

The cacao bud mite, *Aceria reyesi* (Nuzzaci 1973)—supplementary description, distribution and comparison with *Gymnaceria cupuassu* Oliveira, Rodrigues & Flechtmann 2012 (Acari: Eriophyidae)

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Abstract

The cacao bud mite, *Aceria reyesi* (Nuzzaci 1973) (Eriophyidae), reported as causing serious damage to the cacao tree in Central and South America, is studied based on type specimens from Venezuela and adults and immatures specimens from Costa Rica, Ecuador and the Brazilian states of Amazonas, Bahia and Rondônia, offering a supplementary description and the first report of this species in Costa Rica and Ecuador. The probable origin and the potential geographic distribution of this noxious phytophagous mite is discussed, and a detailed morphological comparison between *A. reyesi* and the related eriophyid species *Gymnaceria cupuassu* Oliveira, Rodrigues & Flechtmann 2012, both associated with *Theobroma* species (Malvaceae) of economic importance, is given.

Key words: Taxonomy, morphological comparison, *Theobroma cacao*, Costa Rica, Ecuador

Introduction

The cacao bud mite, *Aceria reyesi* (Nuzzaci 1973) (Acari: Eriophyidae), was described (as *Eriophyes*) based on illustrations and measurements of morphological structures of females collected causing damage in cacao trees (*Theobroma cacao* L., Malvaceae) in the state of Caucaúga, Venezuela (Nuzzaci 1973). The type material, deposited in the Department of Soil, Plant and and Food Sciences, Section of Entomology and Zoology, University Aldo Moro of Bari, was informed in that publication as ‘a type slide’ and ‘5 paratype slides’, with slides containing several specimens in each. The bud mite was reported in Brazil (Soria *et al.* 1991, Trevisan *et al.* 2008), Cuba (de la Torre & Martínez 2004) and Venezuela (Sánchez & Capriles de Reyes 1979).

Aceria reyesi attacks the terminal buds of the cacao tree branches, causing atrophy, premature fall of the leaves and shortening of the internodes, a symptom known in Spanish as "engurrñadera" (Doreste *et al.* 1975). The intensity of the attack appears to be greater in unshaded cacao tree plantations or after a long period of drought, which can lead plants to death in more severe cases (Doreste *et al.* 1975; Soria *et al.* 1991; Trevisan *et al.* 2008; Oliveira & Navia 2013). Although the published records of *A. reyesi* in Brazil are old and restricted to the state of Bahia (Abreu & Soria 1979; Soria *et al.* 1991), the mite has been reported recently causing serious damage and leading

plants to death in cacao plantations in the state of Bahia (Oliveira & Navia 2013) and in germplasm banks in the state of Rondônia (Trevisan *et al.* 2008).

Although other five eriophyoid mite species have been reported associated with *Theobroma* spp. (*Davisella trevisani* Rodrigues, Navia & Oliveira 2017, *Eriomacrotergum flechtmanni* Rodrigues, Navia & Oliveira 2016, *Floracarus theobromae* Keifer 1973, *Gymnaceria cupuassu* Oliveira, Rodrigues & Flechtmann 2012, and *Tetra theobromae* Rodrigues, Navia & Oliveira 2017), *A. reyesi* is the only species observed causing serious alterations to the plants. Despite the severity of the damages caused by *A. reyesi* and its importance as a cacao pest in some Central and South American countries, basic studies of this species are still needed. Regarding species characterization, there are some apparent inconsistencies in the original description of females, and descriptions of males and immatures have never been published, making difficult the comparison with other species. For example, *A. reyesi* seems to be very similar to *G. cupuassu*, a monotypic genus described from *Theobroma grandiflorum* (Willd. ex Spreng.) K.Schum., except by the absence of the opisthosomal ventral seta II (*e*) in the last species, what based the proposition of the new genus *Gymnaceria* (Oliveira *et al.* 2012).

The objective of this work is to use modern criteria adopted for Eriophyoidea to providing a supplementary description of *A. reyesi*, based on type females from Venezuela and on adult and immature specimens from Costa Rica, Ecuador and the Brazilian states of Amazonas, Bahia and Rondônia. With the first records of the cacao bud mite we reported in Costa Rica and Ecuador, the probable origin and the potential geographic distribution of this noxious phytophagous mite is discussed. In addition, a detailed morphological comparison between *A. reyesi* and *G. cupuassu*, both associated with *Theobroma* species of economic importance, is offered.

Material and methods

In addition to the material studied by Nuzzaci (1973) when describing *A. reyesi* (within that population from Venezuela, Caucagua, 27-II-1973, coll. H. Reyes, 8 females and 2 males were still in suitable conditions in order to be studied nowadays), specimens collected from cacao tree buds from the following localities were considered for morphological study: Costa Rica – Turrialba, Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), 13-VI-2013, intercepted at the plant germplasm quarantine station, “Embrapa Recursos Genéticos e Biotecnologia” Brasília, Brazil on seedlings introduced as germplasm in Brazil, by F. J. Carvalho and H. M. C. Rocha (1 female); Ecuador – Saracay, El Oro, 3°38'47"S, 79°51'31"W, 13-VI-2014, coll. D. Navia and F. Ferragut (5 females and 1 nymph); and Brazil – Amazonas state, Novo Airão, 02°37'17"S, 60°56'39"W, 5-IX-2013, colls. D. Navia and F. Ferragut (5 females, 3 males, 2 nymphs and 2 larvae), Bahia state, Ilhéus, Ceplac, 14°45'35,8"S, 39°13'49,09"W, 10-III-2015 to 21-III-2017, coll. A. N. Carvalho (5 females, 3 males, 2 nymphs and 2 larvae), and Rondônia state, Ouro Preto do Oeste, Ceplac/Extex, 10°44'30"S, 62°13'30"W, 6-V-2010, colls. O. Trevisan and J. I. L. Moura (5 females, 3 males, 2 nymphs and 2 larvae).

The morphological study of specimens of *A. reyesi* was performed mainly in a phase-contrast microscope Leica DM2500 1,500x magnification (oil immersion), with specimens from Bahia mounted on slides in Hoyer's and specimens from Amazonas, Costa Rica, Ecuador, and Rondônia mounted on slides in modified Berlese's medium (Amrine & Manson 1996). Type specimens of *A. reyesi* mounted in Keifer's II (Amrine & Manson 1996) were studied in a phase contrast microscope Olympus BX50, 1,000X magnification (oil immersion). Complementary morphological analyzes and scanning electron micrographs of adults were performed with additional specimens from Ceplac, 21-III-2017, using an environmental Scanning Electron Microscope Quantum 250 FEI.

Morphology and nomenclature follow Lindquist (1996) and systematic classification follows that of Amrine *et al.* (2003). Terminology of the internal female genital apparatus follows Chetverikov (2014) and Chetverikov *et al.* (2014). Minimum–maximum measurements/counts of each character are given for female, male, nymph and larva. Unless stated otherwise, measurements (in micrometers) refer to the length of the structure. Particular measurements/counts ranges in adults and immature specimens observed in each of the different localities examined in this study were compared between localities, with those in the original description of *A. reyesi* by Nuzzaci (1973), and with those in description of *G. cupuassu* (Oliveira *et al.* 2012).

Slides with specimens from Venezuela are deposited in the acarological collection of Department of Soil, Plant and Food Sciences, Section of Entomology and Zoology, University Aldo Moro of Bari, Bari, Italy. Slides with specimens from Costa Rica, Ecuador, Amazonas and Rondônia are deposited in the acarological collection of “Embrapa Recursos Genéticos e Biotecnologia”, Brasília, DF, Brazil. Slides with specimens from Bahia are deposited in the acarological collection of “Universidade Estadual de Santa Cruz”, Ilhéus, BA, Brazil. Vouchers are deposited in the acarological collections of “Escola Superior de Agricultura “Luiz de Queiroz” (ESALQ), Universidade de São Paulo” (USP), in Piracicaba, SP, Brazil, and of “Departamento de Zoologia e Botânica, Universidade Estadual Paulista” (DZSJRP-UNESP), São José do Rio Preto, SP, Brazil.

Results

The measurements/counts were similar between specimens from the different localities examined in this study (see Table 1 and supplementary material for measurements/counts obtained for each locality). Based on the absence of differences, all measurements/counts given in the supplementary description text below represents a synthesis of all specimens examined in this work considered together, including adults from Venezuela.

Supplementary description of *Aceria reyesi* (Nuzzaci 1973) (Figs. 1–3)

Family: Eriophyidae Nalepa 1898

Subfamily: Eriophyinae Nalepa 1898

Tribe: Aceriini Amrine & Stasny 1994

Diagnosis: Body elongated, vermiform; gnathosoma small, projecting downwards; prodorsal shield subtriangular; scapular setae (*sc*) directed divergently posterior; legs with all the usual setae and simple rayed empodia; all coxal setae present; female genitalia coverflap with longitudinal ridges; anterior genital apodeme trapezoidal; opisthosomal annuli mostly continuous dorsoventrally, microtuberculated and subequal; opisthosomal ventral seta *e* very small.

