	-	-	-	tc''
Tv	-	v'	-	-	-	tc''
Female/Male–Th	-	-	-	-	-	-
Female–Tv	-	-	-	-	-	-
Leg IV						
Protonymph–Th	-	-	ev'	-	(v)	$(u), ft'$
Tv	-	-	ev'	-	(v)	$(u), ft'$
Deutonymph–Th	4b	-	-	-	-	-
Tv	4b	-	-	-	-	-
Female/Male–Th	-	v'	-	-	-	tc''
Female–Tv	-	v'	-	-	-	tc''

FIGURE 16: *Tenuipalpus heveae* Baker (Protonymph): dorsal habitus.

FIGURE 17: *Tenuipalpus heveae* Baker (Larva): dorsal habitus.

TABLE 2: Measurements of the body and dorsal setae for type and non-type females of *Tenuipalpus heveae* Baker. Measurements for the holotype with range for the paratypes are shown in parentheses.

	Pará State ¹	Amazonas State ²	Bahia State ³	Goiás State ⁴	São Paulo State ⁵
Body					
<i>v2-h1</i>	240 (230–250)	210–225	227–242	225–232	230–240
<i>sc2-sc2</i>	150 (145–150)	132–135	135–150	140–150	140–147
<i>c3-c3</i>	175 (165–175)	155–170	160–172	160–170	161–170
<i>f2-f2</i>	82 (80–97)	82–95	87–95	90–100	80–95
Dorsal setae					
<i>v2</i>	5 (4–5)	4	5–6	4–6	4–5
<i>sc1</i>	10 (9–10)	7–10	8–11	7–11	8–10
<i>sc2</i>	20 (20–23)	17–23	15–17	17–23	16–20
<i>c1</i>	4 (3–4)	3–5	4–6	4–5	4–6
<i>c3</i>	19 (16–19)	14–17	13–15	14–17	11–17
<i>d1</i>	4 (3–4)	3–4	3–5	4–5	4–5
<i>d3</i>	4 (4)	4–5	4–5	5	4–5
<i>e1</i>	4 (4)	4–6	3–5	4–6	4–5
<i>e3</i>	16 (17–20)	12–20	14–18	14–19	14–18
<i>f2</i>	16 (13–18)	11–15	14–16	15–17	14–16
<i>f3</i>	15 (14–17)	13–17	14–15	13–17	13–15
<i>h1</i>	14 (10–14)	11–12	12–13	10–12	10–12
<i>h2</i>	120 (100–125)	105–119	98–130	105–125	100–135

Type material measured: ¹ four specimens: holotype and three paratypes; Non-type material measured: ² five specimens; ³ four specimens; ^{4,5} five specimens.

***Tenuipalpus vieirae* n. sp.**
Castro, Ramos and Feres
Figures (18–25)

Zoobank: [3F539E51-5C3E-470F-B6DE-C63FE8AEACC8](https://zoobank.org/3F539E51-5C3E-470F-B6DE-C63FE8AEACC8)

Diagnosis — Female: Dorsum completely smooth; triangular to semicircular plate evident encompassing *c3-d3*. Anterior margin of prodorsum with pair median triangular projections, forming a notch. Dorsum with setae *v2*, *sc1*, *c1*, *c3*, *d1*, *d3*, *e1*, *e3* minute to short; setae *sc2* narrowly lanceolate, barbed; setae *f2*, *f3* and *h1* lanceolate to ovate, barbed, much broader than other dorsal setae; setae *h2* elongate, flagelliform. Palps three segmented. Ventral integument with regions of smooth cuticle and with regions of finely striate cuticle; transverse to oblique striations between setae *1a* and *3a*; ventral prodorsum with lateral margin longitudinally

striate; striae surrounding coxae III and IV oblique; large region of smooth cuticle laterad *4a-ps* setae; fine transverse striae between setae *ag* and *g1-g2*. Coxal setae *1b* and *2b* filiform and smooth, other coxal setae sparsely plumose. Tarsi I – IV 9(1)-9(1)-4-4 (setae *tc'* absent on tarsus III and IV); trochanters I-IV 1-1-2-1 (seta *l'* present on trochanter III); setae *d* present on tibia III but absent on tibia IV. **Immatures:** most dorsal setae are similar to those of the female.

