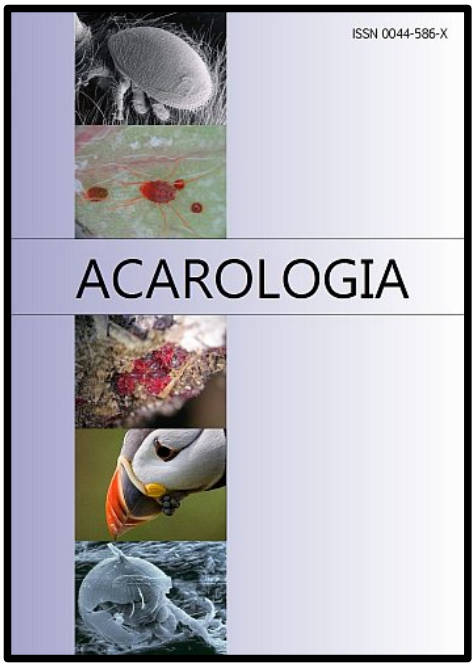

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Two new species of *Daidalotarsonemus* (Acari: Prostigmata: Tarsonemidae) from Brazil

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ABSTRACT — Two new tarsonemid species, *Daidalotarsonemus esalqi* **n. sp.** and *Daidalotarsonemus savanicus* **n. sp.**, found on both native and crop plants in Brazil are described herein, based on adult females. Biological aspects of these species are briefly discussed. Individuals of *Daidalotarsonemus savanicus* **n. sp.** have been misidentified as *Daidalotarsonemus tessellatus* De Leon in previous reports of this species from Brazil. A key is provided to distinguish females of the *Daidalotarsonemus* species known to occur in Brazil.

KEYWORDS — Heterostigmata; Cerrado; rubber tree; taxonomy

INTRODUCTION

The genus *Daidalotarsonemus* De Leon (1956) (Prostigmata: Tarsonemidae) currently consists of 37 described species. It has been registered on all continents, except Antarctica, and is considered a plant inhabiting group with apparent preference for humid places, with an abundance of algae, lichen and fungi (Lindquist 1986; Lin and Zhang 2002; Lofego *et al.* 2005; Sousa *et al.* 2014; Rezende *et al.* 2015a; b).

Three species, *Daidalotarsonemus folisetae* Lofego & Ochoa, *D. annonae* Sousa, Lofego & Gondim Jr. and *D. oliveirai* Rezende, Lofego & Ochoa, have been described from Brazil (Lofego *et al.* 2005; Sousa *et al.* 2014; Rezende *et al.* 2015a). In addition, *Daidalotarsonemus fossae* De Leon was reported in the State of Pernambuco (Sousa *et al.* 2015). Based on an examination of specimens deposited in museum collections, two new Brazilian species of the genus, *Daidalotarsonemus esalqi* **n. sp.** and *Daidalotarsonemus savanicus* **n. sp.**, found in rubber tree crops and Cerrado *sensu stricto* habitats, respectively, are described and illustrated.

MATERIALS AND METHODS

Specimens were examined from the mite collections of Departamento de Entomologia, Fitopatologia e Zoologia Agrícola, Universidade de São Paulo, Escola Superior de Agricultura "Luiz de Queiroz" (ESALQ/USP), Piracicaba; and Departamento de Zoologia e Botânica (DZSJRP), Universidade Estadual Paulista, São José do Rio Preto, both from State

of São Paulo, Brazil. They were analyzed by two techniques: phase contrast microscopy (PC) and differential interference contrast microscopy (DIC). The specimens were examined, drawn and photographed using an optical microscope Leica® DFC 500.

The terminology used herein mainly follows Lindquist (1986), except for gnathosomal setae *dgs* and *vgs* (Magowski *et al.* 1998; Suski 1967). For each structure, the mean measurements are provided in micrometers (μm), followed in parentheses by the range of the specimens measured (when available), including the holotype. For the diagnoses, comparisons with previously described species were based on the study of the types. The following abbreviations are used for institutions where the types are deposited: DZSJRP, ESALQ/USP and USNM (United States National Museum of Natural History, Smithsonian Institution, at National Insect and Mite Collection at USDA, SEL, Beltsville, Maryland, USA).

RESULTS

Key to the species of *Daidalotarsonemus* from Brazil (based only on females)

1. Setae *c1* inserted near posterior border of tergite C; tegula rounded apically 2
— Setae *c1* inserted in the middle of the tergite C or near anterior border of this plate; tegula truncated..... 3

2. Posterior dorsal setae *d*, *e* and *f* leaf-shaped..... *Daidalotarsonemus annonae* Sousa, Lofego & Gondim Jr.
— Posterior dorsal setae *d*, *e* and *f* rod-shaped..... ... *Daidalotarsonemus fossae* De Leon

3. No rows of reticula on tergite C 4
— At least one row of reticula on tergite C..... 5

4. Setae *c1* setiform; setae *e* phylliform..... .... *Daidalotarsonemus folisetae* Lofego & Ochoa
— Setae *c1* with rounded tip; setae *e* cordate..... *Daidalotarsonemus oliveirai* Rezende, Lofego & Ochoa

5. Setae *e* thin (± 3 μm); palps long (± 18 μm)..... ..... *Daidalotarsonemus esalqi* **n. sp.** (Figures 1-4)
— Setae *e* broad (± 17 μm); palps short (± 10 μm)..... ..... *Daidalotarsonemus savanicus* **n. sp.** (Figures 5-8)

Daidalotarsonemus esalqi n. sp. (Figures 1-4)

Diagnosis — Females of this new species are most similar to *Daidalotarsonemus venustus* Attiah (1970) by the reticulated ornamentation on tergite C and by the similar length of the dorsal setae *v1*, *sc2*, *c1*, *c2* and *h*. However, they differ by having the ornamentation pattern on tergite D reticulated only between setae *d* for *D. esalqi*; by the length of palps, longer for the new species; by pharynx shape, larger for *D. esalqi*; and by the shape, length and width of the posterior setae *d*, *e* and *f*, all smaller for this new species.

Adult female (three specimens measured).

