

SYSTEMATICS, MORPHOLOGY AND PHYSIOLOGY

Stigmaeidae Mites (Acari: Raphignathoidea) from Arecaceae of the Atlantic Forest in São Paulo State, Brazil

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Ácaros Stigmaeidae (Acari: Raphignathoidea) de Arecaceae da Mata Atlântica do Estado de São Paulo

RESUMO - Este trabalho registra os ácaros Stigmaeidae encontrados em plantas nativas da família Arecaceae em áreas da Mata Atlântica do estado de São Paulo. Foram realizadas quatro coletas, uma em cada estação, no ano 2000 em Cananéia, Pariquera-Açu, Piracicaba e São Pedro, em nove espécies nativas de palmeiras. Duas espécies novas de Stigmaeidae foram encontradas e descritas, *Agistemus palmae* sp. n. e *Agistemus caissara* sp. n. Com base em espécimes originários do estado de Mato Grosso, estágios imaturos de *Agistemus floridanus* Gonzalez-Rodriguez, 1965 são descritos pela primeira vez, enquanto machos e fêmeas adultas da mesma espécie são redescritos.

PALAVRAS-CHAVE: Taxonomia, controle biológico, predador

ABSTRACT - This work reports the Stigmaeidae mites from native plants of the family Arecaceae, in areas of Atlantic Forest in the State of São Paulo. Samplings were conducted once in each season of the year 2000 in Cananéia, Pariquera-Açu, Piracicaba and São Pedro, on nine native species of palm trees. Two new species of Stigmaeidae were found and described, *Agistemus palmae* n. sp. and *Agistemus caissara* n. sp. Based on specimens from the State of Mato Grosso, Brazil, immature stages of *Agistemus floridanus* Gonzalez-Rodriguez, 1965 are described for the first time, while adult males and females of the same species are redescrbed

KEY WORDS: Taxonomy, biological control, predator

The diversity of mites on palm trees (Arecaceae) is still little known in Brazil. Reports of mites on those plants were published by Aquino & Arruda (1967), Flechtmann (1967, 1994), Ferreira (1987), Santana *et al.* (1994), Santana & Flechtmann (1988), Gondin Jr. *et al.* (2000), and Gondin Jr. & Moraes (2001).

Stigmaeidae is the second most frequent and abundant group of predatory mites on plant leaves, after Phytoseiidae. Preliminary observations have indicated that the former are also frequently found on leaves of palm trees in the Atlantic Forest of the State of São Paulo. Those mites are generally orange, yellowish, greenish or reddish. They are characterized by having the so called "thumb-claw" process, chelicera with stylet-like movable digit; dorsal shields frequently present, ventral shields absent; coxae I and II distinctly separated from coxae III and IV, and genital and anal openings contiguous (Flechtmann 1975, Krantz 1978).

A few stigmaeid mites have been reported from Brazil. In the State of São Paulo, mites of this group were reported by Flechtmann (1968, 1981, 1985), Vila & Flechtmann (1970), Chiavegato (1972), Feres (2000), Mineiro & Moraes

(2002) and Matioli *et al.* (2002). Flechtmann (1995) described a new stigmaeid from the State of Rio de Janeiro. Ferla & Moraes (1998) reported two species from the State of Rio Grande do Sul.

Some stigmaeids of the genera *Agistemus* Summers and *Zetzellia* Oudemans have been reported to prey on phytophagous mites of the families Eriophyidae, Tetranychidae and Tenuipalpidae (Santos & Laing 1985, Gerson & Smiley 1990). N.J. Ferla (personal communication) studied the biology of *Agistemus floridanus* Gonzalez-Rodriguez collected on rubber trees (*Hevea brasiliensis* Muell. Arg.) in the State of Mato Grosso. He concluded that this mite can be more important in controlling *Calacarus heveae* Feres (Eriophyidae) and *Tenuipalpus heveae* Baker (Tenuipalpidae) than other predators found on the same substrate.

The objective of this study was to identify the species of Stigmaeidae on native palm trees of the Atlantic Forest of the State of São Paulo and to provide a dichotomous key to help in the separation of mites of this family collected on those plants in that region.

Material and Methods

A survey of stigmatid mites was carried out in Cananéia, Pariquera-Açú, Piracicaba and São Pedro counties, State of São Paulo, Brazil, from January to November 2000.

Nine species of native palm trees were sampled in those locations: *Euterpe edulis* Mart., *Syagrus oleracea* (Mart.) Becc., *Syagrus romanzoffiana* (Cham.), *Attalea dubia* (Mart.) Burret, *Acrocomia aculeata* (Jacq.) Lodd., *Geonoma schottiana* Mart., *Geonoma brevispatha* Barb. Rodr., *Astrocarium aculeatissimum* (Schott) Burret and *Bactris setosa* Mart. These species are among the most common palm trees in those locations. Samples of each plant consisted of the terminal shoot (only developing leaves were taken, without removing the apical meristem) and 20 leaflets taken from a single median leaf of the plant crown (five from the apical third, 10 from the median third and five from the basal third). Whenever present, 20 rachillae (ramifications of the main inflorescence axis) and 20 fruits were also randomly collected per plant. The leaflets of each leaf were placed into a paper bag, which was then placed into a plastic bag and stored in a cool box (12-21°C) to prevent mite loss during transportation. Fruits, flowers and terminal shoots were placed into 5-liter plastic containers 30% filled with 70% ethanol. Immediately after placing the plant parts, the containers were shaken to immobilize the mites and drop them in the solution.

To collect the mites, the leaflets were examined directly under stereomicroscope and the ethanol was passed through a fine sieve which was in turn examined under stereomicroscope. Mites collected were mounted on microscope slides for identification. Measurements of the new species described in this paper are in micrometers.

All specimens were collected by G. P. Arruda Filho. Types of the new species were deposited in "Setor de Zoologia, Departamento de Entomologia, Fitopatologia e Zoologia Agrícola, University of São Paulo / ESALQ", Piracicaba. Representatives of other species found were deposited in the same institution.