Type material examined — **Holotype:** female collected on *Hevea brasiliensis* Muell Arg. (Euphorbiaceae) from Manaus, Amazonas, Brazil, 21 Dec. 2000, coll. T.J. Izzo, deposited in Acari Collection, Departamento de Zoologia e Botânica, UNESP, located at the São José do Rio Preto, State of São Paulo, Brazil (DZSJRP no. 10158). **Paratypes:** 5 females, 1 deutonymph, 2 protonymphs and 2 larvae with

the same data as that of the holotype (DZSJRP nos. 10159–10164); 3 females, 1 deutonymph and 1 larva collected on *H. guianensis* Aubl. (Euphorbiaceae) from Manaus, Amazonas, Brazil, Aug. 2012, coll. F.M. Nuvoloni (DZSJRP no. 10165, USNM).

Description

Female (Figures 18–22, n=9) — Body measurements: distance between setae *v2-h1* 232 (210 – 237), *sc2-sc2* 135 (120 – 142); other measurements: *v2-v2* 30 (27 – 30), *sc1-sc1* 75 (72 – 77), *c1-c1* 22 (17 – 27), *c3-c3* 162 (152 – 167), *d1-d1* 10 (10 – 12), *d3-d3* 142 (130 – 142), *e1-e1* 7 (5 – 10), *e3-e3* 97 (82 – 102), *f2-f2* 95 (80 – 97), *f3-f3* 77 (67 – 80), *h2-h2* 62 (37 – 62), *h1-h1* 17 (15 – 22).

Dorsum (Figures 18–19) — Anterior margin of prodorsum with a pair of median triangular projections forming a notch. Dorsum completely smooth; triangular to semicircular plate encompassing setae *c3-d3* weakly evident. Dorsal setae *v2*, *sc1*, *c1*, *c3*, *d1*, *d3*, *e1*, *e3* minute to short; setae *sc2* narrowly lanceolate and barbed; setae *f2*, *f3* and *h1* lanceolate to ovate, barbed, much broader than other dorsal setae; setae *e3* distinctly smaller than setae *f2* and *f3*; *h2* elongate, flagelliform. Setal lengths: *v2* 4 (2 – 4), *sc1* 4 (2 – 5), *sc2* 15 (15 – 31), *c1* 4 (3 – 4), *c3* 6 (4 – 6), *d1* 4 (2 – 4), *d3* 5 (2 – 5), *e1* broken (1 – 4), *e3* 5 (5 – 9), *f2* 13 (13 – 16), *f3* 14 (12 – 18), *h1* 12 (8 – 12), *h2* 120 (95 – 120).

Venter (Figure 20) — Ventral integument with regions of smooth cuticle and regions of finely striate cuticle; transverse to oblique striations between setae *1a* and *3a*; ventral prodorsum with lateral margin longitudinally striate. Striae surrounding coxae I and II longitudinal; striae surrounding coxae III and IV oblique; large region of smooth cuticle laterad setae *4a-ps* setae; fine transverse striae between *ag* and *g1-g2*. Coxal setae *1b* and *2b* filiform and smooth, other coxal setae sparsely plumose; setae *1a* and *4a* elongate and flagelliform; seta *3a* smooth; setae *ag*, *g1-2* and *ps2-3* sparsely plumose. Setal lengths: *1a* broken (65 – 80), *1b* 7 (5 – 11), *1c* 15 (10 – 17), *2b* 11 (10 – 13), *2c* 20 (16 – 24), *3a* 10 (9 – 10), *3b* 15 (12 – 22), *4a* 90 (60 – 95), *4b* 18 (13 – 20), *ag* 21 (14 – 21), *g1* 17 (15 – 21), *g2* 17 (14 – 17), *ps2* 20 (13 – 20), *ps3* 15 (10 – 15).