Gnathosoma — covered by the prodorsum, subtriangular in ventral view, length 34 (32 – 36), maximum width 24 (23 – 26); dorsal apodeme distinct. Setae *dgs* 10 (9 – 11) and *vgs* 7 (7 – 8) smooth; palps long 17 (17 – 18), with one small subterminal seta. Pharynx fusiform, 14 (13 – 16) long and 8 (7 – 10) wide at maximum width.

Idiosoma - dorsum (Figures 1 and 4): length 201 (198 – 207), width at level of *c1* 97 (95 – 102). Stigma located near lateral notch of prodorsal shield, which is equidistant to the *v1* and *sc2* setal bases. Prodorsum with regular ornamentation covering it; tergite C with three transverse central rows of reticula and irregular ridges around it; tergite D with three central rows of reticula and irregular ridges around setae *d*. Lengths of the setae: *v1* 25 (22 – 27), *sc1* 13 (13 – 14), *sc2* 27 (24 – 30), *c1* 18 (16 – 21), *c2* 17 (16 – 18), *d* 25 (24 – 26), *e* 13 (12 – 14), *f* 25 (24 – 27) and *h* 12 (11 – 13). Maximum width of expanded setae: *d*

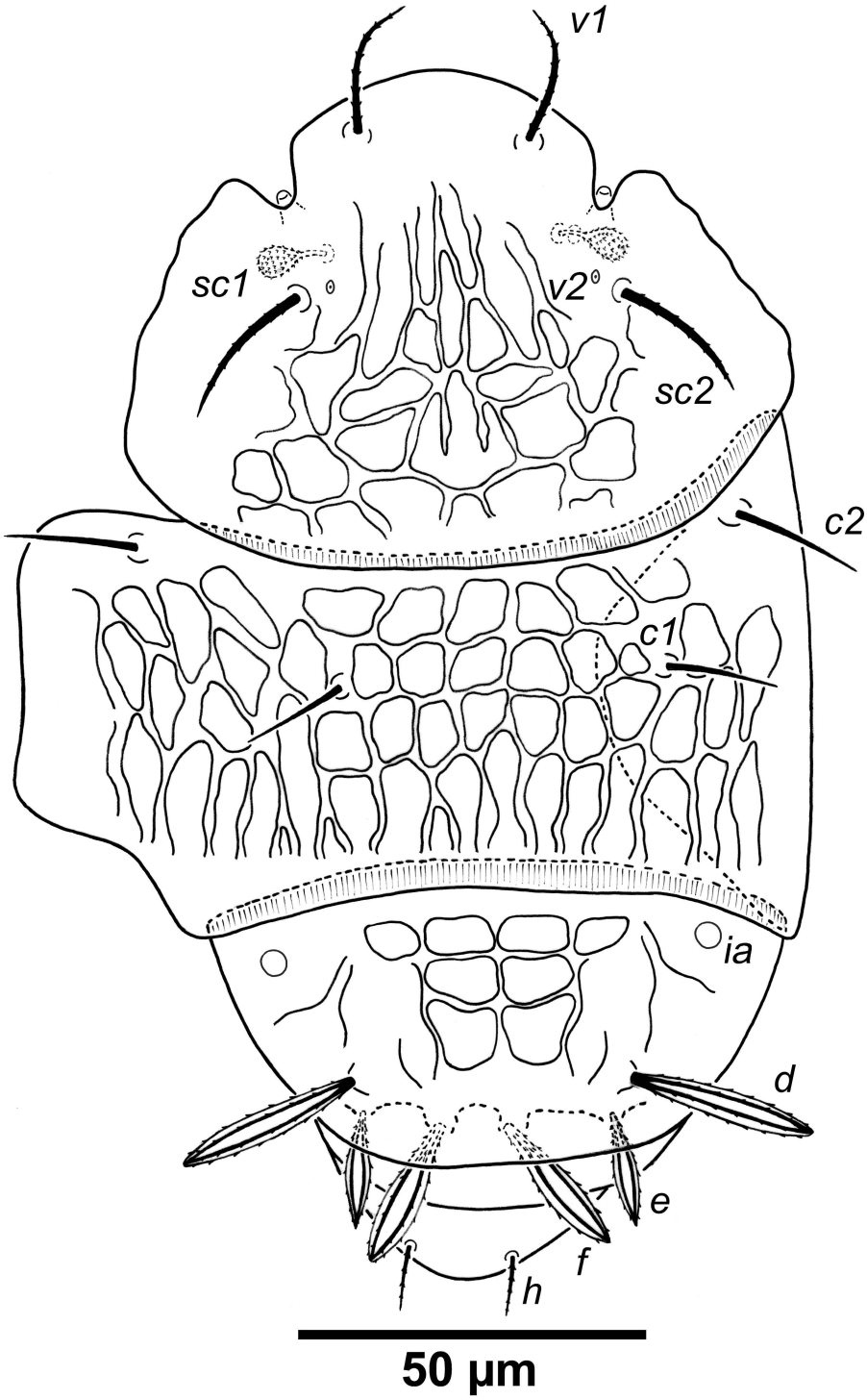

FIGURE 1: *Daidalotarsonemus esalqi* **n. sp.** (female): Dorsal surface of the idiosoma.