Results and Discussion

Agistemus palmae Arruda Filho & Moraes, sp. n. (Figs. 1-2)

Diagnosis. This species differs from *Agistemus striolatus* Gonzalez-Rodriguez, 1965 by the larger ratios $vi/vi-vi$ and c_1/c_1-c_1 (2.6 x 2.0 and 2.5 x 1.0, respectively) and the shorter h_2 (25-28 in the new species and 30.5 in *A. striolatus*). It also differs from *Agistemus brideliae* Gonzalez-Rodriguez, 1965 by the lightly sclerotized and longitudinally striate median hysterosomal plate.

Adult Female. Gnathosoma (Fig. 1A): palp femur with three setae, two of which are hairy; genu with only one seta; tibia with two setiform and two claw-like (accessory and terminal claws) setae; tarsus with six setae, including one solenidium and one trifurcate sensillum. Propodosoma (Fig. 1B): propodosomal plate entire, smooth, with three pairs of hairy setae (vi , ve and sci) and a pair of post-ocular bodies; pre-ocular seta (ve) approximately

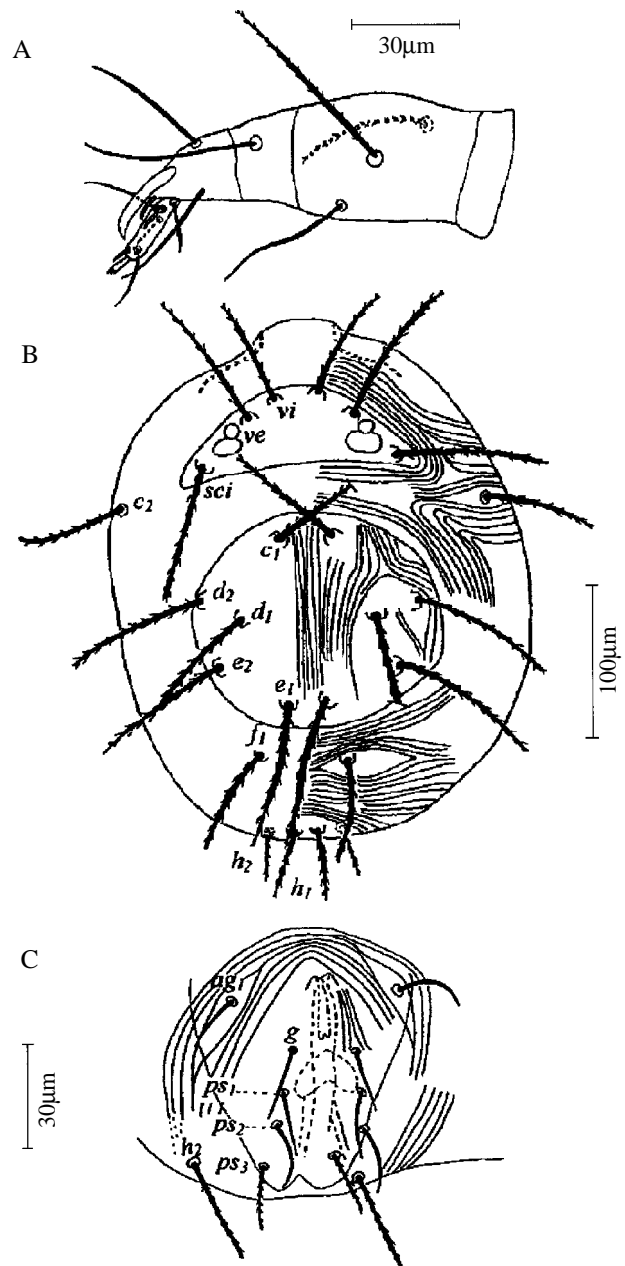


Figure 1. Adult female of *Agistemus palmae* sp. n. A, right palp; B, dorsum of idiosoma; C, anogenital region.

as long (103-108) as the dorsolateral seta e_2 (103-105); $vi=75$, $sci=95-98$, $vi-vi=28-30$, $vi-ve=28$, $ve-sci=40$. Hysterosoma (Fig. 1B): median dorsal plate lightly sclerotized, with discrete longitudinal striae and five pairs of setae; dorsal setae elongate, hairy and inserted on small tubercles; $c_1=83-88$, $c_2=75-78$, $d_1=85-90$, $e_1=100-103$, $d_2=95-98$, $c_1-c_1=33-35$, $c_1-d_1=63-65$, $e_1-e_1=25-30$, $d_2-e_2=50$; setae f_1 (73-75) on intercalary plates; supra-anal plate: $h_1=43$, $h_2=25-28$, $h_1-h_1=15$. Ventral region of opistosoma (Fig. 1C): four pairs of anogenital setae (g , ps_1 , ps_2 , ps_3) and one pair of aggenital setae (ag). Legs (Fig. 2): chaetotaxy from coxa to tarsus (solenidia in parentheses): I - 2 - 1 - 5 - 3 - 5 (1) - 12 (1); II - 1 - 1 - 4 - 1 - 5 (1) - 9 (1); III - 2 - 1 - 2 - 0 - 5 (1) - 7 (1); IV - 2 - 1 - 2 - 0 - 6 (1) - 7.

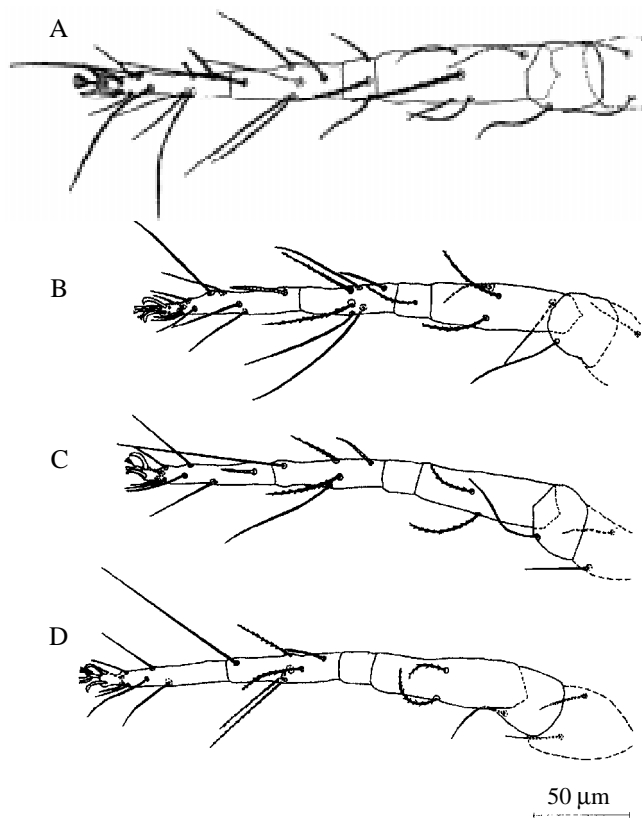


Figure 2. Legs of adult female of *Agistemus palmae* sp. n. A, leg I; B, leg II; C, leg III; D, leg IV.