Gnathosoma (Figure 21) — Palps 3-segmented, second segment elongate bearing long, barbed *d* seta 10 (7 – 12); third segment small with 1 eupathidium *ul'* 7 (5 – 7). Ventral setae *m* 9 (5 – 9), sparsely plumose; distance between setae *m-m* 14 (11 – 14).

Legs (Figure 22) — Setal counts (from coxae to tarsi): I 2-1-4-1-5-9(1), II 2-1-4-1-5-9(1), III 1-2-2-0-3-4, IV 1-1-1-0-2-4. Setal additions: only two setae are added to the legs in the adult female, *v'* is added to trochanter IV and *tc''* is added to tarsus IV. Setae *d* in distinctly dorsal position on femora I – II; seta *d* present on genua I and II; seta *d* present on tibia III and absent on tibiae IV; seta *tc'* absent on tarsi III and IV. Seta *ft''* on tarsi I and II short, broadly lanceolate, barbed; tarsi I and II each with 1 short solenidion ω'' 4 (3 – 4) (for both tarsi I and tarsi II) and 2 eupathidia *p'* and *p''* (5 – 6, 4 – 7 for both tarsi). Ventral setae on trochanters, femora and tibiae sparsely plumose. See details of the development of leg chaetotaxy in Table 1.

Color — The body is dark red with some black spots. The legs are red. Leg and dorsal setae are orange.

Male — Unknown.

Deutonymph (n=2) — Body size measurements: distance between setae *v2-h1* 217 – 235, *sc2-sc2* 105 – 130; other measurements: *v2-v2* 25 – 27, *sc1-sc1* 75 – 80, *c1-c1* 22, *c3-c3* 142 – 160, *d1-d1* 10 – 12, *d3-d3* 107 – 122, *e1-e1* 2 – 5, *e3-e3* 70 – 87, *f2-f2* 65 – 80, *f3-f3* 52 – 62, *h2-h2* 32 – 40, *h1-h1* 12 – 15.

Dorsum (Figure 23) — Anterior margin of prodorsum with a pair of small rounded projections, forming a shallow notch. Prodorsum with anterior central region smooth; region between setae *sc2* and *d1* with widely spaced transverse folds becoming oblique laterally; region posterior to *d1-c3* smooth. Dorsal setae mostly similar in shape to adult female, except setae *sc2*, *c3* and *e3* of different size – *v2*, *sc1*, *c1*, *d1*, *e1* minute; *sc2* long, narrow; *c3*, *e3*, *f2*, *f3*, *h1* lanceolate to weakly falcate; *h2* elongate, flagelliform. Setal lengths: *v2* 2, *sc1* 3, *sc2* 36 – 37, *c1* 3 – 4, *c3* 8 – 14, *d1* 3, *d3* 2, *e1* 2, *e3* 12 – 15, *f2* 15 – 16, *f3* 15 – 17, *h1* 7 – 10, *h2* 70 – 110.

Venter — Ventral integument covered with fine transverse striae, weakly between setae *3a* and *4a*.

FIGURE 18: *Tenuipalpus vieirae* n. sp. (Female): dorsum.

FIGURE 19: DIC image of *Tenuipalpus vieirae* n. sp. (Female): dorsum.

FIGURE 20: *Tenuipalpus vieirae* n. sp. (Female): venter.

FIGURE 21: *Tenuipalpus vieirae* n. sp. (Female): ventral infracapitulum.

FIGURE 22: *Tenuipalpus vieirae* n. sp. (Female), dorsal aspect, right side, of: a – leg I; b – leg II; c – leg III; d – leg IV.

FIGURE 23: *Tenuipalpus vieirae* n. sp. (Deutonymph): dorsal habitus.