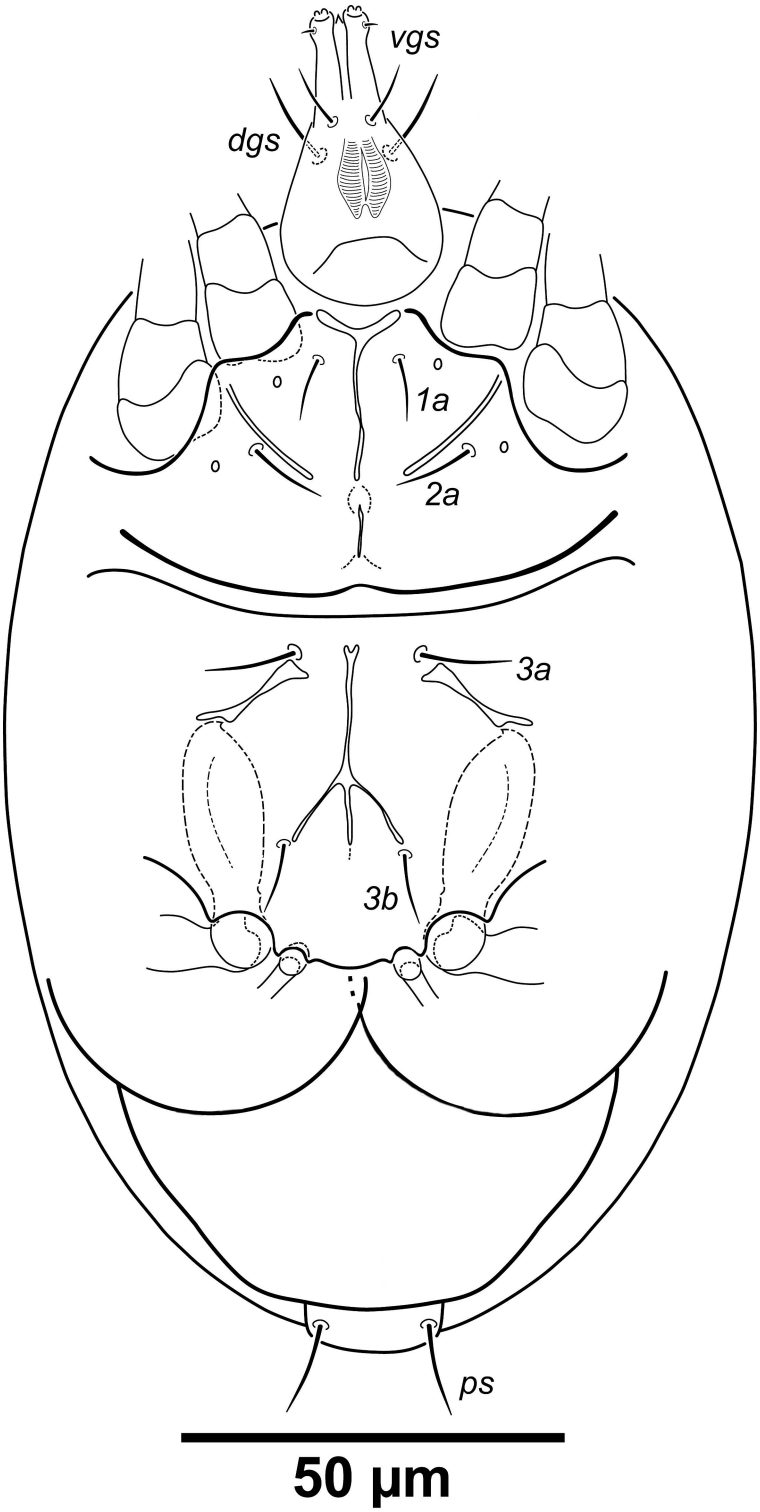

FIGURE 2: *Daidalotarsonemus esalqi* **n. sp.** (female): Ventral surface of the idiosoma.

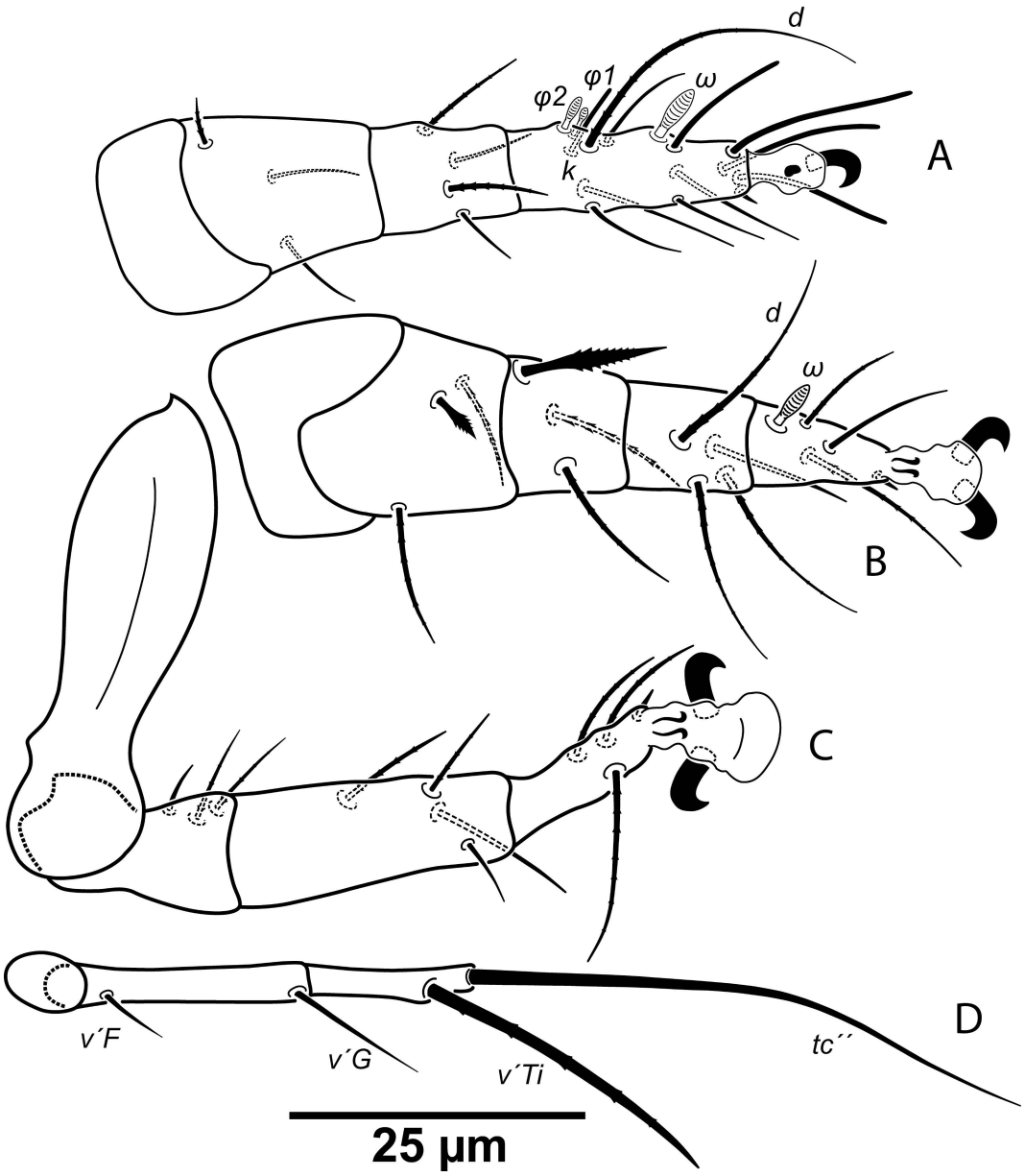

FIGURE 3: *Daidalotarsonemus esalqi* **n. sp.** (female). Legs: A – leg I; B – leg II; C – leg III; D – leg IV.