FEMALE (n=29). Idiosoma elongated, vermiform, 120–211 from frontal lobe to anal lobes, 136–226 from pedipalp to anal lobes, 33–49 wide. **Gnathosoma** projecting obliquely downwards; dorsal pedipalp genual setae *d* 3–4, simple and slightly bent, pedipalp coxal setae *ep* 1.5–3; chelicera 11–12; pedipalp 14–17. **Prodorsal shield** subelliptical, 20–27, including frontal lobe 25–31, 23–39 wide between external margins and 7–12 wide between second submedian lines *sm*2; median line *m* incomplete, prominent in posterior 2/3 of shield, frequently interrupted in middle; admedian lines *ad* complete, slightly diverging towards rear and somewhat recurved inward posteriorly; first and second submedian lines *sm*1 and *sm*2 incomplete (*sm*2 not described in Nuzzaci 1973), converging

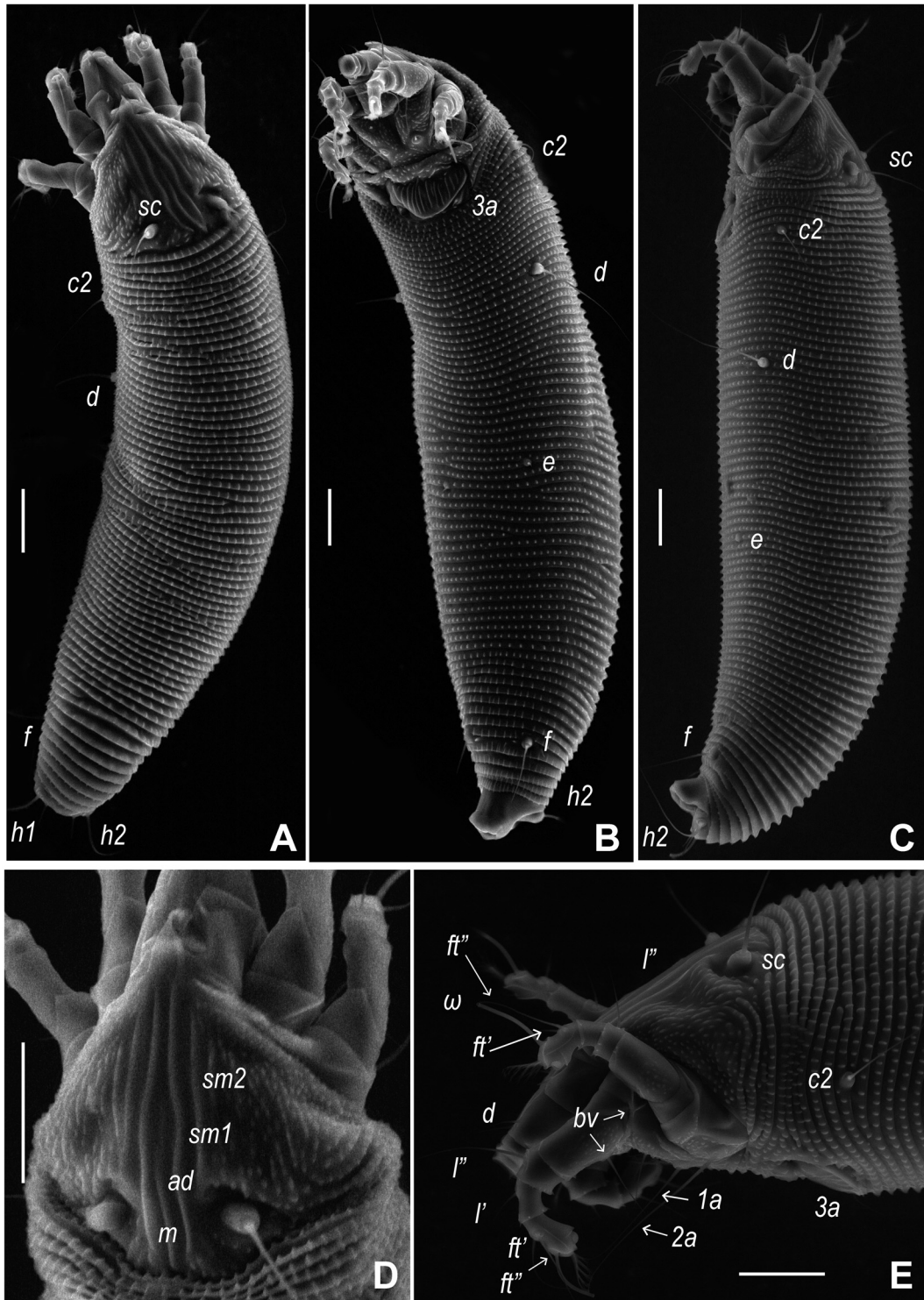


FIGURE 1. Scanning electron micrographs of *Aceria reyesi* from Ilhéus. A. Dorsal habitus; B. Ventral habitus, female; C. Lateral habitus, female; D. Prodorsal shield; E. Anterior region, lateral, female. Scale bar = 10 μ m.

posteriorly, running from anterior margin to about middle of shield. Shield surface lateral to *sm2* with short lines and many coarse granules. Scapular setae *sc* 15–22, directed posterior divergently, scapular tubercles near posterior margin of shield, scapular tubercles 7–13 apart; *sc* bases 10–14 apart. Frontal lobe subtriangular, 3–4, 3–6 wide at base level (this was not reported in Nuzzaci 1973 and in its Fig. 6, even though a line in Fig. 2 might be interpreted as a short frontal lobe). **Legs** with all segments and usual setae present. Leg **I** 15–28 without empodium, 20–32 from trocanter to end of empodium; femur 7–10, ventral basifemoral setae *bv* 5–9; genu 2–4, antaxial genual setae *l''* 11–19; tibia 2–6, paraxial tibial setae *l'* 2–5; tarsus 4–7, antaxial fastigial tarsal setae *ft''* 14–26, paraxial fastigial tarsal setae *ft'* 9–17, paraxial unguinal tarsal setae *u'* 1.5–3, tarsal solenidion ω 7–8 slightly curved, blunt; tarsal empodium 4–6 including portion inside tarsus, 3–5 not including portion inside tarsus, 5-rayed, each ray (except first) further divided into two branches each. Leg **II** 15–22 without empodium, 19–27 from trocanter to end of empodium; femur 7–10, *bv* 4–7; genu 2–3.5, *l''* 4–6; tibia 2–5; tarsus 4–6, *ft''* 15–21, *ft'* 3–5, *u'* 1–3, ω 8–10; empodium 5–6 including portion inside tarsus, 3–5 not including portion inside tarsus, 5-rayed. **Coxisternal region.** Prosternal apodeme 4–7, anterior setae on coxisternum I *Ib* 4–7, 6–8 apart; proximal setae on coxisternum I *Ia* 10–19, 5–7 apart; proximal seta on coxisternum II *2a* 20–37, 13–18 apart; coxisternal area with 4–7 annuli separating coxae from genital coverflap, microtuberculate. Coxae with coarse granules. **External genitalia** 9–15, 14–18 wide, coverflap with 10–15 longitudinal ridges; setae *3a* 3–6. **Internal genitalia** with anterior genital apodeme trapezoidal; oblique apodeme distinct, forming an inverted V-like figure, with bent arms laterally directed; spermatheca spherical or slightly elongated, 4–5, 4 (no range) wide, directed posteriad or laterad; spermathecal duct short, ~1 long, tube like, directed posteriad (average angle of 110° between spermathecal apparatus and longitudinal bridge); longitudinal bridge ~ 10 long, postspermathecal part of longitudinal bridge reduced. **Opisthosoma** with 63–78 dorsal annuli and 48–74 ventral annuli considering complete annuli from posterior genitalia to anal lobes, 55–81 considering both complete annuli and semi-annuli posterior to coxa II to anal lobes. Annuli mostly continuous dorsoventrally, microtuberculated and subequal in most of opisthosoma, except in the 9–11 posterior annuli, which are broader and less microtuberculated dorsally. Setae *c2* 11–17, on annulus 2–5 considering only complete annuli from posterior genitalia, 6–12 considering both semi-annuli and complete annuli posterior to coxa II; ventral setae *d* 24–43, on annulus 14–22 considering only complete annuli from posterior genitalia, 19–29 considering both semi-annuli and complete annuli posterior to coxa II, 24–37 apart; setae *e* 1–4, on annulus 28–41 considering only complete annuli from posterior genitalia, 33–48 considering both semi-annuli and complete annuli posterior to coxa II, 12–18 apart; setae *f* 12–16, on annulus 44–68 considering only complete annuli from posterior genitalia, 51–75 considering both semi-annuli and complete annuli posterior to coxa II, 9–12 apart; setae *h2* 32–50, with rounded apex; setae *h1* 2–5.