Setal lengths: *1a* 75, *1b* 5, *1c* 5–9, *2b* 4, *2c* 8–9, *3a* 7–9, *3b* 5–7, *4a* 35–45, *4b* 5–6, *ag* 6–8, *g1* 5–6, *ps2* 5–6, *ps3* 4. Setae *g2* absent.

Gnathosoma — Palps similar to those of adults. Tibial seta *d* 5–6, tarsal eupathidium *ul'* 5. Ventral seta *m* 5–6; distance between setae *m-m* 5–11.

Legs — Setal counts (from coxae to tarsi): I 2-1-4-1-5-9(1), II 2-1-4-1-5-9(1), III 1-2-2-0-3-4, IV 1-0-1-0-2-3. Setal additions: setae *v'* added to trochanters I-III; setae *l'* added to femora I-II; setae *d* added to genua I and II; setae *tc'-tc''* added to tarsi I-II; setae *tc''* added to tarsus III. Seta *ft''* on tarsi I and II short, broadly lanceolate, barbed; tarsi I and II each with 1 short solenidion ω'' (tarsi I 2–3 and tarsi II 3) and eupathidia *p'* and *p''* (5, 5–6; 5, 5 respectively). See details of the development of leg chaetotaxy in Table 1.

Protonymph (n=2) — Body size measurements: distance between setae *v2-h1* 174–176, *sc2-sc2* 103–108; other measurements: *v2-v2* 21–23, *sc1-sc1* 65–67, *c1-c1* 20, *c3-c3* 120–124, *d1-d1* 9–11, *d3-d3* 91–95, *e1-e1* 4–5, *e3-e3* 69–72, *f2-f2* 61–63, *f3-f3* 45–48, *h2-h2* 28–31, *h1-h1* 10.

Dorsum (Figure 24) — Anterior margin of prodorsum with a pair of small rounded projections, forming a shallow notch. Prodorsum with anterior central region smooth; region between setae *sc2* and *d1* with widely spaced transverse folds becoming oblique laterally; region posterior to setae *d1-c3* smooth. Dorsal setae mostly similar in shape to deutonymph, except *c1*, *d1* thicker and more barbed; dorsal setae similar in shape to larva, except *c1*, *d1*, *e1* smaller. Setal lengths: *v2* 2, *sc1* 2, *sc2* 28–32, *c1* 3–4, *c3* 10, *d1* 3–5, *d3* 1–2, *e1* 2–3, *e3* 12–14, *f2* 17–19, *f3* 17–20, *h1* 5–10, *h2* 40–45.

Venter — Ventral integument covered with fine transverse striae. Setal lengths: *1a* 55, *1b* 4–5, *1c* 4–5, *2c* 6–7, *3a* 5, *3b* 6–8, *ag* 5–6, *ps2* 5, *ps3* 3. Setae *2b*, *4a*, *4b*, *g1* and *g2* absent.

Gnathosoma — Palps similar to those of adults. Tibial seta *d* 5, tarsal eupathidium *ul'* 3–4. Ventral seta *m* 4–5; distance between setae *m-m* 9–10.

Legs — Setal counts (from coxae to tarsi): I 2-0-3-0-5-7(1), II 1-0-3-0-5-7(1), III 1-1-2-0-3-3, IV 0-0-1-0-2-3. Setal additions: *1c* added to coxae I; *2c* added to

coxae II; *3b* added to coxae III; *l'* added to trochanter III. Tarsi I and II each with 1 solenidion ω'' (tarsi I 2–3 and tarsi II 2) and 2 eupathidia *p'* and *p''* (5, 5, for both tarsi I and II).

Larva (n=3) — Body measurements: distance between setae *v2-h1* 138–150, *sc2-sc2* 75–82; other measurements: *v2-v2* 16–17, *sc1-sc1* 59–60, *c1-c1* 21–24, *c3-c3* 79–94, *d1-d1* 10–13, *d3-d3* 53–65, *e1-e1* 4, *e3-e3* 53–55, *f2-f2* 45–47, *f3-f3* 31–35, *h2-h2* 12–18, *h1-h1* 5–8.