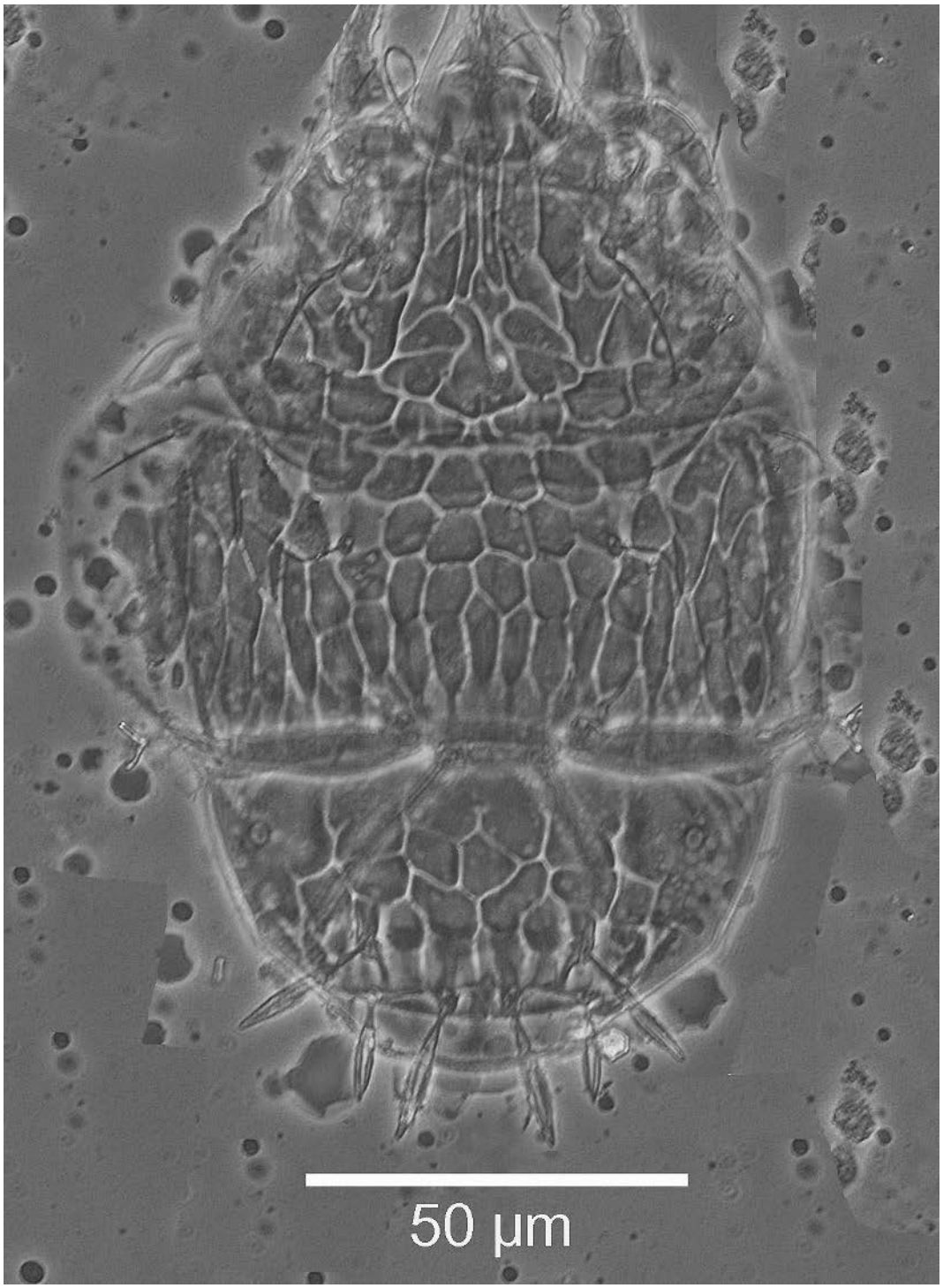

FIGURE 4: *Daidalotarsonemus esalqi* **n. sp.** (female): Dorsal micrograph of the idiosoma.

5, *e* 3 and *f* 7. All dorsal setae serrate; except for *c1* and *c2* smooth. Setae *v1*, *c1*, *c2*, *d*, *e* and *f* inserted on tubercles. Setae *v1*, *sc2*, *c1*, *c2* and *h* setiform; setae *d*, *e* and *f* lanceolate with two central serrate veins. Distances between dorsal setae: *v1-v1* 28 (25 – 31), *sc2-sc2* 45 (42 – 48), *v1-sc2* 29 (27 – 31), *c1-c1* 50 (48 – 52), *c2-c2* 97 (94-101), *c1-c2* 41 (40 – 44), *d-d* 43 (42 – 44), *f-f* 10 (10 – 11), *e-f* 15 (15 – 16) and *h-h* 16 (14 – 17). Seta *sc2* inserted posterolateral to *sc1*.

Idiosoma - venter (Figure 2) — setae *1a* 9 (9), posteriad of apodemes 1; *2a* 10 (10 – 11), posterolaterad of apodeme 2; *3a* 13 (12 – 15) near anteriomedial margins of apodemes 3; *3b* 11 (10 – 12) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 long but not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to the proximal end of the apodeme 2, and diffuse from this point to the sejugal apodeme. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near the anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from the middle of the poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula wide 25 (23 – 26) and very short 5 (5); posterior margin slightly arched. Setae *ps* 15 (15 – 16) serrate.