Adult Male. Unknown

Type-Material. Holotype and paratype females, on leaflets of *Syagrus oleracea*, São Pedro, State of São Paulo, 16-V-2000, G. P. de Arruda Filho

Etymology. *palmae* refers to the common name of the family (Arecaceae) to which *S. oleracea* belongs.

Agistemus caissara Arruda Filho & Moraes, sp. n. (Figs. 3-4)

Diagnosis. This species differs from *Agistemus novazelandicus* Gonzalez-Rodriguez, 1963 by having *sci* more than twice as long as *c*₂, much shorter *h*₂, shorter hairy seta of the femur I, two hairy setae on tibiae I and II, *c*₂ shorter than *c*₁ and *d*₁, and *ps*₃ longer than other anogenital setae.

Adult Female. Gnathosoma (Fig. 3A): palp femur with two dorsal setae, one of which hairy, and one ventral seta; genu with only one dorsal seta; tibia with two setiform and two claw-like (accessory and terminal claws) setae; tarsus with seven setae, including two solenidia and one trifurcate sensillum. Propodosoma (Fig. 3B): propodosomal plate entire, areolate, with three pairs of hairy setae (*vi*, *ve* and *sci*) and a pair of post-ocular bodies; *vi*=30, *ve*=61, *sci*=56, *vi-vi*=25, *vi-ve*=20, *ve-sci*=30. Hysterosoma (Fig. 3B): median dorsal plate well

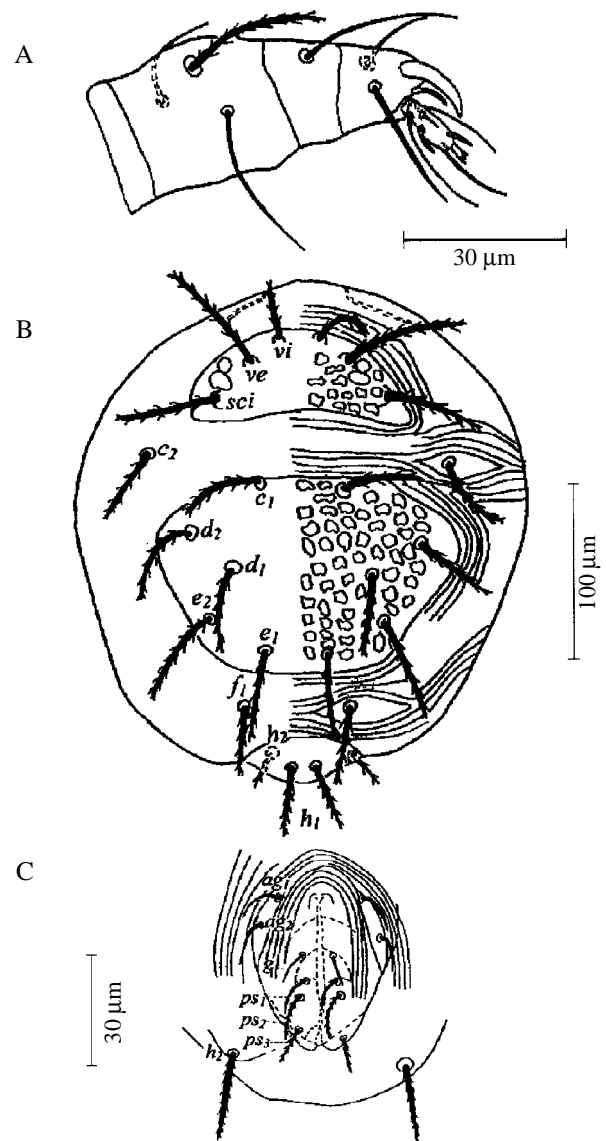


Figure 3. Adult female of *Agistemus caissara* sp. n. A, left palp; B, dorsum of idiosoma; C, anogenital region.

sclerotized and areolate, with five pairs of setae; dorsal setae robust and hairy; *c*₁=44, *c*₂(22), *d*₁=44, *e*₁=51, *d*₂=49, *e*₂=57, *c*₁-*c*₁=49, *c*₁-*d*₁=52, *e*₁-*e*₁=33, *d*₂-*e*₂=53; setae *f*₁(40) on intercalary plates; supra-anal plate: *h*₁=32, *h*₂=22, *h*₁-*h*₁=9. Ventral region of opistosoma (Fig.3C): four pairs of anogenital setae (*g*, *ps*, *ps*₂, *ps*₃) and two pairs of aggenital setae (*ag*₁ and *ag*₂). Legs (Fig. 4): chaetotaxy from coxa to tarsus (solenidia in parentheses): I - 2 - 1 - 5 - 3 - 5 (1) - 12 (1); II - 1 - 1 - 4 - 1 - 5 (1) - 9 (1); III - 2 - 1 - 2 - 0 - 4 (1) - 7 (1); IV - 2 - 1 - 2 - 0 - 5 (1) - 7.

Adult Male. Unknown

Type-Material. Holotype female on leaflet of *Astrocarium aculeatissimum*, Cananéia, State of São Paulo, 12-VII-2000, G. P. de Arruda Filho

Etymology. *caissara* refers to the inhabitants of Cananéia.