Dorsum (Figure 25) — Anterior margin of prodorsum smoothly rounded, without median projections. Prodorsum with anterior central region colliculate; region between *sc2* and *d1-c3* with transverse to oblique folds becoming oblique laterally; region posterior to setae *d1* with longitudinal to oblique striations. Dorsal setae mostly similar in shape to protonymph, except *c1*, *d1* slightly larger. Setal lengths: *v2* 1–2, *sc1* 1–2, *sc2* 20, *c1* 6–7, *c3* 7–12, *d1* 7, *d3* 1, *e1* 4, *e3* 11–12, *f2* 13–14, *f3* 11–12, *h1* 9, *h2* 37–40.

Venter — Ventral integument with fine irregular striae. Setal lengths: *1a* 20, *1b* 4, *3a* 4–6, *ps2* 1–2, *ps3* 1. As is normal for tenuipalpids, setae *1c*, *2b*, *2c*, *3b*, *4a*, *4b*, *ag*, *g1* and *g2* absent.

Gnathosoma — Palps similar to that of adults. Tibial seta *d* 6, tarsal eupathidium *ul'* 4. Ventral setae *m* absent.

Legs — Setal counts (from coxae to tarsi): I 1-0-3-0-5-7(1), II 0-0-3-0-5-7(1), III 0-0-2-0-3-3. Chaetotaxy: setae *l'* absent on genua I-III; setae *d* present on tibia III. Tarsi I and II each with 1 solenidion ω'' 2 (for both tarsi I and tarsi II) and eupathidia *p'* and *p''* (4, 5; 5, 5 respectively). All legs covered with colliculate sculpturing.

Hosts and distribution — On two species of rubber tree, *Hevea brasiliensis* and *H. guianensis*, from the State of Amazonas, Brazil. This species occurs mainly on the upper surface of the leaflets.

Etymology — This species is named in honor to Dr. Marineide Rosa Vieira, of the Universidade Estadual Paulista-UNESP, campus de Ilha Solteira, SP, Brazil, a Brazilian Acarologist who has been contributing to the study of rubber tree mites.

FIGURE 24: *Tenuipalpus vieirae* n. sp. (Protonymph): dorsal habitus.

FIGURE 25: *Tenuipalpus vieirae* n. sp. (Larva): dorsal habitus.

Remarks — This new species belongs to the *Tenuipalpus* sensu lato group (Castro *et al.* 2016b). It resembles *Tenuipalpus heveae* Baker, 1945 in that it shares a similar pattern of ventral striations and shapes of the leg setae, but *T. vieirae* **n. sp.** has different features of the dorsum and leg chaetotaxy to *T. heveae*. In *T. vieirae* **n. sp.**, the dorsum is smooth, versus heavily ornamented in *T. heveae*; setae *sc1*, *c3*, *e3* are smaller on *T. vieirae* **n. sp.** than those setae on *T. heveae*; the anterior median projections on the prodorsum are longer on *T. vieirae* **n. sp.** than on *T. heveae*. The chaetotaxy differences are: trochanter 1-1-2-1 in *T. vieirae* **n. sp.** and 1-1-1-1 in *T. heveae* (*l'* absent on trochanter III); tibia 5-5-3-2 in *T. vieirae* **n. sp.** and 5-5-2-2 in *T. heveae* (*d* absent on tibiae III). In addition, setae *bv''* on femora II and setae *d* on femora III are shorter and much broader on *T. vieirae* than those setae on *T. heveae*.

Besides *T. heveae*, four other Brazilian species of *Tenuipalpus* were described from Euphorbiaceae plants (*T. moraes* Feres & Hernandez (2006), *T. isabelae* Mesa, Moraes & Ochoa (2006), *T. tapiae* De Castro & Feres (2013) and *T. toropi* Castro, Ramos & Feres (2015)), but none of them were collected on the same host plant species as *T. vieirae* **n. sp.**. Furthermore, *T. vieirae* is readily differentiated from these four species by the dorsum being completely smooth.