MALE (n=11). Generally smaller than female, idiosoma 119–158 from frontal lobe to anal lobes, 133–173 from pedipalp to anal lobes, 31–43 wide. **Gnathosoma** *d* 2–4, *ep* 1–2, chelicera 11–12; pedipalp 14–17. **Prodorsal shield** 17–27, including frontal lobe 21–31, 23–35 wide between external margins, and 5–10 wide between *sm2*; *sc* 15–18, scapular tubercles 7–9 apart; *sc* bases 11–13 apart. Frontal lobe 4, 3 (no range) wide at base level. **Legs.** Leg **I** 18–23 without empodium, 22–27 from trocanter to end of empodium; femur 7–9, *bv* 5–9; genu 2–4, *l''* 12–17; tibia 4 (no range), *l'* 2–4; tarsus 4–6, *ft''* 13–20, *ft'* 7–15, *u'* 2–3, ω 6–8; empodium 4–6 including portion inside tarsus, 3–5 not including portion inside tarsus, 5-rayed. Legs **II** 16–20 without empodium, 20–24 from trocanter to end of empodium; femur 7–9, *bv* 3–7; genu 2–4, *l''* 4–6; tibia 2–4; tarsus 3–5, *ft''* 14–22, *ft'* 2–4, *u'* 1–2, ω 8–9; empodium 4–5 including portion inside tarsus, 3–4 not including portion inside tarsus, 5-rayed. **Coxisternal region** with coarse granules. Sternal line 5–6; *Ib* 3–7, 5–9 apart; *Ia* 10–16, 5–6 apart; *2a* 21–30, 13–1 apart; coxisternal area with 3–8 annuli. **External genitalia** 6, 10–15 wide; *3a* 3–6. **Opisthosoma** with 59–70 dorsal annuli and 53–63 ventral annuli considering

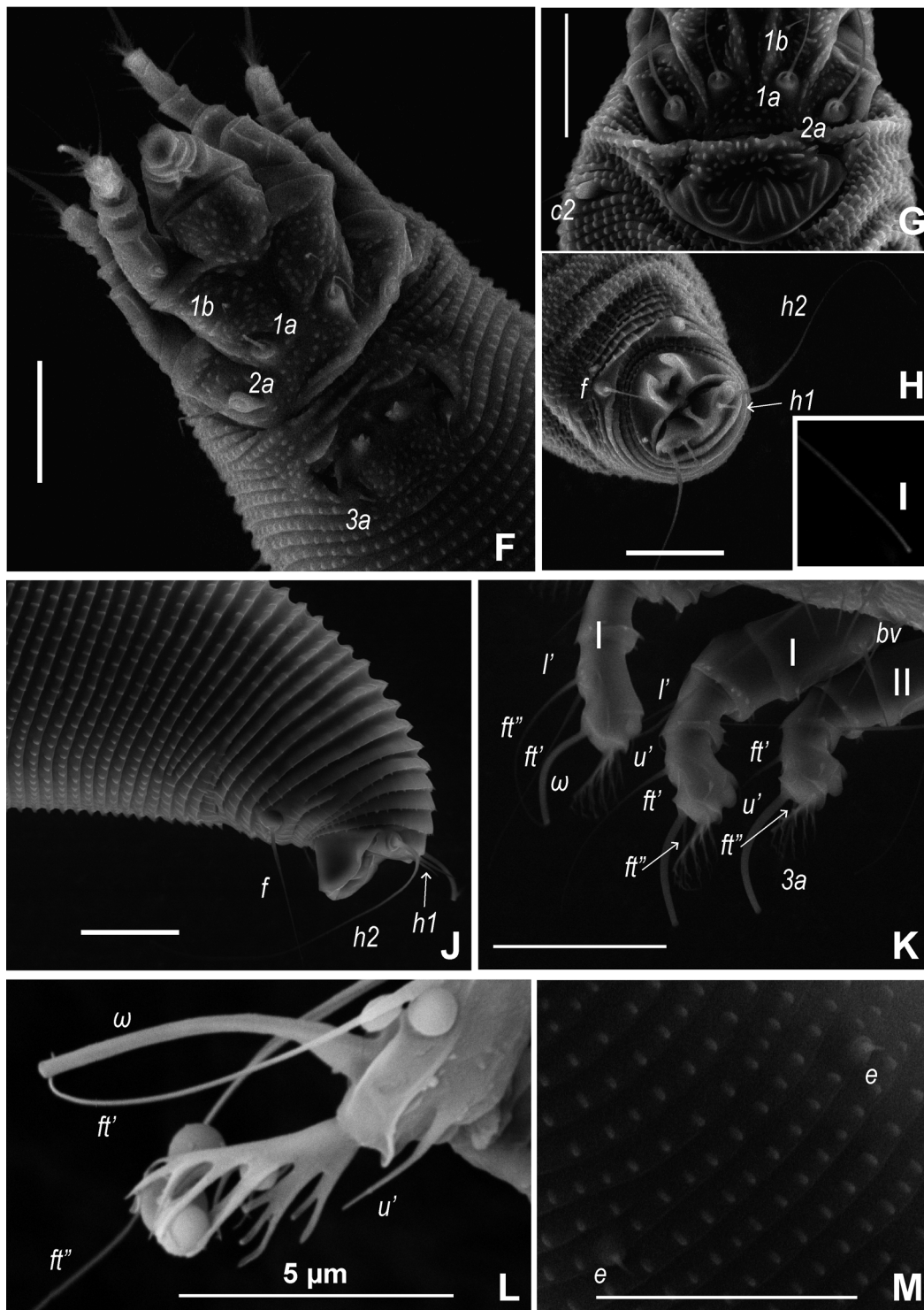


FIGURE 2. Scanning electron micrographs of *Aceria reyesi* from Ilhéus. F. Coxisternal and genital regions, male. G. Coxisternal and genital regions, female; H. Anal region, ventral; I. Seta *h2* distal, showing rounded apex; J. Anal region, lateral; K. Leg I, antiaxial view, legs I and II, paraxial view; L. Leg I distal detail; M. Setae *e* and annuli microtubercles, ventral, female. Scale bar = 10 μ m, except 2L = 5 μ m.

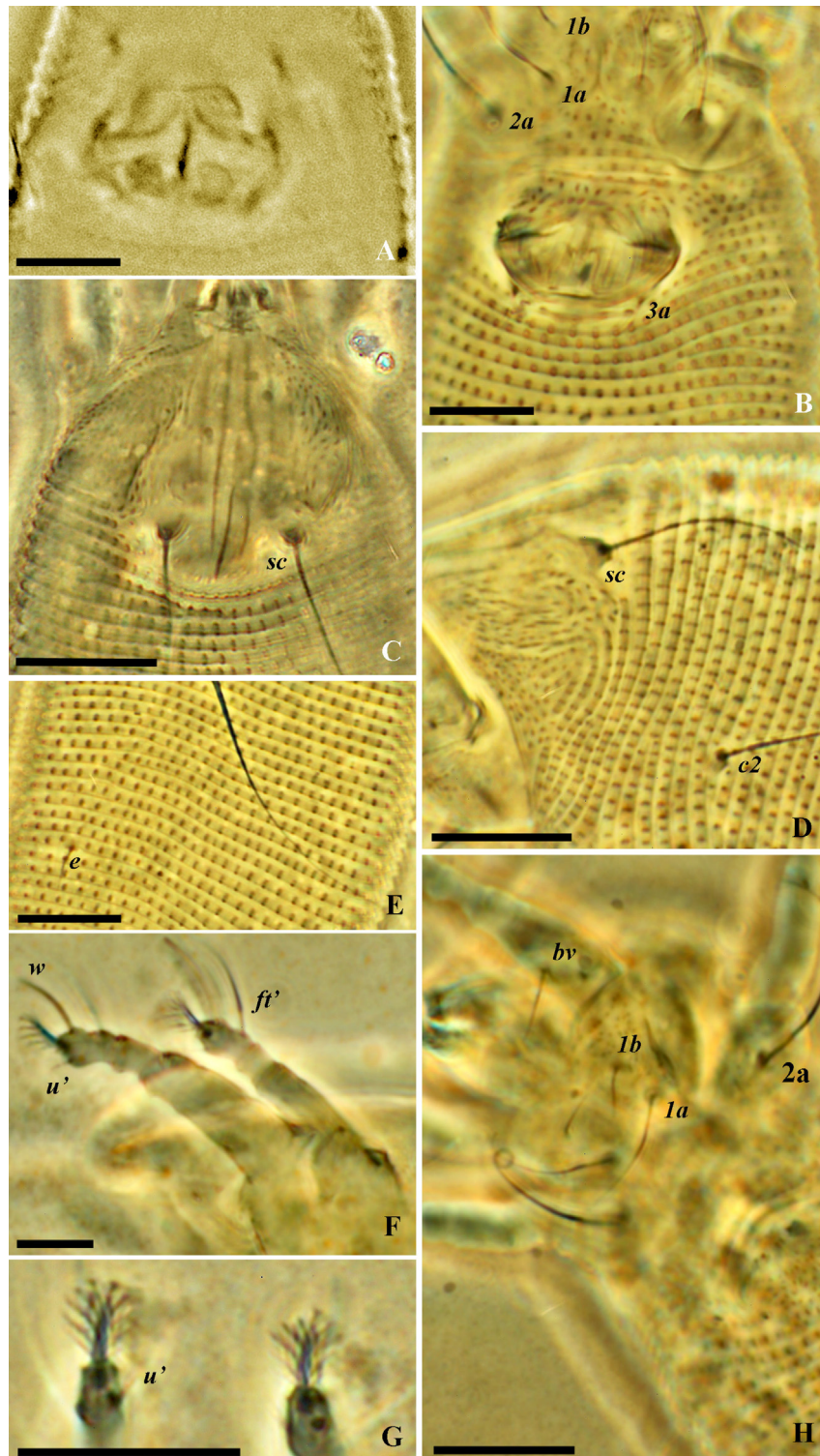


FIGURE 3. Phase-contrast micrographs of *Aceria reyesi* from Rondônia (A) and Venezuela (B–H; type specimens). A. Internal genitalia, female. B. Coxisternal and genital regions, female; C. Prodorsal shield, dorsal; D. Prodorsal shield, lateral; E. Seta *e* region, ventro-lateral; F. Legs I and II, lateral; G. Empodia of legs I and II, ventral; H. Coxisternal and genital regions, male. Scale bar = 10 μ m.

complete annuli from posterior genitalia to anal lobes, 59–68 considering both semi-annuli and complete annuli posterior to coxa II to anal lobes; *c2* 13–21, on annulus 2–3 considering only complete annuli from posterior genitalia, 7–11 considering both semi-annuli and complete annuli posterior to coxa II; *d* 29–39, on annulus 11–21 considering only complete annuli from posterior genitalia, 17–29 considering both semi-annuli and complete annuli posterior to coxa II, 22–28 apart; *e* 1–4, on annulus 26–39 considering only complete annuli from posterior genitalia, 32–46 considering both semi-annuli and complete annuli posterior to coxa II, 11–15 apart; *f* 11–15, on annulus 48–64 considering only complete annuli from posterior genitalia, 54–72 considering both semi-annuli and complete annuli posterior to coxa II, 9–10 apart; *h2* 32–40; *h1* 3–5.