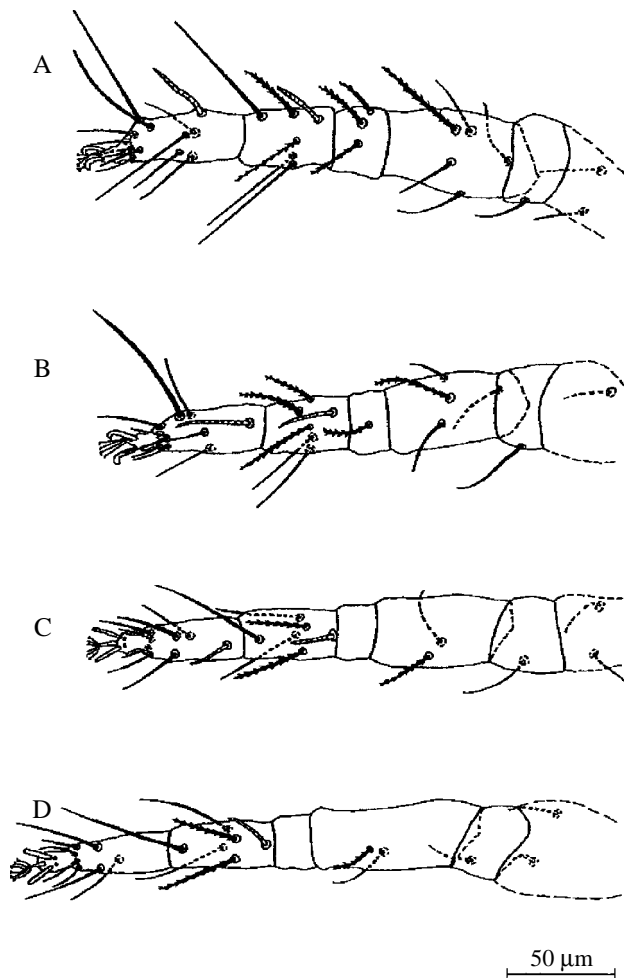


Figure 4. Legs of adult female of *Agistemus caissara* sp. n. A, leg I; B, leg II; C, leg III; D, leg IV.

Agistemus floridanus Gonzalez-Rodriguez

A. floridanus Gonzalez-Rodriguez, 1965: 42.

Distribution. Brazil, Costa Rica, Mexico and United States of America

Specimens Examined. Cananéia, *A. aculeatissimum* VII-2000, X-2000; *G. schottiana* I-2000, IV-2000, VII-2000; *S. romanzoffiana* IV-2000, VII-2000, X-2000; Pariquera-Açu, *A. aculeatissimum* I-2000, IV-2000; *S. romanzoffiana* IV-2000, VII-2000; *E. edulis* IV-2000, VII-2000; *A. dubia* VII-2000; Piracicaba, *A. aculeata* II-2000, V-2000, XI-2000; *E. edulis* II-2000, XI-2000; *S. romanzoffiana* VIII-2000, XI-2000; one female identified as *A. floridanus* on a microscope slide indicating "Paratype series; R. H. Gonzalez, 20/7/60, Parrish Fruit, Florida", of Florida State Collection of Arthropods (F.S.C.A) and two males on a microscope slide indicating "Paratypes, 06/1/53, Lake Alfred, Florida", of F.S.C.A.

Observations. Sixty-one adult females of this species were found; 15 of those were measured. Seta *ve* of the specimens collected is ca. twice as long as the distance *ve-sci*, instead

of at most 1.5 times longer, indicated in the key of the paper containing the original description of the species. In the female paratype examined in this study, seta *ve* is ca. 1.7 times longer than the distance *ve-sci*. Similarly to that paratype, the females collected have d_2 approximately 1.3 times longer than the distance d_2-e_2 . In the original description, this seta is mentioned to be as long as or shorter than the distance d_2-e_2 . Descriptions of the larva, protonymph and deutonymph as well as redescrptions of adult females and males are subsequently provided. Those are based on specimens reared in the laboratory from a population identified as *A. floridadnus*, collected on *H. brasiliensis* in the State of Mato Grosso.

Larva (n=4). Prodorsum (Fig. 5A): propodosomal plate entire, smooth, with three pairs of setae and a pair of post-ocular bodies; $vi=28-29$; $ve=45-50$ and $sci=40-43$. Hysterosoma (Fig. 5A): median dorsal plate absent; setae c_1 , d_1 and d_2 individually inserted on small plates; setae e_1 and e_2 inserted on a single plate: $c_1=35-39$, $c_2=21-23$, $d_1=35-38$, $d_2=35-38$, $e_1=35-40$, $e_2=34-38$, $f_1=21-23$, $h_1=13-15$ and $h_2=13-14$. Ventral region of opistosoma (Fig. 5B): three pairs of anal setae (ps_1 , ps_2 and ps_3). Legs (Fig. 6): chaetotaxy from coxa to tarsus (solenidia in parentheses): I - 1 - 0 - 4 - 2 - 4 (1) - 11 (2); II - 0 - 0 - 4 - 1 - 4 (1) - 8 (2); III - 0 - 0 - 2 - 0 - 5 (1) - 8.

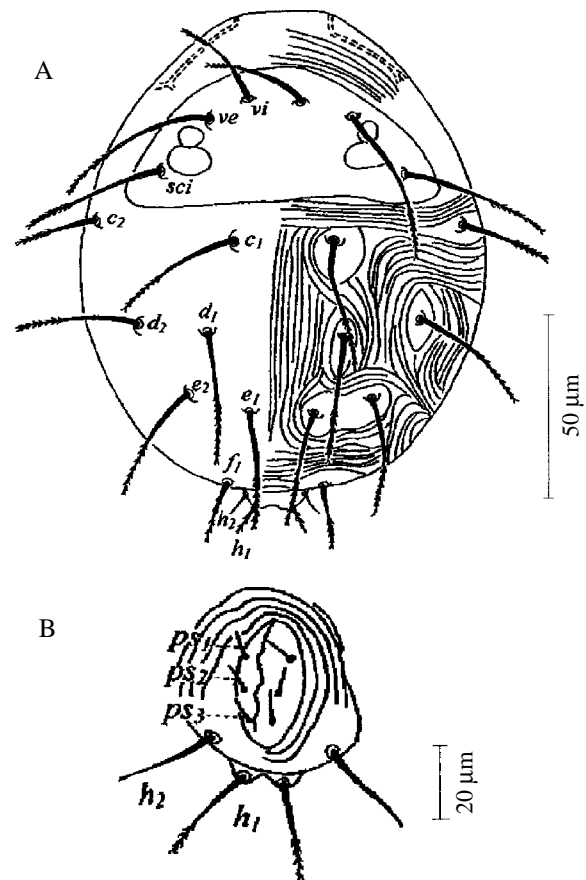


Figure 5. Larva of *Agistemus floridanus*. A, dorsum of idiosoma; B, anal region.