The new species also resembles *Tenuipalpus zanthus* De Leon, 1965 because both species have a smooth dorsum. We examined the types and found that, in addition to a few other characters listed below, the chaetotaxy of the genua, tibiae and tarsi are different between these two species: genua 1-1-0-0 in *T. vieirae* **n. sp.** and 3-3-1-0 in *T. zanthus*; tibia 5-5-3-2 in *T. vieirae* **n. sp.** and 5-5-3-3 in *T. zanthus* and; tarsi 9(1)-9(1)-4-4 in *T. vieirae* **n. sp.** and 9(1)-9(1)-5-5 in *T. zanthus*. *Tenuipalpus zanthus* is recorded as being pale green (De Leon 1965), and it is a larger mite also, being 250 – 265 long (*v2-h1*) and 155 – 165 wide (*sc2-sc2*), while *T. vieirae* is 210 – 237 long (*v2-h1*) and 120 – 142 wide (*sc2-sc2*).

ONTOGENY

Tenuipalpus heveae and *T. vieirae* have setae *v'* on trochanters I, II and III added in the deutonymph and on trochanter IV in the adults. This is the standard pattern for other *Tenuipalpus* (Welbourn *et al.* 2017) and also for Tetranychidae (Lindquist 1985). Setae *l'* on trochanters III appears in the protonymph of *T. vieirae* and is not present in *T. heveae*. The expression of setae *l'* on the protonymph is common in the Tenuipalpidae (de Castro *et al.* 2015; Khanjani *et al.* 2013). *Tenuipalpus spinosaurus* Castro, Feres & Ochoa (2016) and the new species described by Welbourn *et al.* (2017) have the expression of *l'* unusually delayed one stage to appear in the deutonymph, with *v'*. The absence of setae *l'* on trochanter III is not common in *Tenuipalpus*, but it does occur in related taxa, such as *Gahniacarus* and *Prolixus* (Beard & Ochoa 2011; Xu & Zhang 2014). While comparing species of *Tenuipalpus*, an examination of the type specimens of *T. tapiae* (De Castro & Feres 2013) revealed some errors in the setal count for legs in the protonymph and deutonymph. The correct setal count for trochanters I-IV in the deutonymph is 1-1-2-0, and not 1-2-2-0, and the addition of setae is similar to that found here.

Setae *l'* are added to femora I and II in the deutonymph of *T. heveae* and *T. vieirae*, and this pattern of expression on the femora appears to be common in the taxon *Tenuipalpus* (Khanjani *et al.* 2013; de Castro *et al.* 2015b; Castro *et al.* 2016a), and in the family Tetranychidae (Lindquist 1985). Seta *l'* is also added to femora I-II in the deutonymph of *Acaricis*, *Prolixus* and *Lisaepalpus* (Welbourn *et al.* 2017). Seta *l'* is also added to femora I-II in the deutonymph of *T. tapiae*, and the protonymph have three setae (*d*, *v'*, *bv''*), not four as in De Castro & Feres (2013). Tenuipalpids usually have similar setal count on femora I-IV in both the female and male adults, with the exception of setae *l''* being added only in the male of *P. corruginus* (Xu & Zhang 2014).

Tenuipalpus heveae and *T. vieirae* have setae *d* added on genua I-II in the deutonymph and setae on genua III-IV are suppressed (1-1-0-0). *Tenuipalpus toropi* and *T. spinosaurus* have *l'* present on genua I-II in the larva and protonymph, and add setae *l''* and *d* to genua I-II in the deutonymph, and

seta *d* to genu III in the deutonymph, while genu IV remains nude (3-3-1-0). Setae *d* are also added on genua I-II in the deutonymph of *T. tapiae*, not in the protonymph as listed in De Castro & Feres (2013). *Prolixus corruginus* have setae *l'* added on genu II only in the adult male (Xu & Zhang 2014), while most of tenuipalpids have similar setal count on genua I-IV in both females and males.