NYMPH (n=7). Idiosoma 118–156 from frontal lobe to anal lobes, 132–171 from pedipalp to anal lobes, 30–40 wide. **Gnathosoma** *d* 1–3; *ep* 1–2; chelicera 10 (no range); pedipalp 14–17. **Prodorsal shield** 15–23, including frontal lobe 19–27, 17–32 wide between external margins, and 5–6 between submedian lines *sm2*; *sc* 14–18, directed posterior divergently, scapular tubercles 9–11 apart, *sc* bases 8–13 apart. **Legs**. Leg **I** 15–18 without empodium, 18–22 from trocanter to end of empodium; femur 6–7, *bv* 3–4; genu 2–3, *l''* 10–18; tibia 2–4, *l'* 1–3; tarsus 3–5, *ft''* 12–17, *ft'* 8–10, *u'* 1, *ω* 5–7; empodium 4–5 including portion inside tarsus, 3–4 not including portion inside tarsus, 4–5 rayed. Legs **II** 13–15 without empodium, 16–18 from trocanter to end of empodium; femur 6–7, *bv* 2–4; genu 1–3.5, *l''* 2–4; tibia 2–4; tarsus 3–4, *ft''* 11–17, *ft'* 2–3, *u'* 1, *ω* 7–8; empodium 4–5 including portion inside tarsus, 3–4 not including portion inside tarsus, 4–5 rayed. **Coxisternal region** with coarse granules. Sternal line 5; *lb* 2–3, 5–6 apart; *la* 6–7, 3–4 apart; *2a* 14–20, 8–12 apart. **External genitalia** absent; *3a* 1–3. **Opisthosoma** with 59–69 dorsal annuli and 54–60 ventral annuli posterior to coxa II to anal lobes; *c2* 6–11, on annulus 8–12; *d* 17–28, on annulus 18–25, 19–31 apart; *e* 2–3, on annulus 31–39, 6–13 apart; *f* 10–13, on annulus 52–57, 4–10 apart; *h2* 20–29; *h1* 2–3.

LARVA (n=5). Idiosoma 90–109 from frontal lobe to anal lobes, 102–123 from pedipalp to anal lobes, 27–33 wide. **Gnathosoma** *d* 1.5–2; *ep* 1.5–2, chelicera 9 (no range); pedipalp 12–15. **Prodorsal shield** 17–22, including frontal lobe 19–24, 18–30 wide between external margins; *sm2* not visible; *sc* 11–16, directed posterior divergently, scapular tubercles 8–10 apart, *sc* bases 11–12 apart. **Legs**. Leg **I** 13–15 without empodium, 16–19 from trocanter to end of empodium; femur 6, *bv* 2–5; genu 2–3, *l''* 10–13; tibia 2–3, *l'* 1–2; tarsus 3–3.5, *ft''* 12–18, *ft'* 8–10, *u'* 1, *ω* 5–6; empodium 3–4 including portion inside tarsus, 2–3 not including portion inside tarsus, 4–5 rayed. Leg **II** 11–13 without empodium, 14–16 from trocanter to end of empodium; femur 5–6, *bv* 1–2; genu 1–2, *l''* 2–3; tibia 2 (no range); tarsus 3, *ft''* 11–15, *ft'* 1.5–2, *u'* 1, *ω* 5–6; empodium 3–4 including portion inside tarsus, 2–3 not including portion inside tarsus, 4-rayed. **Coxisternal region** with coarse granules. *lb* 2, 6 apart (no range); *la* 5–6, 4 apart (no range); *2a* 11–15, 10–13 apart. **External genitalia** absent; *3a* 1 (no range). **Opisthosoma** with 60–65 dorsal annuli and 41–44 ventral annuli posterior to coxa II to anal lobes; *c2* 4–6, on annulus 9–11; *d* 13–20, on annulus 14–19, 13–29 apart; *e* 1 (no range), on annulus 22–27, 8–10 apart; *f* 10–11, on annulus 37–42, 5–10 apart; *h2* 18–21; *h1* 1–3.

Discussion

Measurements among females from different locations examined in this study were similar, in a way that we decided to present all measurements/counts in the supplementary description text of *A. reyesi* considering all specimens examined together. See supplementary material for female, male, nymph and larva measurements/counts from different localities. On the other hand, some inconsistencies were observed between the female original description by Nuzzaci (1973) and the current study (Table 1). Although the sub-median lines were not adequately illustrated by Nuzzaci (1973), with

sm1 incomplete and *sm2* absent (Fig. 6 in original description), both were redescribed in the present study (Fig. 1D). Minor inconsistency can be observed on the leg I on Figure 2, where the line separating genu from femur was skipped (it is clear on Fig. 4 in original description). Radiated empodium with bifurcated end, each empodium containing five rays (Fig. 2L). Setae *c2* longer, 32 μm (against 11–17 in specimens used in the supplementary description), the setae *d* and *f* shorter, 27 μm (24–43) and 8 μm (12–16), respectively. The other measures were very close. Still in relation to figure 2, the setae *c2* is much smaller, contrary to what is reported in the text (32 μm). Although the distal portion of setae *h2* was not illustrated by Nuzzaci (1973) (Fig. 8 in original description), it was possible to observe its rounded apex in the present study (Fig. 2I).

TABLE 1. Morphological traits of the cacao bud mite, *Aceria reyesi*. Means, followed by standard deviation (SD) and minimum–maximum (on the second line) when numbers varied, of measurements/counts in females according to the original description by Nuzzaci (1973) and as observed in the different localities examined in this study.

Characters	Nuzzaci (1973)	Venezuela	Costa Rica	Ecuador	Amazonas	Bahía	Rondônia
Idiosoma from frontal lobe to anal lobes		149 ± 12.38 132–167	158	140 ± 19.62 120–160	189 ± 17.13 162–201	164 ± 32.78 126–198	187 ± 23.73 149–211
Idiosoma from pedipalp to anal lobes	170–190	163 ± 12.54 145–180	173	155 ± 19.86 136–177	206 ± 17.30 178–218	180 ± 32.50 143–213	202 ± 23.88 164–226
Idiosoma width	30	40 ± 2.31 37–41	39	36 ± 2.61 33–39	42 ± 4.02 38–47	44 ± 5.72 38–49	43 ± 4.39 35–46
Dorsal pedipalp genual seta (<i>d</i>)		3 ± 0.48 3–4	4	3 ± 0.45 3–4	4 ± 0.55 3–4	3 ± 0.55 3–4	4 ± 0.45 3–4
Pedipalp coxal seta (<i>ep</i>)		2 ± 0.18 1.5–2		2	2 ± 0.45 2–3	2	2
Chelicera		12 ± 0.52 11–12					
Pedipalp	14–15	15 ± 0.99 14–17	15	16 ± 0.84 15–17	16 ± 0.45 16–17	16 ± 1.10 15–17	16 ± 0.84 15–17
Prodorsal shield	19	23 ± 0.92 22–24	24	22 ± 1.52 21–24	22 ± 2.28 20–25	25 ± 2.92 20–27	24 ± 1.92 22–27
Prodorsal shield including frontal lobe		26 ± 1.04 25–28				31 ± 0.71 30–31	
Prodorsal shield width between external margins	22–24	29 ± 1.00 28–30	33	26 ± 2.65 23–30	31 ± 3.81 25–35	34 ± 4.30 29–39	33 ± 4.06 26–36
Prodorsal shield width between lines <i>sm2</i>		10 ± 0.96 9–11		7	8 ± 1.10 7–10	10 ± 1.41 8–12	9 ± 1.41 7–10
Scapular seta (<i>sc</i>)	17	19 ± 1.15 17–20	21	19 ± 0.89 18–20	19 ± 1.52 17–20	18 ± 2.86 15–22	19 ± 1.10 18–20
Scapular tubercles space	9	9	10	8 ± 0.84 7–9	10 ± 1.79 9–13	9 ± 1.10 8–11	8
Scapular <i>sc</i> bases space			12	11 ± 0.55 11–12	12 ± 0.45 12–13	12 ± 1.10 11–14	12 ± 1.14 10–13
Frontal lobe		4 ± 0.52 3–4				4	
Frontal lobe width at base level		3				6	
Leg I without empodium		24 ± 2.00 22–27	25	20 ± 0.89 19–21	22 ± 1.92 20–25	22 ± 5.27 15–28	23 ± 0.89 22–24
Leg I from trocanter to end of empodium	32–34	29 ± 2.00 27–32	29	24 ± 1.30 22–25	26 ± 1.92 24–29	27 ± 5.20 20–32	27 ± 1.73 25–29
Femur I		8 ± 0.35 8–9	7	8	8 ± 0.45 8–9	9 ± 1.10 8–10	9 ± 0.55 9–10

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TABLE 1 (continued)