Legs (Figure 3) — lengths (femur to tarsus): leg I 57 (54 – 61), leg II 50 (48 – 52), leg III 84 (81 – 88). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)-7(1), leg II: 3-3-4-4(1), leg III: 3-4-4. Tarsal solenidion ω of tibiotarsus I 5 (5-6), stout, wider medially. Sensory cluster of tibia I complete, solenidion $\varphi 1$ 3 (3 – 4), slender, capitate; solenidion $\varphi 2$ 3 (3), robust, slightly capitate; famulus *k* 5 (5 – 6); all inserted at approximately the same level. Seta *d* of tibia I 21 (20 – 24), serrate. Solenidion ω of tarsus II proximal, 4 (4) long, stout, wider medially. Seta *d* of tibia II 21 (19 – 24), serrate. Femorogenu IV 16 (15 – 17); tibiotarsus IV 10 (9 – 11). Length of leg IV setae: *v′* F 6 (6 – 7), *v′* G 10 (10 – 11), *v´* Ti 18 (17 – 20) and *tc″* 45 (45 – 46); all setae smooth, except for *v′* Ti serrate; *v′* Ti falcate.

Adult male and larva — Unknown.

Type material — Holotype and two paratypes. Holotype and paratypes from *Hevea brasiliensis* L. (Euphorbiaceae), 47°38′W 22°42′S, Universidade de São Paulo, Escola Superior de Agricultura "Luiz de Queiroz" (ESALQ/USP), Piracicaba, State of São Paulo, 02/X/2002, R.M.J. De Vis. Holotype deposited at ESALQ/USP; and paratypes deposited at DZSJRP.

Etymology — the name *esalqi* is in honor of the university where this species was first registered. ESALQ is the acronym for Escola Superior de Agricultura "Luiz de Queiroz".

***Daidalotarsonemus savanicus* n. sp.**
(Figures 5-8)

Diagnosis — Females of this new species are most similar to *Daidalotarsonemus tessellatus* De Leon (1956) and *Daidalotarsonemus ethiopicus* Mahunka (1981) for the ornamentation pattern on tergite C and shape of anterior setae *v1*, *sc2*, *c1* and *c2*. They differ from the others by the ornamentation pattern on tergite D, with reticulation all over it including a rhomboid reticulum on the center of the plate; shape of posterior setae *d*, *e*, *f* and *h*; and shape of the setae *pl″* on tarsus II, which are stout and serrate.

Adult female (eight specimens measured).

Gnathosoma — covered by the prodorsum, subtriangular in ventral view, length 31 (30 – 33), maximum width 20 (19 – 23); dorsal apodeme distinct. Setae *dgs* 13 (11 – 14) and *vgs* 9 (8 – 10) smooth; palps short 9 (9 – 10), with one small subterminal seta. Pharynx fusiform, 17 (15 – 18) long and wide10 (9 – 12) at maximum width.

Idiosoma - dorsum (Figures 5 and 8) — length 228 (223 – 232), width at level of *c1* 141 (138 – 142); prodorsal shield with regular ornamentation. Stigma located near lateral notch of prodorsal shield, which is equidistant to the *v1* and *sc2* setal bases. Tergite C with four transverse central rows of reticula and irregular ornamentation laterally. Tergite D with irregular ridges, including a rhomboid reticulum on the center of the plate. Lengths of the setae: *v1* 27 (26 – 29), *sc1* 12 (11 – 14), *sc2* 38 (36 –

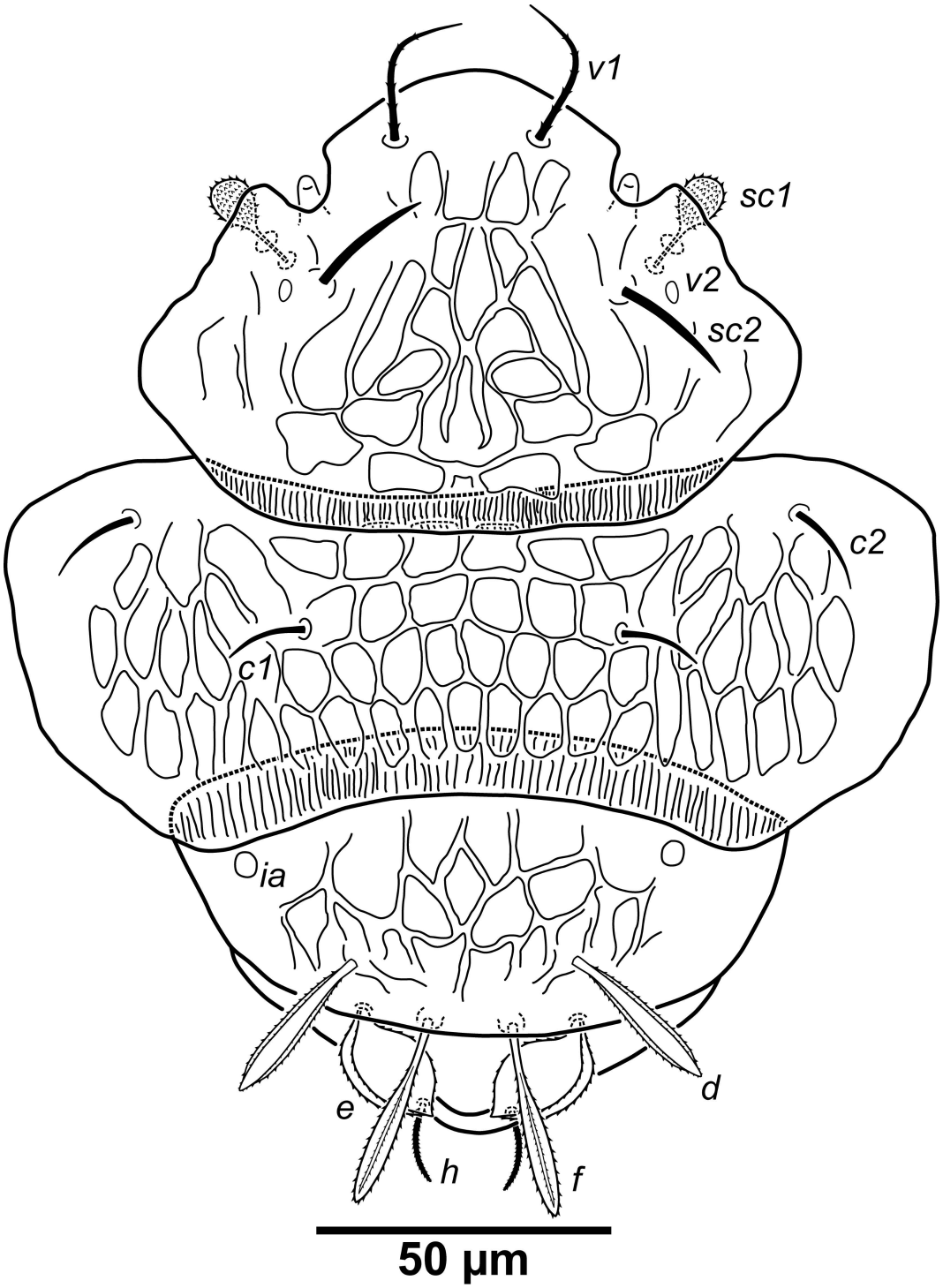

FIGURE 5: *Daidalotarsonemus savanicus* **n. sp.** (female): Dorsal surface of the idiosoma.