The number of tibial setae is 5-5-2-2 in *T. heveae* and 5-5-3-2 in *T. vieirae*, with setae *d* on tibiae III-IV being suppressed in the former, and suppressed only on tibia IV in the latter. The most common pattern of tibial setae for *Tenuipalpus* is 5-5-3-3 (Baker & Tuttle 1987; Meyer 1979), while this pattern varies across other tenuipalpids taxa, e.g. *Dolichotetranychus* have *l''* absent on tibiae I-II (4-4-3-3). These tibial setal counts represent the larval complement and no post-larval additions are made to tibiae I-IV in the Tenuipalpidae (Lindquist 1985).

Tenuipalpus heveae and *T. vieirae* have a pair of tectal setae added to tarsi I-II in the deutonymph, and only setae *tc''* are added to tarsi III in the deutonymph and to tarsi IV in the adult. Setae *tc'* are not expressed at all on tarsi III-IV of these two species. The addition of tectal setae normally occurs in the protonymph on tarsi I-III, and in the deutonymph on tarsi IV (Lindquist 1985). Here the additions are delayed one stage. This pattern is shared by other species of *Tenuipalpus*, for example *T. toropi* and *T. tapiae* (setal count to tarsi I-IV in the protonymph of *T. tapiae* is 7(1)-7(1)-3-3, and not 8(1)-8(1)-4-3 as listed in De Castro & Feres (2013)). This pattern is similar to that found on *Tenuipalpus sarcophilus* Welbourn & Beard (2017) and on *T. spinosaurus*, except that these two species add setae *tc''* to tarsi III in the deutonymph and to tarsi IV in the adult (9(1)-9(1)-5-5). The pattern of additions to the leg chaetotaxy during ontogeny in *T. heveae* and *T. vieirae* is listed in Table 1.

The posterior ventral setal changes are as follows: *ag* is added in the protonymph, *4a* and *g1* appear in the deutonymph and *g2* is added in the adult. This pattern of ontogenetic additions is the same as the general pattern observed for Tetranychidae by Lindquist (1985). All setae of the gnathosoma are present in the larva, except setae *m* which

are added in the protonymph.

DISCUSSION

Systematics of mites has greatly improved due to the critical study of all stages of development using differential interference contrast microscopy (DIC) and particularly the Low-Temperature SEM (LT-SEM). The use of the LT-SEM has made it possible to observe mites at extremely high magnification (up to 20,000x) and resolution. This has greatly enhanced the ability to identify new characteristics, in addition to recognizing key identifying traits to distinguish mites and thus, develop and produce vitally important taxonomic studies of mites. Although *T. heveae* is considered a pest of rubber tree plantations in Brazil (Pontier & Flechtmann 2000; Ferla & Moraes 2008), prior to this study, key details of the female, male and immatures (e.g. leg chaetotaxy and setal measurements) have not been described adequately enough to allow its correct identification. The new species described here, *T. vieirae* **n. sp.**, occurs on the same host plant as *T. heveae* and this increases the necessity and importance of a description detailed enough to allow the consistent and reliable differentiation between these two species. It is important to note that *T. heveae* occurs mainly on lower surface of the leaflets, while individuals of *T. vieirae* **n. sp.** are found on the upper surface of the leaflets (F.M. Nuvoloni, pers. comm.). This difference may be useful in the identification of these two species. In addition, *T. heveae* is recorded in rubber plantations from several states of Brazil (Daud & Feres 2007; Hernandez & Feres 2006), while *T. vieirae* **n. sp.** is described here from only specimens collected in the Amazonas state. To date, there is no record of this species in other localities. We believe that this new species may not be adapted to climatic conditions (e.g. temperature and air humidity) present in the other regions of Brazil where the rubber tree is more commonly cultivated.

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