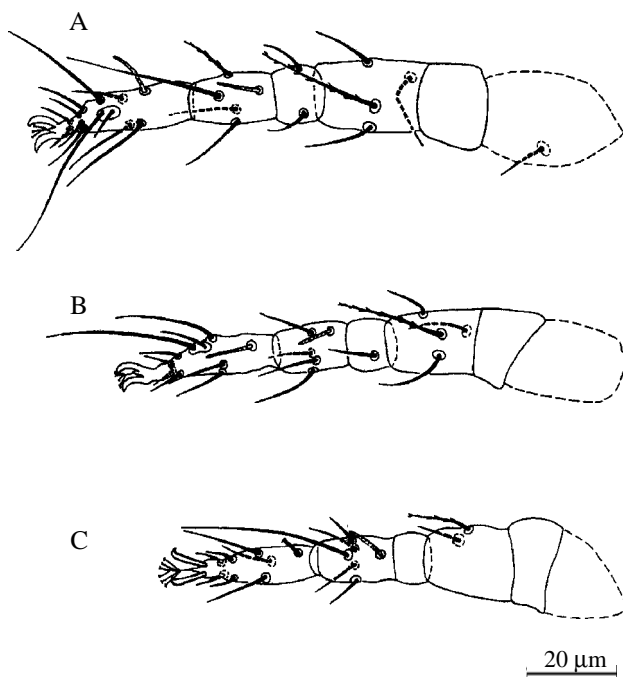


Figure 6. Legs of larva of *Agistemus floridanus*. A, leg I; B, leg II; C, leg III.

Protonymph (n = 4). Prodorsum (Fig. 7A): propodosomal plate entire, smooth, with three pairs of setae and a pair of post-ocular bodies; $vi=30-35$; $ve=45-53$; $sci=43-48$. Hysterosoma (Fig. 7A): median dorsal plate smooth; humeral (c_1) and intercalary (f_1) setae inserted on separate plates: $c_1=36-43$, $c_2=23-28$, $d_1=36-40$, $d_2=33-38$, $e_1=40-44$, $e_2=39-43$, $f_1=23-25$, $h_1=13-18$, $h_2=9-11$. Ventral region of opistosoma (Fig. 7B): three pairs of anal setae (ps_1 , ps_2 and ps_3) and one pair of aggenital setae (ag_1). Legs (Fig. 8): chaetotaxy from coxa to tarsus (solenidia in parentheses): I - 2 - 0 - 4 - 3 - 5 (1) - 12 (1); II - 0 - 0 - 4 - 1 - 5 (1) - 8 (1); III - 2 - 0 - 2 - 0 - 5 (1) - 7 (1); IV - 0 - 0 - 1 - 0 - 5 (1) - 6.

Deutonymph (n = 2). Prodorsum (Fig. 9A): propodosomal plate entire, smooth, with three pairs of setae and a pair of post-ocular bodies; $vi=38$; $ve=59$; $sci=46-53$. Hysterosoma (Fig. 9A): median dorsal plate smooth; humeral (c_1) and intercalary (f_1) setae inserted on separate plates: $c_1=45-50$, $c_2=28-35$, $d_1=43-48$, $d_2=40-43$, $e_1=45-50$, $e_2=45-48$, $f_1=28-33$, $h_1=18-23$, $h_2=15$. Ventral region of the opistosoma (Fig. 9B): three pairs of anal setae (ps_1 , ps_2 and ps_3) and two pairs of aggenital setae (ag_1 and ag_2). Legs (Fig. 10): chaetotaxy from coxa to tarsus (solenidia in parentheses): I - 2 - 1 - 5 - 4 - 5 (1) - 12 (1); II - 1 - 1 - 4 - 1 - 5 (1) - 9 (1); III - 2 - 1 - 2 - 0 - 5 (1) - 7 (1); IV - 2 - 0 - 2 - 0 - 5 (1) - 7.

Adult Female (n = 4). Gnathosoma (Fig. 11A): palp femur with three setae, one of which is hairy; genu with only one, hairy seta; tibia with two setiform and two claw-like (accessory and terminal claws) setae; tarsus with seven setae, including two solenidia and one trifurcate sensillum. Propodosoma (Fig. 11B): propodosomal plate entire, smooth, with three pairs of setae (vi , ve and sci) inserted on small tubercles and a pair of

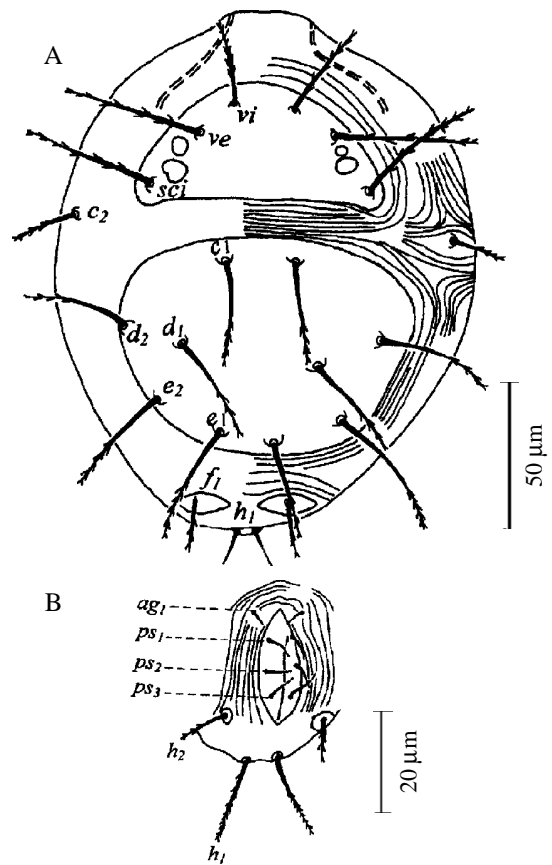


Figure 7. Protonymph of *Agistemus floridanus*. A, dorsum of idiosoma; B, anal region.