Characters	Nuzzaci (1973)	Venezuela	Costa Rica	Ecuador	Amazonas	Bahia	Rondônia
Ventral basifemoral seta (<i>bv</i>) I		7 ± 0.89 6-8	6	6 ± 0.71 5-7	7 ± 1.00 6-8	7 ± 1.30 6-9	7 ± 0.55 7-8
Genu I		4	2	3 ± 0.45 3-4	3 ± 0.55 3-4	4 ± 0.71 2.5-4	4 ± 0.45 3-4
Antaxial genual seta (<i>l'</i>) I		16 ± 2.20 12-19	17	15 ± 0.89 15-17	15 ± 0.89 15-17	16 ± 3.56 11-19	17 ± 0.89 16-18
Tibia I	6	5 ± 0.35 5-6	5	3 ± 0.84 2-4	4 ± 0.55 4-5	5 ± 0.71 3.5-5	5 ± 0.45 4-5
Paraxial tibial seta (<i>l'</i>) I	3	3 ± 0.76 2-4	4	3	3 ± 0.55 3-4	4 ± 1.00 2-4.5	4 ± 0.45 4-5
Tarsus I	6	6 ± 0.53 5-6	6	5	5 ± 0.89 5-7	5 ± 0.55 4-5.5	6 ± 0.45 5-6
Antaxial fastigial tarsal seta (<i>ft''</i>) I		18 ± 1.22 16-19	20	20 ± 3.56 17-26	16 ± 1.22 14-17	18 ± 2.35 15-21	19 ± 0.89 18-20
Paraxial fastigial tarsal seta (<i>ft'</i>) I		10 ± 0.79 9-11	13	14 ± 2.41 11-17	12 ± 1.22 11-14	13 ± 1.30 11-14	13 ± 0.55 12-13
Paraxial unguinal tarsal seta (<i>u'</i>) I		2	3	2 ± 0.22 2-2.5	2	3 ± 0.55 2-3	2 ± 0.71 1.5-3
Tarsal solenidion (<i>ω</i>) I		6 ± 0.52 6-7	7	8 ± 0.45 7-8	8 ± 0.45 7-8	6 ± 0.55 6-7	8
Tarsal empodium I including portion inside tarsus		6	6	5 ± 0.45 5-6	5 ± 0.71 4-6	5 ± 0.71 4-6	6 ± 0.45 5-6
Tarsal empodium I not including portion inside tarsus	5	5	5	4 ± 0.55 3-4	4 ± 0.45 3-4	4 ± 0.71 3-5	4 ± 0.45 4-5
Tarsal empodium I rays number		5	5	5	5	5	5
Leg II without empodium	27-29	21 ± 1.20 19-22	18	18 ± 1.10 17-20	20 ± 1.73 18-22	19 ± 3.05 15-22	21 ± 1.14 19-22
Leg II from trochanter to end of empodium		26 ± 1.41 23-27	23	22 ± 1.79 20-25	23 ± 1.73 22-26	22 ± 2.97 19-26	25 ± 0.84 24-26
Femur II		8 ± 0.46 7-8	7	8	8	8 ± 0.55 8-9	9 ± 0.45 9-10
Ventral basifemoral seta (<i>bv</i>) II		5 ± 0.49 5-6	6	5 ± 0.55 5-6	6 ± 0.55 5-6	6 ± 1.22 4-7	6 ± 0.45 6-7
Genu II		3	3	2 ± 0.55 2-3	3 ± 0.55 2-3	3 ± 0.55 2-3.5	3
Antaxial genual seta (<i>l''</i>) II		4 ± 0.52 4-5	5	4 ± 0.55 4-5	6 ± 0.55 5-6	6 ± 0.89 4-6	5 ± 1.00 4-6
Tibia II	4	4 ± 0.52 3-4	5	3 ± 0.22 2.5-3	3 ± 0.45 3-4	3 ± 0.89 2-4	3 3-4
Tarsus II	5	5 ± 0.35 4-5	6	5 ± 0.45 4-5	5 ± 0.84 4-6	5 ± 0.89 4-6	5 ± 0.71 4-6
Antaxial fastigial tarsal seta (<i>ft''</i>) II		18 ± 0.90 17-19	21	18 ± 1.10 17-20	18 ± 2.07 16-21	20 ± 2.61 15-21	19 ± 1.34 18-21
Paraxial fastigial tarsal seta (<i>ft'</i>) II		3	4	3	3	4 ± 0.84 3-5	4 ± 0.45 3-5
Paraxial unguinal tarsal seta (<i>u'</i>) II		2 ± 0.27 1.5-2	2	2 ± 0.42 1-2	2 ± 0.55 1.5-3	2 ± 0.22 1.5-2	2 ± 0.22 2-2.5
Tarsal solenidion (<i>ω</i>) II		9 ± 0.46 8-9	10	9 ± 0.71 8-10	9 ± 0.84 8-10	9 ± 0.45 8-9	10
Tarsal empodium II including portion inside tarsus		6 ± 0.53 5-6	6	5 ± 0.45 5-6	5	6 ± 0.55 5-6	6 ± 0.45 5-6
Tarsal empodium II not including portion inside tarsus	4	5 ± 0.53 4-5	4	4 ± 0.45 3-4	4 ± 0.45 3-4	4 ± 0.27 4-4.5	4 ± 0.89 3-5

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TABLE 1 (continued)

Characters	Nuzzaci (1973)	Venezuela	Costa Rica	Ecuador	Amazonas	Bahia	Rondônia
Tarsal empodium I rays number		5	5	5	5	5	5
Sternal line		5 ± 0.50 4-5		6 ± 0.55 5-6	7 ± 0.55 6-7	6 ± 0.55 5.5-7	7
Coxal seta I (<i>Ib</i>)		5 ± 0.93 4-6	4	5 ± 0.55 6-7	6 ± 0.45 6-7	6 ± 0.45 5-7	6 ± 0.45 6-7
Coxal seta I (<i>Ib</i>) space		6	6	7 ± 0.55 6-7	6 ± 0.45 6-7	7 ± 0.45 6-7	7 ± 0.57 6.5-8
Coxal seta II (<i>Ia</i>)		15 ± 1.37 13-17	10	14 ± 0.45 14-15	15 ± 3.03 11-19	15 ± 0.55 14-15	16 ± 1.14 14-17
Coxal seta II (<i>Ia</i>) space		6 ± 0.58 5-6	5	6 ± 0.45 5-6	6 ± 0.89 5-7	6 ± 0.84 5-7	6 ± 0.89 5-7
Coxal seta III (<i>2a</i>)		26 ± 2.60 24-32	20	28 ± 3.51 23-32	29 ± 4.51 21-33	31 ± 4.77 25-37	34 ± 2.35 30-36
Coxal seta III (<i>2a</i>) space		15 ± 0.50 14-15	13	15 ± 1.10 13-16	15 ± 1.22 14-17	16 ± 1.79 13-17	17 ± 1.22 13-18
Coxisternal area annuli number		5 ± 0.53 5-6		6 ± 0.84 5-7	5 ± 0.71 4-6	5	5 ± 1.00 4-6
External genitalia	11	10 ± 0.53 9-10	12	11 ± 0.55 10-11	11 ± 0.84 10-12	11 ± 2.17 10-15	13 ± 1.00 12-14
External genitalia width	16	16 ± 0.55 16-17	15	16 ± 1.10 15-17	15 ± 0.55 15-16	16 ± 1.82 14-18	17 ± 0.89 16-18
External genitalia longitudinal ribs number	12-14	14 ± 1.00 13-15		11 ± 1.14 10-13	11 ± 1.10 10-12	12 ± 0.45 11-14	12 ± 1.48 11-14
Seta (<i>3a</i>)	3.5	5 ± 0.84 4-6	5	3	4 ± 0.84 3-5	4 ± 0.89 3-5	4 ± 0.89 3-5
Dorsal annuli number		73 ± 3.27 69-78	74	70 ± 3.03 67-75	70 ± 3.56 67-75	73 ± 1.48 71-75	69 ± 4.32 63-74
Ventral annuli number considering only complete annuli from posterior genitalia to anal lobes	67	63 ± 3.36 59-68	69	60 ± 3.63 54-64	63 ± 1.95 60-65	65 ± 10.09 48-74	60 ± 5.03 54-66
Ventral annuli number considering both semi-annuli and complete annuli posterior to coxa II to anal lobes	72	66 ± 5.12 61-73	76	66 ± 4.32 59-71	68 ± 1.00 67-69	68 ± 10.28 55-81	68 ± 5.70 60-74
Lateral seta (<i>c2</i>)	32	15 ± 1.37 13-16	16	14 ± 1.10 13-15	15 ± 1.10 13-16	13 ± 2.17 11-16	16 ± 0.89 15-17
Lateral seta (<i>c2</i>) annulus considering only complete annuli from posterior genitalia		4 ± 0.63 3-5	3	3 ± 0.55 3-4	4 ± 1.14 2-5	4 ± 0.45 3-5	3 ± 0.84 2-4
Lateral seta I (<i>c2</i>) annulus considering both semi-annuli and complete annuli posterior to coxa II	7	8 ± 0.63 7-9	9	7 ± 1.64 6-9	9 ± 0.45 8-9	11 ± 0.71 10-12	10 ± 0.84 9-11
Ventral seta I (<i>d</i>)	27	37 ± 1.62 36-40	43	33 ± 5.17 24-36	37 ± 3.67 32-41	35 ± 7.16 24-40	37 ± 3.70 31-40
Ventral seta I (<i>d</i>) annulus considering only complete annuli from posterior genitalia		19 ± 0.75 18-20	18	16 ± 0.84 15-17	16 ± 1.00 15-17	19 ± 1.73 18-22	16 ± 1.64 14-18
Ventral seta I (<i>d</i>) annulus considering both semi-annuli and complete annuli posterior to coxa II	23	23 ± 0.52 22-23	25	22 ± 1.30 20-23	21 ± 1.82 19-24	27 ± 1.34 26-29	24 ± 2.39 20-26
Ventral seta I (<i>d</i>) space		28	35	27 ± 1.14 26-29	31 ± 5.54 24-37	31 ± 4.45 26-37	33 ± 2.83 28-35