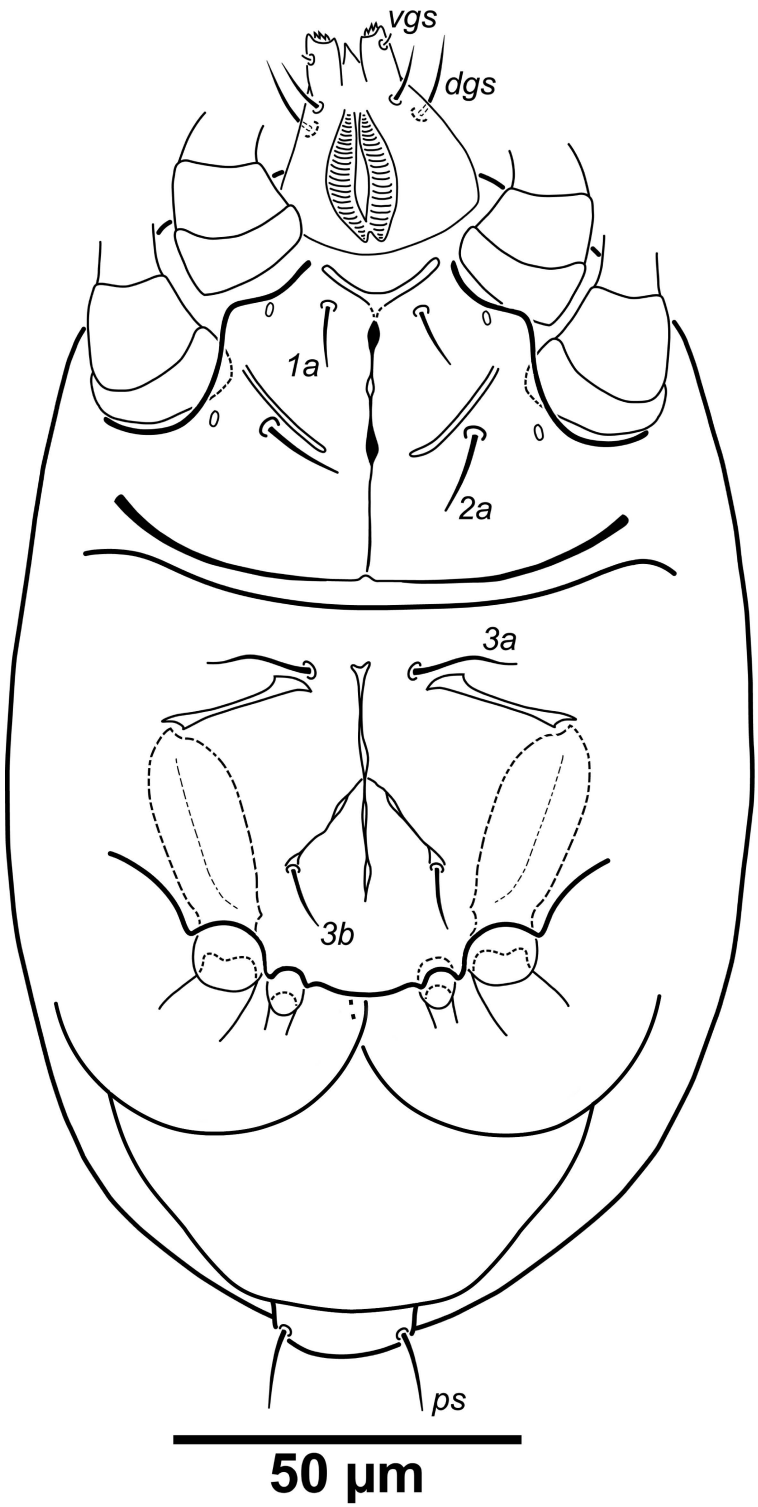

FIGURE 6: *Daidalotarsonemus savanicus* **n. sp.** (female): Ventral surface of the idiosoma.