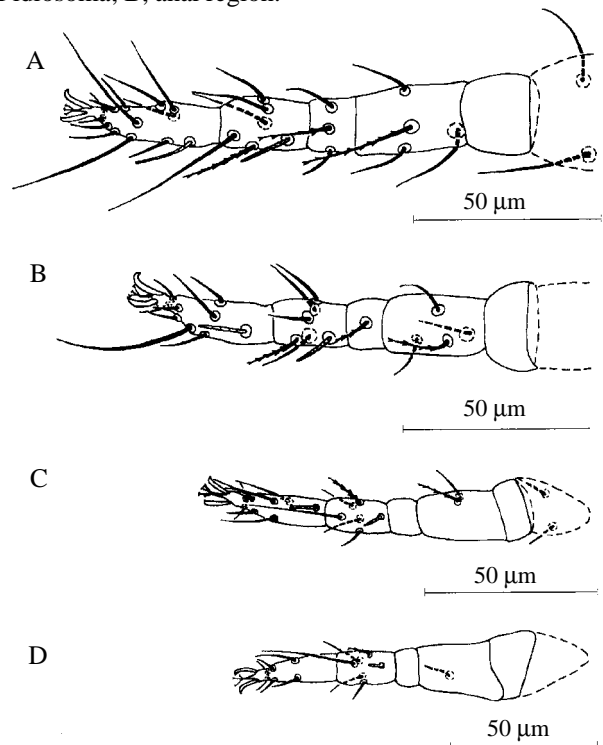


Figure 8. Legs of protonymph of *Agistemus floridanus*. A, leg I; B, leg II; C, leg III; D, leg IV.

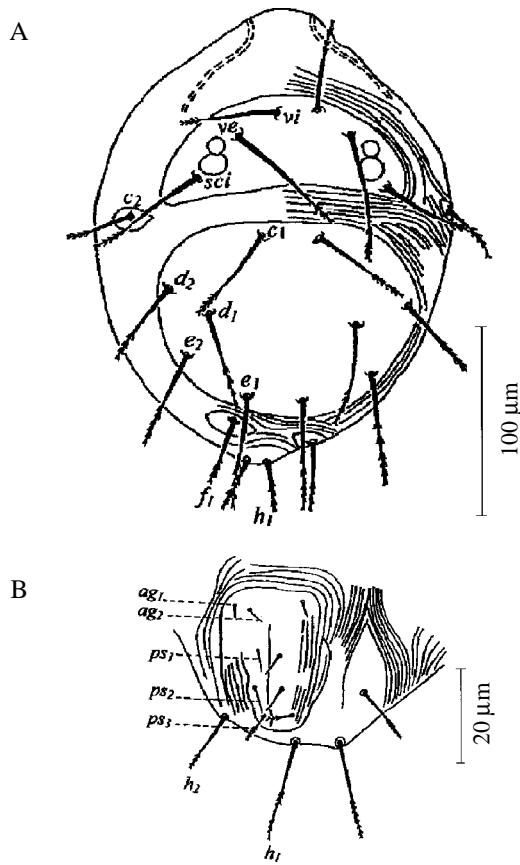


Figure 9. Deutonymph of *Agistemus floridanus*. A, dorsum of idiosoma; B, anal region.

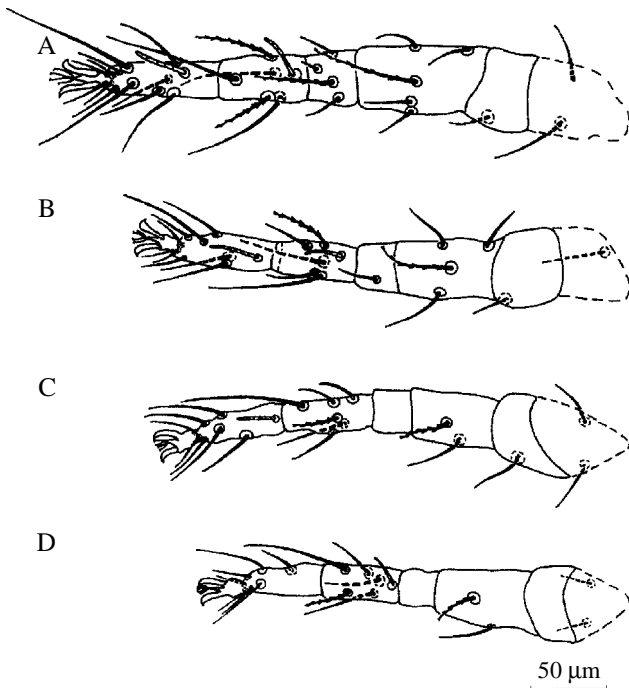


Figure 10. Legs of deutonymph of *Agistemus floridanus*. A, leg I; B, leg II; C, leg III; D, leg IV.