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TABLE 1 (continued)

Characters	Nuzzaci (1973)	Venezuela	Costa Rica	Ecuador	Amazonas	Bahia	Rondônia
Ventral seta II (<i>e</i>)	3.5	1 ± 0.26 1–1.5	4	2 ± 0.45 2–3	3 ± 0.71 2–4	3 ± 0.55 3–4	3 ± 0.45 2–3
Ventral seta II (<i>e</i>) annulus considering only complete annuli from posterior genitalia		32 ± 2.41 30–35	36	31 ± 2.41 28–34	33 ± 1.48 31–35	38 ± 1.92 36–41	33 ± 1.95 31–36
Ventral seta II (<i>e</i>) annulus considering both semi- annuli and complete annuli posterior to coxa II	41	36 ± 2.61 34–40	43	37 ± 2.88 33–41	38 ± 1.30 37–40	45 ± 1.92 43–48	41 ± 2.65 37–44
Ventral seta II (<i>e</i>) space		14 ± 0.71 13–14	14	15 ± 1.30 14–17	15 ± 1.52 13–17	15 ± 1.87 12–17	16 ± 2.07 13–18
Ventral seta III (<i>f</i>)	8	14 ± 1.03 13–15	15	13 ± 1.14 12–15	13 ± 1.14 12–15	15	15 ± 1.10 13–16
Ventral seta III (<i>f</i>) annulus considering only complete annuli from posterior genitalia		58 ± 3.42 54–63	64	55 ± 3.63 49–59	58 ± 1.95 55–60	61 ± 9.50 44–68	58 ± 3.39 54–62
Ventral seta III (<i>f</i>) annulus considering both semi- annuli and complete annuli posterior to coxa II	67	62 ± 3.83 59–68	71	61 ± 4.32 54–66	63 ± 1.00 62–64	68 ± 9.70 51–75	66 ± 4.04 60–70
Ventral seta III (<i>f</i>) space		10	10	10	10 ± 0.71 9–11	11 ± 0.45 10–11	11 ± 0.84 10–12
Caudal seta (<i>h</i> ₂)		43 ± 3.72 37–47	50	36 ± 3.05 32–39	39 ± 3.90 33–44	42 ± 5.94 34–48	41 ± 1.92 38–43
Accessory seta (<i>h</i> ₁)	3	5 ± 0.52 4–5	4	3 ± 0.71 2–4	3 ± 0.55 3–4	4	4

The genus *Theobroma* includes at least 20 species from tropical forests. The detailed *A. reyesi* morphological characterization herein presented surely is going to contribute to further taxonomic studies on eriophyoid mites associated with these plants. The cacao bud mite was previously reported in Brazil, Cuba and Venezuela (Soria *et al.* 1991; Trevisan *et al.* 2008; Oliveira & Navia 2013; de la Torre & Martínez 2004; Sánchez & Capriles de Reyes 1979), and with the specimens from Costa Rica and Ecuador analysed in the present study, its known geographic distribution was amplified, rising the expectation that *A. reyesi* is eventually present in most of the cacao plantations in Central and South America. Cacao tree is native to tropical regions of Central and South America, and it is possible that the cacao bud mite is also native from this region.

Although *A. reyesi* has never been reported in cacao production countries in Africa, Asia and Oceania (Middlej & Santos 2012), the absence of records of this mite in those continents is surprising. Cacao trees are commonly propagated through seedlings and this propagation material has been exchanged among production countries. Due to the difficulty in detecting these minute mites, which live hidden in the buds, it is possible that *A. reyesi* have been accidentally introduced and established in other continents. Detection of these mites is only possible if a detailed acarological inspection is conducted under a stereomicroscope examination (40x), such as that proceeded at the plant quarantine station (in this study) that allowed interception of a Costa Rica specimen. Based on that expectation, specific surveys for *A. reyesi* in Africa, Asia and Oceania plantations are highly needed, in order to a better understanding of the cacao bud mites as pest worldwide. Symptoms and even losses caused by these mites can be occurring in different countries and erroneously attributed to other biotic or abiotic factors.

An interesting point is that a comparison between the descriptions of *A. reyesi* and *G. cupuassu* showed that those species are morphologically similar, except by the absence of the opisthosomal

ventral seta II (*e*) in the last species, what based the proposition of the new genus *Gymnaceria* by Oliveira *et al.* (2012). *Aceria reyesi* and *G. cupuassu* have the same dorsoventral ornamentation, with microtuberculated annuli present around the whole body and similar ornamentation of the coverflap. The female internal genital structures are also similar. Regarding the measurements, the only differences are (1) the setae 3*a*, which are longer in the females of *G. cupuassu* (7–10 against 3–6 in *A. reyesi*), (2) the immature body lengths, which are longer in the nymph and larvae of *A. reyesi* (respectively 132–171 against 101–112, and 102–123 against 80–82 in *G. cupuassu*), and (3) the ventral setae I *d*, which are longer in the larvae of *A. reyesi* (13–20 against 7–8 in *G. cupuassu*).

The similarities between *A. reyesi* and *G. cupuassu* and the fact that both species occur in *Theobroma* host plants in South America could give support for a proposition that these eriophyid mites could be co-generic. The fact that setae *e* are so short on *A. reyesi* and absent on *G. cupuassu* can be a very good example of speciation. On the other hand, *Aceria* is a too-huge genus and an expansion in the diagnosis of it to include *G. cupuassu* would add more complexity to this heterogeneous genus. Further phylogenetic studies involving molecular data should be considered in a way to better understanding the phylogenetic relationship between *Aceria* and *Gymnaceria*, and discuss the value of presence and absence of the opisthosomal setae *e* on Eriophyoidea mite systematics.

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Supplementary material

Morphological traits of the cacao bud mite, *Aceria reyesi*. Measurements/counts (minimum–maximum when numbers varied) in females (F), males (M), nymphs (N) and larvae (L) according to the original description by Nuzzaci (1973) and as observed in the different localities examined in this study.

Characters	Nuzzaci (1973)	Venezuela	Costa Rica	Ecuador	Amazonas	Bahia	Rondônia
Idiosoma from frontal lobe to anal lobes		F 132–167 M 119–121	F 158	F 120–160 N 131	F 162–201 M 144–158 N 144–156 L 109	F 126–198 M 127–150 N 150 L 90–93	F 149–211 M 153–158 N 118–123 L 103–109
Idiosoma from pedipalp to anal lobes	F 170–190	F 145–180 M 133–136	F 173	F 136–177 N 148	F 178–218 M 160–172 N 158–171 L 123	F 143–213 M 142–162 N 165 L 102–108	F 164–226 M 168–173 N 132–138 L 115–123
Idiosoma width	F 30	F 37–41 M 31–32	F 39	F 33–39 N 30	F 38–47 M 36–43 N 35–40 L 27	F 38–49 M 37–41 N 38–40 L 33	F 35–46 M 38–40 N 30
Dorsal pedipalp genual seta (<i>d</i>)		F 3–4 M 2–3	F 4	F 3–4	F 3–4 M 3–4 N 1–2 L 2	F 3–4 M 3 L 2	F 3–4 M 4 N 2–3 L 2
Pedipalp coxal seta (<i>ep</i>)		F 1.5–2 M 1.5		F 2 N 2	F 2–3 M 1–2 N 1	F 2 M 2	F 2 M 2 N 1.5–2 L 1.5–2
Chelicera		F 11–12 M 11–12					
Pedipalp	F 14–15	F 14–17 M 16–17	F 15	F 15–17 N 17	F 16–17 M 14–16 N 14–15 L 14	F 15–17 M 14–16 N 15 L 12–15	F 15–17 M 15 N 14–15 L 12–14
Prodorsal shield	F 19	F 22–24 M 21	F 24	F 21–24 N 15	F 20–25 M 20–24 N 18–19 L 20	F 20–27 M 22–27 N 20–23 L 20–22	F 22–27 M 17–21 N 18–19 L 17–18
Prodorsal shield including frontal lobe		F 25–28 M 25				F 30–31	
Prodorsal shield width between external margins	F 22–24	F 28–30 M 23–25	F 33	F 23–30	F 25–35 M 28–35 N 30–32	F 29–39 M 33 L 18–30	F 26–36 M 25–30 N 17
Prodorsal shield width between lines <i>sm</i> ₂		F 9–11 M 10		F 7	F 7–10 M 5–7 N 6	F 8–12 M 7–10	F 7–10 M 8 N 5
Scapular seta (<i>sc</i>)	F 17	F 17–20 M 16–17	F 21	F 18–20	F 17–20 M 17–18 N 14–15 L 12	F 15–22 M 15–16 N 15–18 L 11–15	F 18–20 M 16–18 N 15–16 L 15–16
Scapular tubercles space	F 9	F 9 M 9	F 10	F 7–9	F 9–13 M 9 N 10–11 L 10	F 8–11 M 7–8 N 10 L 8–10	F 8 M 7–9 N 9 L 9
Scapular <i>sc</i> bases space			F 12	F 11–12	F 12–13 M 11–13 N 13 L 11	F 11–14 M 11–12 N 8 L 11–12	F 10–13 M 11–12 N 11–12 L 12