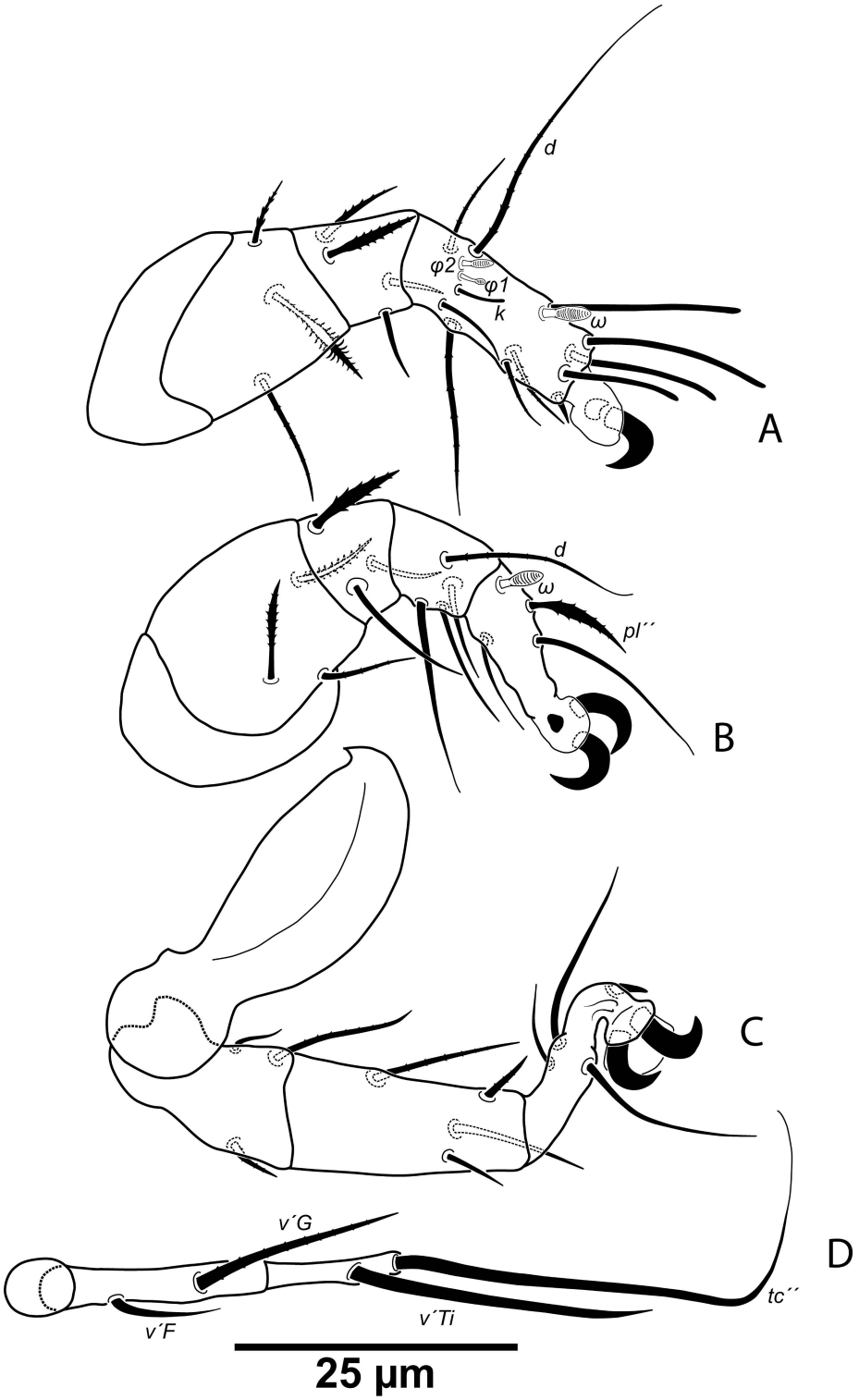

FIGURE 7: *Daidalotarsonemus savanicus* **n. sp.** (female). Legs: A – leg I; B – leg II; C – leg III; D – leg IV.

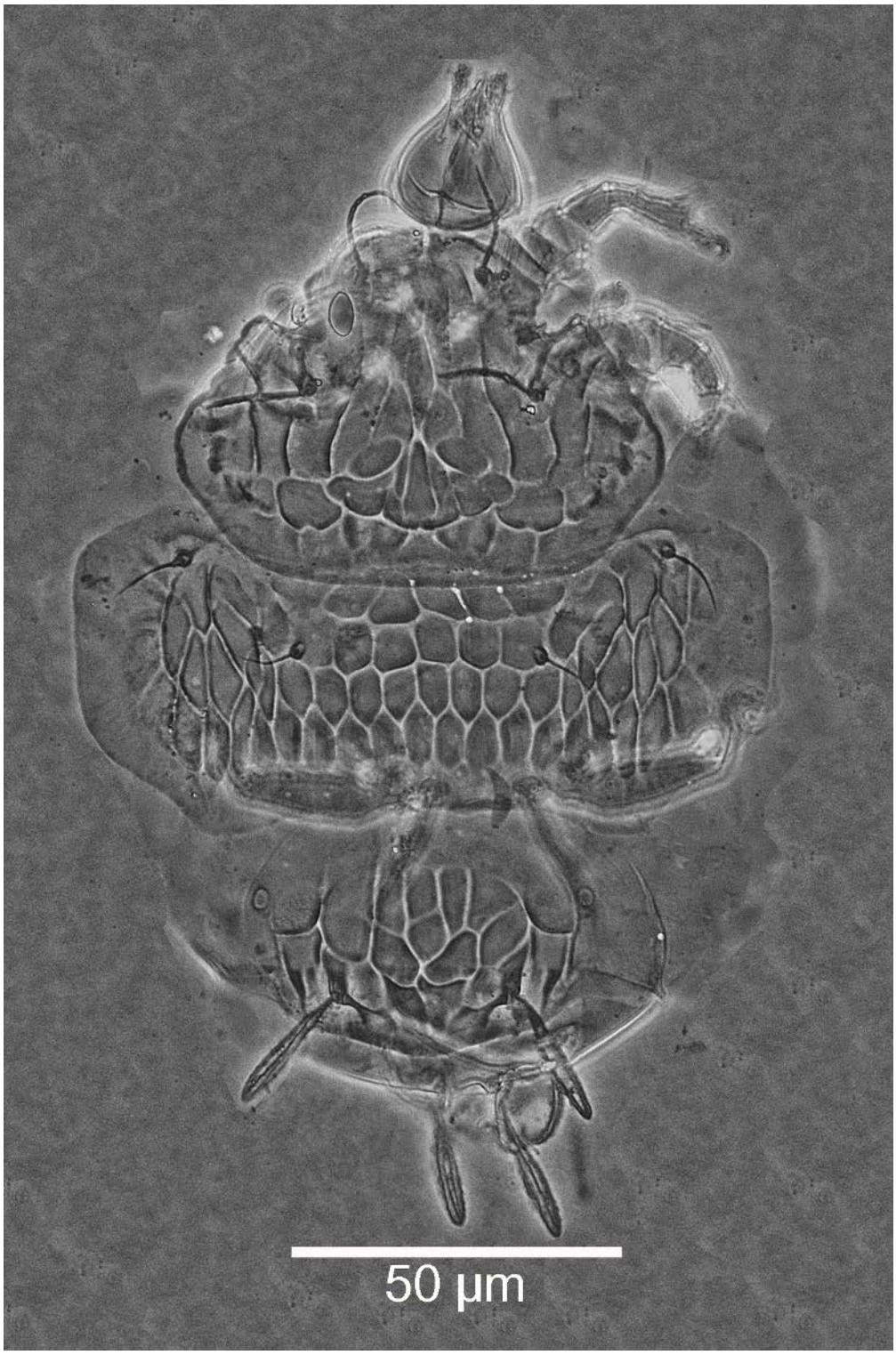

FIGURE 8: *Daidalotarsonemus savanicus* **n. sp.** (female): Dorsal micrograph of the idiosoma.