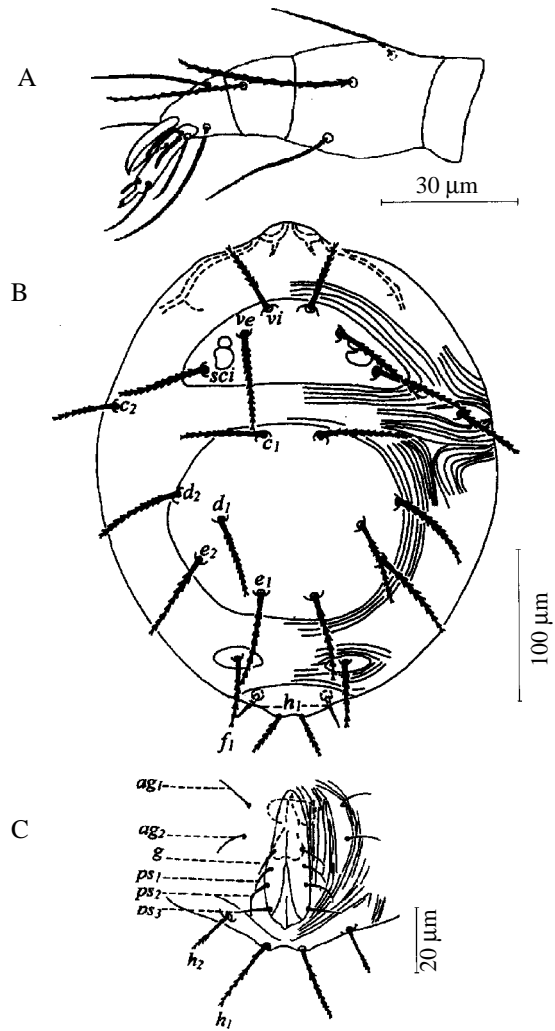


Figure 11. Adult female *Agistemus floridanus*. A, right palp; B, dorsum of idiosoma; C, anogenital region.

post-ocular bodies; *ve* is the longest of the propodosomal setae. Hysterosoma (Fig. 11B): median dorsal plate smooth; dorsal setae inserted on small tubercles, conspicuously hairy and tapering; humeral (*c*₂) and intercalary (*f*₁) setae inserted on separate plates. Ventral region of opistosoma (Fig. 11C): four pairs of anogenital setae (*g*, *ps*₁, *ps*₂ and *ps*₃) and two pairs of aggenital setae (*ag*₁ and *ag*₂). Measurements of the specimens collected in this study, followed (in parentheses) by measurements of one paratype are: idiossoma=305-310 (290), ratio *vi/vi-vi*=1.6 (1.3), *vi*=38 (40), *ve*=63-64 (60), *ve-sci*=28-30 (33), *sci*=55-58 (58), *c*₁=48-50 (48), *c*₁-*d*₁=53-58 (53), *c*₂=43-49, *d*₁=48-54 (49), *d*₂=49-50 (53), *d*₂-*e*₂=40-43 (40), *e*₁=51-55 (55), *e*₁-*e*₁=25-33 (30), *e*₂=52-55 (55), *f*₁=46-49 (52), *h*₁=30-33 (35), *h*₁-*h*₁=9-14 (13), *h*₂=23-24 (20). Legs (Fig. 12): chaetotaxy from coxa to tarsus (solenidia in parentheses): I - 2 - 1 - 5 - 3 - 5 (1) - 12 (1); II - 1 - 1 - 4 - 1 - 5 (1) - 9 (1); III - 2 - 1 - 2 - 0 - 5 (1) - 7 (1); IV - 2 - 1 - 2 - 0 - 5 (1) - 7.

Adult Male. Gnathosoma (Fig. 13A): palp femur with three setae, one of which is hairy; genu with only one, smooth seta; tibia with two setiform and two claw-like (accessory and

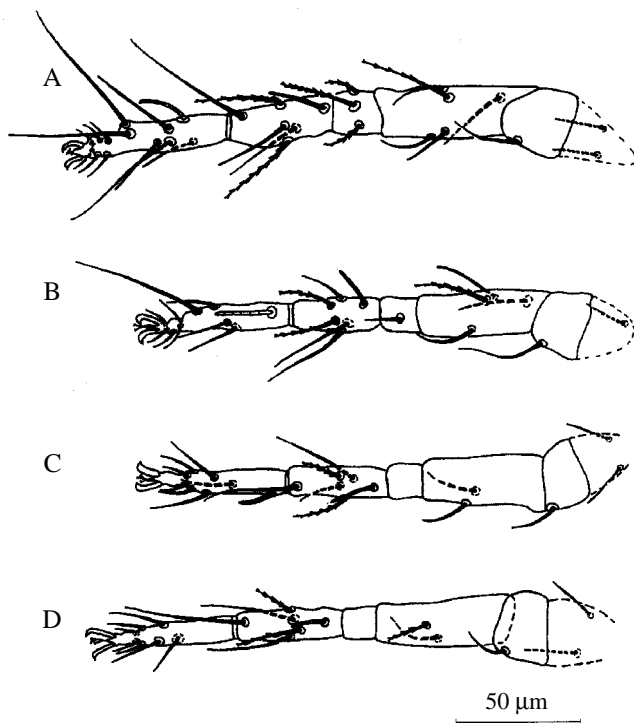


Figure 12. Legs of adult female *Agistemus floridanus*. A, leg I; B, leg II; C, leg III; D, leg IV.

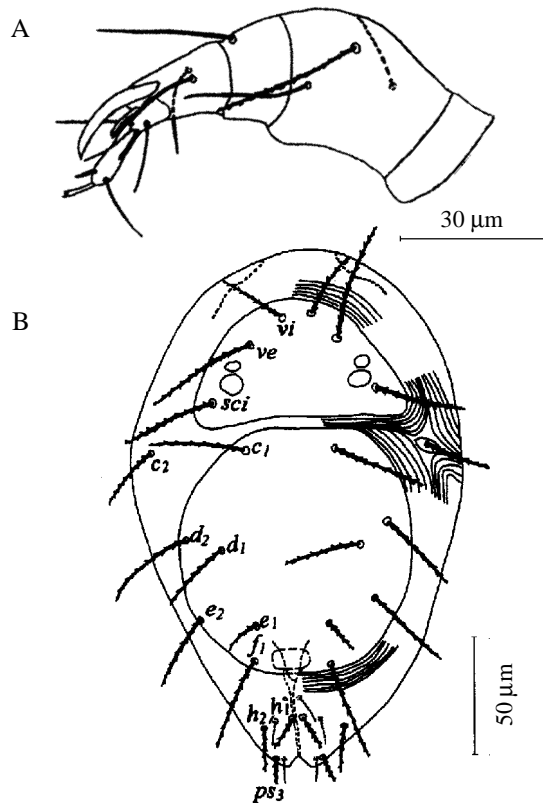


Figure 13. Adult male *Agistemus floridanus*. A, right palp; B, dorsum of idiosomal.