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Characters	Nuzzaci (1973)	Venezuela	Costa Rica	Ecuador	Amazonas	Bahia	Rondônia
Frontal lobe		F 3-4 M 4				F 4	
Frontal lobe width at base level		F 3 M 3				F 6	
Leg I without empodium		F 22-27 M 20-22	F 25	F 19-21 N 15	F 20-25 M 18-23 N 15-17 L 13	F 15-28 M 20-23 N 15-18 L 13-15	F 22-24 M 20-22 N 15-16 L 14
Leg I from trocanter to end of empodium	F 32-34	F 27-32 M 24-26	F 29	F 22-25 N 19	F 24-29 M 22-27 N 18-20 L 16	F 20-32 M 24-26 N 19-22 L 17-19	F 25-29 M 24-26 N 19-20 L 17
Femur I		F 8-9 M 8	F 7	F 8 N 6	F 8-9 M 7-8 N 6 L 6	F 8-10 M 8-9 N 7 L 6	F 9-10 M 8-9 N 6-7 L 6
Ventral basifemoral seta (<i>bv</i>) I		F 6-8 M 5-7	F 6	F 5-7	L 6-8 M 5-7 N 3 L 2	F 6-9 M 6-9 N 4 L 2	F 7-8 M 5-7 N 4 L 5
Genu I		F 4 M 3-4	F 2	F 3-4 N 2	F 3-4 M 2-3 N 3 L 2	F 2.5-4 M 3 N 3 L 3	F 3-4 M 3-4 N 2 L 2
Antaxial genual seta (<i>l'</i>) I		F 12-19 M 12-14	F 17	F 15-17 N 11	F 15-17 M 14-16 N 10-11 L 12	F 11-19 M 14-15 N 13-18 L 12	F 16-18 M 15-17 N 14 L 10-11
Tibia I	F 6	F 5-6 M 4	F 5	F 2-4 N 3	F 4-5 M 4 N 3 L 2	F 3.5-5 M 4 N 3-4 L 4	F 4-5 M 4 N 2-3 L 2-3
Paraxial tibial seta (<i>l'</i>) I	F 3	F 3 (2-4) M 3 (2-3)	F 4	F 3 N 2	F 3 (3-4) M 3 (3-4) N 2 (1-3) L 1	F 4 (2-4.5) M 3 (3-4) N 3 (2-3)	F 4 (4-5) M 3 (2-3) N 2 L 2 (1-2)
Tarsus I	F 6	F 6 (5-6) M 5 (4-5)	F 6	F 5 N 3	F 5 (5-7) M 5 (4-5) N 4 (3-4) L 4	F 5 (4-5.5) M 5 (5-6) N 5 (4-5) L 4	F 6 (5-6) M 5 (5-6) N 4 L 3
Antaxial fastigial tarsal seta (<i>ft'</i>) I		F 18 (16-19) M 14 (13-15)	F 20	F 20 (17-26) N 13	F 16 (14-17) M 16 (15-17) N 13 (12-13) L 13	F 18 (15-21) M 19 (18-20) N 17 (16-17) L 18	F 19 (18-20) M 17 (15-18) N 15 (14-15) L 12
Paraxial fastigial tarsal seta (<i>ft'</i>) I		F 10 (9-11) M 8 (7-8)	F 13	F 14 (11-17) N 9	F 12 (11-14) M 10 (9-11) N 9 (8-10) L 10	F 13 (11-14) M 11 (10-12) N 10 L 8	F 13 (12-13) M 13 (12-15) N 10 (9-10) L 10 (9-10)
Paraxial unguinal tarsal seta (<i>ut'</i>) I		F 2 M 2	F 3	F 2 (2-2.5)	F 2 M 2 N 1	F 3 (2-3) M 2	F 2 (1.5-3) M 3 N 1 L 1
Tarsal solenidion (<i>o</i>) I		F 6 (6-7) M 7 (6-7)	F 7	F 8 (7-8) N 6	F 8 (7-8) M 7 (6-8) N 6 (5-6) L 5	F 6 (6-7) M 7 (7-8) N 8 L 5	F 8 M 8 N 7 L 6 (5-6)
Tarsal empodium I including portion inside tarsus		F 6 M 5	F 6	F 5 (5-6) N 4	F 5 (4-6) M 5 (4-5) N 4 L 3	F 5 (4-6) M 5 (5-6) N 5 (4.5-5) L 4	F 6 (5-6) M 5 (5-6) N 5 L 4

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Characters	Nuzzaci (1973)	Venezuela	Costa Rica	Ecuador	Amazonas	Bahia	Rondônia
Tarsal empodium I not including portion inside tarsus	F 5	F 5 M 4	F 5	F 4 (3-4) N 3	F 4 (3-4) M 3 (3-4) N 3 L 2	F 4 (3-5) M 4 (3-5) N 4 (3-4) L 3	F 4 (4-5) M 4 N 4 (3-4) L 3
Tarsal empodium I rays number		F 5 M 5	F 5	F 5	F 5 M 5 N 5 L 5	F 5 M 5 N 5 L 4	F 5 M 5 N 5 (4-5) L 5 (4-5)
Leg II without empodium	F 27-29	F 21 (19-22) M 19 (18-20)	F 18	F 18 (17-20) N 13	F 20 (18-22) M 19 (16-20) N 15 (14-15) L 11	F 19 (15-22) M 18 (17-20) N 14 L 12	F 21 (19-22) M 19 (18-20) N 14 (13-14) L 13
Leg II from trochanter to end of empodium		F 26 (23-27) M 23 (22-24)	F 23	F 22 (20-25) N 16	F 23 (22-26) M 22 (20-23) N 18 L 14	F 22 (19-26) M 23 (21-24) N 18 L 15 (14-15)	F 25 (24-26) M 24 (23-24) N 17 L 16
Femur II		F 8 (7-8) M 8	F 7	F 8 N 6	F 8 M 7 N 6 L 6	F 8 (8-9) M 9 (8-9) N 7 (6-7) L 5	F 9 (9-10) M 8 (8-9) N 7 (6-7) L 6 (5-6)
Ventral basifemoral seta (<i>bv</i>) II		F 5 (5-6) M 3	F 6	F 5 (5-6)	F 6 (5-6) M 5 N 3 L 1	F 6 (4-7) M 5 N 4 L 2	F 6 (6-7) M 5 N 3 (2-3) L 2 (1-2)
Genu II		F 3 M 3	F 3	F 2 (2-3) N 1	F 3 (2-3) M 3 (2-3) N 2 L 1	F 3 (2-3.5) M 3 (2.5-4) N 3 (3-3.5) L 2	F 3 M 3 N 2 L 2
Antaxial genual seta (<i>l'</i>) II		F 4 (4-5) M 5	F 5	F 4 (4-5)	F 6 (5-6) M 5 (5-6) N 4 (3-4) L 3	F 6 (4-6) M 5 (5-6) N 4	F 5 (4-6) M 5 (4-5) N 2 L 2
Tibia II	F 4	F 4 (3-4) M 3 (2-3)	F 5	F 3 (2.5-3) N 2	F 3 (3-4) M 3 N 2 L 2	F 3 (2-4) M 3 (3-4) N 4 (3-4) L 2	F 3 (3-4) M 3 N 2 L 2
Tarsus II	F 5	F 5 (4-5) M 4 (3-4)	F 6	F 5 (4-5) N 4	F 5 (4-6) M 4 (4-5) N 4 (3-4) L 3	F 5 (4-6) M 4 (4-5) N 4 (3-4) L 3	F 5 (4-6) M 5 N 4 (3-4) L 3
Antaxial fastigial tarsal seta (<i>ft'</i>) II		F 18 (17-19) M 15 (14-16)	F 21	F 18 (17-20) N 14	F 18 (16-21) M 19 (16-20) N 13 (11-14) L 12	F 20 (15-21) M 19 (18-20) N 17 (16-17) L 13	F 19 (18-21) M 20 (18-22) N 16 (15-17) L 13 (11-15)
Paraxial fastigial tarsal seta (<i>ft</i>) II		F 3 M 3 (2-4)	F 4	F 3	F 3 M 3 N 2 (2-2.5)	F 4 (3-5) M 3 (3-4) N 3 L 1.5	F 4 (3-5) M 3 N 3 (2.5-3) L 2
Paraxial unguinal tarsal seta (<i>ut</i>) II		F 2 (1.5-2) M 1	F 2	F 2 (1-2)	F 2 (1.5-3) M 1 (1-1.5) N 1	F 2 (1.5-2) M 2 L 1	F 2 (2-2.5) M 2 N 1
Tarsal solenidion (<i>ω</i>) II		F 9 (8-9) M 8	F 10	F 9 (8-10) N 7	F 9 (8-10) M 8 (8-9) N 7 L 5	F 9 (8-9) M 8 (8-9) N 8 L 6 (5-6)	F 10 M 9 N 8 L 6
Tarsal empodium II including portion inside tarsus		F 6 (5-6) M 5	F 6	F 5 (5-6) N 4	F 5 M 5 N 4 L 3	F 6 (5-6) M 5 (4-5) N 5 (4-5) L 4	F 6 (5-6) M 5 N 5 L 4