40), *c1* 18 (16 – 20), *c2* 17 (15 – 18), *d* 34 (33 – 36), *e* 24 (22 – 26), *f* 39 (37 – 40) and *h* 23 (22 – 25). Maximum width of expanded setae: *d* 7, *e* 17 (16 – 18) and *f* 6. All dorsal setae serrate; except for *sc2*, *c1* and *c2* smooth. Setae *v1*, *c1*, *c2* and *h* setiform; *sc2* falcate; *d* and *f* lanceolate with two veins; *e* asymmetrical, subelliptical, with one lateral vein. Distances between dorsal setae: *v1-v1* 28 (26 – 29), *sc2-sc2* 53 (50 – 54), *v1-sc2* 30 (29 – 31), *c1-c1* 56 (54 – 57), *c2-c2* 116 (115 – 117), *c1-c2* 37 (36 – 39), *d-d* 38 (37 – 40), *f-f* 14 (13 – 16), *e-f* 14 (12 – 15) and *h-h* 18 (17 – 20). Setae *sc2* inserted posteromedial to *sc1*.

Idiosoma - venter (Figure 6) — setae *1a* 7 (6 – 9), posteriad of apodemes 1; *2a* 9 (8 – 9), posterolaterad and near middle of apodemes 2; *3a* 16 (15 – 18) near anteriomedial margins of apodemes 3; *3b* 15 (13 – 17) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 not fused to the prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to the middle portion of sejugal apodeme, where is fused with it. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from the middle of the poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 14 (12 – 15) wide and very short 4 (4 – 5); posterior margin slightly arched. Setae *ps* 21 (19 – 22) serrate.

Legs (Figure 7) — lengths (measured from femur to tarsus): leg I 45 (42 – 46), leg II 47 (45 – 48), leg III 85 (83 – 86). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-4-4-3(1), leg III: 3-4-4. Tarsal solenidion ω of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I complete, solenidion $\varphi 1$ 3, slender, capitate; solenidion $\varphi 2$ 2 (2-3), robust, slightly capitate; famulus *k* 4 (4 – 5); all inserted at approximately the same level. Seta *d* of tibia I 13 (12 – 15), serrate. Solenidion ω of tarsus II proximally inserted, 5 long, stout, wider medially; seta *pl″* of tarsus II stout and serrate. Seta *d* of tibia II 12 (11 – 14), serrate. Femorogenu IV 33 (31 – 34); tibiotarsus IV 9 (9). Length of leg IV setae: *v′* F 8 (7 – 9), *v′* G 17 (16 – 19), *v´* Ti 25 (23 – 26) and *tc″* 59 (58 – 62); all setae smooth, except for *v′* G serrate; *v′* Ti falcate.

Adult male and larva — Unknown.

Type material — Holotype and eleven paratypes. Holotype from *Caryocar brasiliense* Camb. (Caryocaraceae). Among paratypes, two from *Campomanesia pubescens* (DC.) Berg (Myrtaceae), one from *Miconia albicans* (Sw.) Triana (Melastomataceae), one from Myrtaceae sp., one from *Pouteria torta* (Mart.) Radlk. (Sapotaceae), 52°35′W 18°51′S, Chapadão do Sul, State of Mato Grosso do Sul, 26/I/2010, J.M. Rezende, A.C. Lofego & P.M. Paulon; one from *Bauhinia* sp. (Fabaceae), one from *Didymopanax vinosum* Cham. & Schltdl. (Araliaceae), one from Myrtaceae sp., 52°44′W 18°15′S, Chapadão do Céu, State of Goiás, 02/II/2010; one from *Genipa americana* L. (Rubiaceae), 51°45′W 17°51′S, Jataí, State of Goiás, 05/II/2010; one from *Xylopia aromatica* (Lam.) Mart. (Annonaceae), 48°54′W 18°31′S, Tupaciguara, State of Minas Gerais, 10/II/2010; one from *Caryocar brasiliense* Camb. (Caryocaraceae), 46°41′W 15°59′S, Unaí, State of Minas Gerais, 03/III/2010. Holotype and five paratypes deposited at DZSJRP; three paratypes deposited at ESALQ/USP; three paratypes deposited at USNM.

Etymology — the name *savanicus* refers to the Cerrado, a savannah biome in which this species is commonly found.

Remarks — Following an examination of voucher specimens, we conclude that individuals of this new species have been recorded as *Daidalotarsonemus tessellatus* De Leon in previous papers (Buosi *et al.* 2006, Demite *et al.* 2009, Feres *et al.* 2005, Lofego *et al.* 2005 and Sousa *et al.* 2015). The observations made by Lofego *et al.* (2005) regarding the habits for *Daidalotarsonemus tessellatus,* for which phytophagy was observed, should be conferred to *Daidalotarsonemus savanicus*.

Discussion

Although *Daidalotarsonemus* has almost always been found in sites having a humid environment, the record of *D. savanicus* in the Cerrado reinforces

that this genus is not exclusively from such places. The Cerrado biome is very dry weather for at least half of the year (Ribeiro and Walter 1998). Another species, *Daidalotarsonemus ethiopicus* Mahunka (1981), is also described from a region with similar dry conditions. Such a range of distribution may represent an extraordinary adaptation of this genus to different levels of humidity, which partially explains the worldwide distribution of the taxon. Also, the diversity of host plants for *D. savanicus* suggests that there is not a host preference for this species; instead, environmental factors might be more important for its occurrence in the Cerrado biome.

The finding of a new species inhabiting rubber trees, a well studied crop around the world, , demonstrates how poor our knowledge of the mite fauna of many areas remains. A large number of mite species have already been recorded in association with *Hevea brasiliensis* in Brazil (Hernandes and Feres 2006; Demite and Feres 2007; Bellini *et al.* 2008; Daud and Feres 2013; Nuvoloni *et al.* 2014; 2015). The added record of *D. esalqi* highlights the importance for a better understanding of host plant inhabiting tarsonemid associations, and their ecological role in natural environments and cultivated areas.

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