terminal claws) setae; tarsus with seven setae, including two solenidia and one trifurcate sensillum. Propodosoma (Fig. 13B): propodosomal plate entire, smooth, with three pairs of setae (*vi*, *ve* and *sci*) inserted on small tubercles and a pair of post-ocular bodies; *ve* is the longest of the propodosomal setae. Hysterosoma (Fig. 13B): median dorsal plate smooth; dorsal setae inserted on small tubercles, conspicuously hairy and tapering; intercalary setae inserted on median plate. Measurements of the specimens collected in this study, followed (in parentheses) by measurements of two paratypes are: $vi=30-35$ (33-35), $vi-vi=23-25$ (28-35), $vi-ve=23-25$ (21-23), $ve=45-53$ (51), $ve-sci=33-35$ (28-30), $sci=40-46$ (40-45), $c_1=40-43$ (30-38), $c_1-d_1=48-62$ (43-48), $c_2=30-34$ (33-40), $d_1=28-33$ (29-33), $d_2=38-43$ (35-40), $d_2-e_2=43-45$ (37), $e_1-e_1=30-33$ (20-25), $e_1=11-18$ (28), $e_2=38-40$ (35-45), $f_1=38-43$ (48), $h_1=10-15$ (13-15), $h_2=13-18$ (15-18). Legs (Fig. 14): chaetotaxy from coxa to tarsus (solenidia in parentheses): I - 2 - 1 - 4 - 3 - 5 (1) - 12 (2); II - 1 - 1 - 4 - 1 - 5(1) - 9 (2); III - 2 - 1 - 2 - 0 - 5 (1) - 7 (1); IV - 2 - 1 - 2 - 0 - 5 (1) - 7 (1).

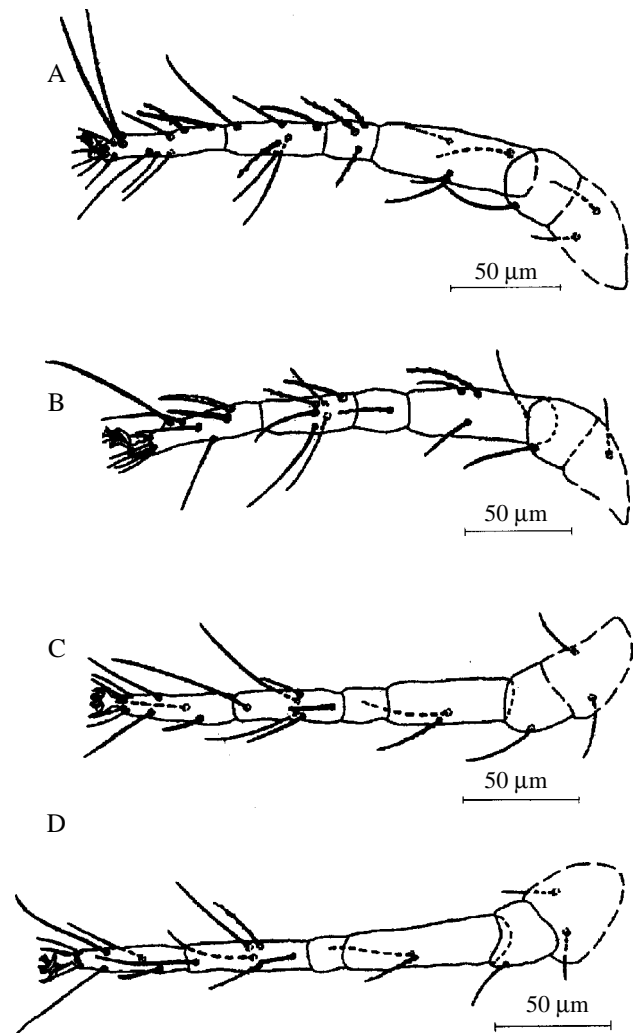


Figure 14. Legs of adult male of *Agistemus floridanus*. A, leg I; B, leg II; C, leg III; D, leg IV.

***Agistemus* sp.**

Observations. Fifty-eight adult males of the genus *Agistemus* were found in this study. Those were identified only to genus because of insufficient data in the literature to allow specific identification.

***Zetzellia languida* Gonzalez-Rodriguez**

Zetzellia languida Gonzalez-Rodriguez, 1965: 21.

Distribution. Brazil, South Africa and Zaire

Specimens Examined. State of São Paulo: Pariquera-Açu, *Syagrus romanzoffiana*, IV-2000

Observations. Only one adult female of this species was found. The measurements of that specimen agree with those of the original description.

A dichotomous key is subsequently provided to help in the separation of the stigmatid mites collected in the Atlantic Forest of the State of São Paulo in this study and in an unpublished study conducted by M.G.C. Gondin Jr. in 1999.

Dichotomous Key to Help in the Separation of Adult Females of Stigmatid Mites from Arecaceae of the Atlantic Forest in the State of São Paulo

1. Propodosomal plate with four pairs of setae.....
.....*Eustigmaeus* sp.
1'. Propodosomal plate with three pairs of setae.....2
2. Dorsum of idiosoma with seven plates; median dorsal plate of hysterosoma with five pairs of setae (c_p , d_p , e_p , d_2 and e_2); seta h_1 short in relation to the remaining dorsal setae.....
genus *Agistemus*.....3
2'. Dorsum of idiosoma with more than seven plates; median dorsal plate of hysterosoma with four pairs of setae (c_p , d_p , e_p and e_2); seta h_1 longer than the remaining dorsal setae.....
.....*Z. languida* Gonzalez-Rodriguez
3. One pair of aggenital setae (ag_1); median plate lightly sclerotized and with longitudinal striae.....*A. palmae* sp. n.
3'. Two pairs of aggenital setae (ag_1 and ag_2); median plate well sclerotized and without longitudinal striation.....4
4. Propodosomal and median plates areolate; ratio $vi/vi-vi$ 1.2.....*A. caissara* sp. n.
4'. Propodosomal and median plates smooth ratio $vi/vi-vi$ 1.6.....*A. floridanus* Gonzales-Rodriguez

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