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Characters	Nuzzaci (1973)	Venezuela	Costa Rica	Ecuador	Amazonas	Bahia	Rondônia
Tarsal empodium II not including portion inside tarsus	F 4	F 5 (4-5) M 4	F 4	F 4 (3-4) N 3	F 4 (3-4) M 3 (3-4) N 3 L 2	F 4 (4-4,5) M 4 (3-4) N 4 (3-4) L 3	F 4 (3-5) M 4 N 3 L 3
Tarsal empodium I rays number		F 5 M 5	F 5	F 5 N 4	F 5 M 5 N 5 (4-5) L 4	F 5 M 5 N 5 (4-5) L 4	F 5 M 5 N 5 (4-5) L 4
Sternal line		F 5 (4-5) M 5		F 6 (5-6)	F 7 (6-7) M 6 (5-6) N 5 L 3	F 6 (5.5-7) M 6	F 7 M 6
Coxal seta I (<i>Ib</i>)		F 5 (4-6) M 3	F 4	F 5 (6-7)	F 6 (6-7) M 5 (4-6) N 3 (2-3)	F 6 (5-7) M 6 (5-7) L 2	F 6 (6-7) M 5 (5-6)
Coxal seta I (<i>Ib</i>) space		F 6 M 6	F 6	F 7 (6-7)	F 6 (6-7) M 8 (6-9) N 6	F 7 (6-7) M 6 (5-7) L 6	F 7 (6.5-8) M 7 N 5
Coxal seta II (<i>Ia</i>)		F 15 (13-17) M 14 (12-15)	F 10	F 14 (14-15)	F 15 (11-19) M 12 (10-13) N 7 (6-7) L 5	F 15 (14-15) M 13 (12-13) L 5	F 16 (14-17) M 14 (13-16) N 7 L 6
Coxal seta II (<i>Ia</i>) space		F 6 (5-6) M 5	F 5	F 6 (5-6)	F 6 (5-7) M 5 (5-6) N 4 L 4	F 6 (5-7) M 6 (5-6) L 4	F 6 (5-7) M 6 (5-6) N 3 L 4
Coxal seta III (<i>2a</i>)		F 26 (24-32) M 23 (22-23)	F 20	F 28 (23-32) N 14	F 29 (21-33) M 24 (21-27) N 16 L 13	F 31 (25-37) M 27 (26-29) N 19 (18-20) L 11	F 34 (30-36) M 30 N 18 (15-20) L 15
Coxal seta III (<i>2a</i>) space		F 15 (14-15) M 15 (13-16)	F 13	F 15 (13-16)	F 15 (14-17) M 15 (13-18) N 10 (8-12) L 10	F 16 (13-17) M 14 (13-15) N 10 (9-11) L 13	F 17 (13-18) M 15 (14-16) N 10 (8-11) L 10
Coxisternal area annuli number		F 5 (5-6) M 8		F 6 (5-7)	F 5 (4-6) M 4 (3-4)	F 5 M 5 (4-6)	F 5 (4-6) M 4 (4-5)
External genitalia	F 11	F 10 (9-10)	F 12	F 11 (10-11)	F 11 (10-12) M 6	F 11 (10-15)	F 13 (12-14) M 6 (5-6)
External genitalia width	F 16	F 16 (16-17) M 11	F 15	F 16 (15-17)	F 15 (15-16) M 12 (11-15)	F 16 (14-18) M 12 (10-13)	F 17 (16-18) M 12 (11-16)
External genitalia longitudinal ribs number	F 12-14	F 14 (13-15)		F 11 (10-13)	F 11 (10-12)	F 12 (11-14)	F 12 (11-14)
Seta (<i>3a</i>)	F 3.5	F 4-6 M 3	F 5	F 3 N 1	F 3-5 M 4-5 N 2	F 3-5 M 3-4 N 2-3	F 3-5 M 5-6 N 2-3 L 1
Dorsal annuli number		F 69-78 M 66	F 74	F 67-75 N 68	F 67-75 M 59-64 N 59-69 L 66	F 71-75 M 67-70 N 66-68 L 61	F 63-74 M 65-67 N 60-65 L 60-65
Ventral annuli number considering only complete annuli from posterior genitalia to anal lobes	F 67	F 59-68 M 57-63	F 69	F 54-64 N 56	F 60-65 M 53-59 N 59 L 43	F 48-74 M 55-60 N 56-60 L 43	F 54-66 M 55-56 N 54-56 L 41-44

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Characters	Nuzzaci (1973)	Venezuela	Costa Rica	Ecuador	Amazonas	Bahia	Rondônia
Ventral annuli number considering both semi-annuli and complete annuli posterior to coxa II to anal lobes	F 72	F 61–73 M 64–68	F 76	F 59–71	F 67–69 M 59–64	F 55–81 M 64–68	F 60–74 M 61–64
Lateral seta (c2)	F 32	F 13–16 M 13–21	F 16	F 13–15 N 7	F 13–16 M 14–17 N 9–11 L 5	F 11–16 M 15–16 N 6–10 L 4–6	F 15–17 M 15 N 8 L 5–6
Lateral seta (c2) annulus considering only complete annuli from posterior genitalia		F 3–5 M 2	F 3	F 3–4 N 9	F 2–5 M 2–3 N 8–12 L 10	F 3–5 M 2–3 N 11–12 L 19–10	F 2–4 M 2 N 10 L 10–11
Lateral seta I (c2) annulus considering both semi-annuli and complete annuli posterior to coxa II	F 7	F 7–9 M 7–9	F 9	F 6–9	F 8–9 M 8–9	F 10–12 M 10–11	F 9–11 M 8–9
Ventral seta I (d)	F 27	F 36–40 M 32	F 43	F 24–36 N 17	F 32–41 M 29–37 N 24–25 L 13	F 24–40 M 33–35 N 27–28 L 15–17	F 31–40 M 34–39 N 22–25 L 15–20
Ventral seta I (d) annulus considering only complete annuli from posterior genitalia		F 18–20 M 15–16	F 18	F 15–17 N 19	F 15–17 M 13–14 N 18–23 L 17	F 18–22 M 14–21 N 23–25 L 17–19	F 14–18 M 11–13 N 21 L 14–18
Ventral seta I (d) annulus considering both semi-annuli and complete annuli posterior to coxa II	F 23	F 22–23 M 20–23	F 25	F 20–23	F 19–24 M 19–20	F 26–29 M 23–29	F 20–26 M 17–21
Ventral seta I (d) space		F 28 M 22–26	F 35	F 26–29 N 20	F 24–37 M 26–28 N 21–28	F 26–37 M 23–27 N 24–31 L 19–29	F 28–35 M 25–28 N 19–22 L 16
Ventral seta II (e)	F 3.5	F 1–1.5 M 1	F 4	F 2–3 N 2	F 2–4 M 3–4 N 2 L 1	F 3–4 M 2–4 N 2–3	F 2–3 M 4 N 2–3 L 1
Ventral seta II (e) annulus considering only complete annuli from posterior genitalia		F 30–35 M 31–32	F 36	F 28–34 N 31	F 31–35 M 26–28 N 36 L 25	F 36–41 M 30–39 N 36–39 L 27	F 31–36 M 27–28 N 34–37 L 22
Ventral seta II (e) annulus considering both semi-annuli and complete annuli posterior to coxa II	F 41	F 34–40 M 36–39	F 43	F 33–41	F 37–40 M 32–34	F 43–48 M 39–46	F 37–44 M 33–36
Ventral seta II (e) space		F 13–14 M 12	F 14	F 14–17 N 8	F 13–17 M 12–15 N 10–13 L 9	F 12–17 M 11–12 N 6 L 10	F 13–18 M 13–14 N 10 L 8
Ventral seta III (f)	F 8	F 13–15 M 12–13	F 15	F 12–15 N 10	F 12–15 M 11–14 N 12 L 10	F 15 M 12–13 N 12 L 11	F 13–16 M 14–15 N 10–13 L 10–11

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Characters	Nuzzaci (1973)	Venezuela	Costa Rica	Ecuador	Amazonas	Bahia	Rondônia
Ventral seta III (<i>f</i>) annulus considering only complete annuli from posterior genitalia		F 54–63 M 52–57	F 64	F 49–59 N 52	F 55–60 M 48–53 N 57 L 38	F 44–68 M 55–64 N 56 L 41–42	F 54–62 M 50–51 N 53 L 37–40
Ventral seta III (<i>f</i>) annulus considering both semi-annuli and complete annuli posterior to coxa II	F 67	F 59–68 M 59–62	F 71	F 54–66	F 62–64 M 54–58	F 51–75 M 64–72	F 60–70 M 56–59
Ventral seta III (<i>f</i>) space		F 10 M 10	F 10	F 10 N 7	F 9–11 M 9–10 N 9–10 L 8	F 10–11 M 9–10 N 4 L 10	F 10–12 M 10 N 7–8 L 9
Caudal seta (<i>h2</i>)		F 37–47 M 35–37	F 50	F 32–39 N 20	F 33–44 M 32–40 N 23–25 L 20	F 34–48 M 35–37 N 28–29 L 18–20	F 38–43 M 35–40 N 25–28 L 21
Accessory seta (<i>h1</i>)	F 3	F 4–5 M 3	F 4	F 2–4 N 2	F 3–4 M 3–4 N 2 L 2	F 4 M 4–5 N 3 L 3	F 4 M 4 N 3 L 2