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NEW SPECIES OF *TRIMALACONOTHRUS* FROM MEXICO (ACARI: ORIBATEI: MALACONOTHRIDAE)

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RESUMEN. Se describen e ilustran seis especies nuevas mexicanas de *Trimalaconothrus* que viven en el dosel, suelo, agua y hojarasca. Se proporciona una clave para la determinación de las especies de las regiones Neotropical y Neartica del género.
PALABRAS CLAVE: *Trimalaconothrus*, especies nuevas, dosel, suelo, hojarasca, acuático, clave, México.

ABSTRACT. Six new Mexican *Trimalaconothrus* living in the canopy, soil, water and litter are described and illustrated. A key for determination of Neotropical and Nearctic species of the genus is given.
KEY WORDS: *Trimalaconothrus*, new species, canopy, soil, litter, water, key, México.

About 60 species of the cosmopolitan genus *Trimalaconothrus* Berlese,1916 have been described most of them living in wet moss, often in lichens, bark of trees, soil litter, and water, but they were not reported from the canopies of tropical forest before. We describe here the first two species collected from this habitat.
Most species of the genus *Trimalaconothrus* known from the Neotropical Region, were described by Hammer (1962). She reported nine species, particularly from Chile. From the United States and Canada there are eight species known (Marshall, Reeves and Norton, 1987) that seem to have a wide distribution. We have also identified six different undescribed species from Mexico (Iglesias, 1995), that are described here.

GENUS *TRIMALACONOTHRUS* BERLESE, 1916

Diagnosis: Legs heterotridactylous. Distance between setae *c1-c1* longer (two times) or similar to *d1- d1*. Lyrifissure *ia* located between setae *c2* and *c3* or just behind *c2*. Epimera IV concave posteriorly. Number of genital setae from 4 to 12. Tarsus long and slender.

Type-species: *Malaconothrus (Trimalaconothrus) indusiatus* BERLESE, 1916

Trimalaconothrus pitentzin sp. nov.
(Fig. 1 A-B)

Dimensions: Length 414 μm, width 177μm
Color: Yellowish.

Prodorsum: Rostrum rounded. There is a weak transverse ridge situated just behind interlamellar setae. There is also a ridge parallel to margin of prodorsum. All prodorsal setae very thin, smooth and long. The rostral setae inserted laterally, very separated between from each other. The lamellar setae reach the base of rostral setae; the interlamellar setae out-reach the bases of lamellar setae.The length and relative distance between themselves are as follows: *in* > *le* > *ro* > *ex*; *ro* = (*ro-ro*); *le* > (*le-le*); *in* < (*in-in*); *in* = 4.5 X *ex*; *ex* < (*ex- ex*). Integument is finely granular.

Notogaster: One pair of longitudinal ridges goes from *c*1 to *h1*, forming at their end a deep V-shaped figure. The margins of notogaster are parallel in the anterior part. All setae are thin and smooth. The length and relative distance are as follows: *h3* > *h2* > *ps2* > *c3* > *ps3* >*e2* > *c1* = *cp* > *d2* = *f2* > *h1* > *c2* > *d1* > *e1* > *ps1*; (*h1-h1*) > (*c1-c1*) = (*e1-e1*) > (*d1-d1*). Integument is finely granular.

Ventral region: Anal plate with one pair of small setae inserted immediately posterior to *ad*2. Adanal plate with three setae, long and thin. Genital plate with five pairs of setae, which are, thin and long. Both, anal and genital setae smooth. The length and relative distance are as follows: *g5* > *g4* = *g3* = *g2* > *g1*; (*g5-g4*) > (*g4-g3*) = (*g3-g2*) > (*g2-g1*). Epimeral formula is: 3-1-3-3. Epimeral setae of different length (Fig. 1B).

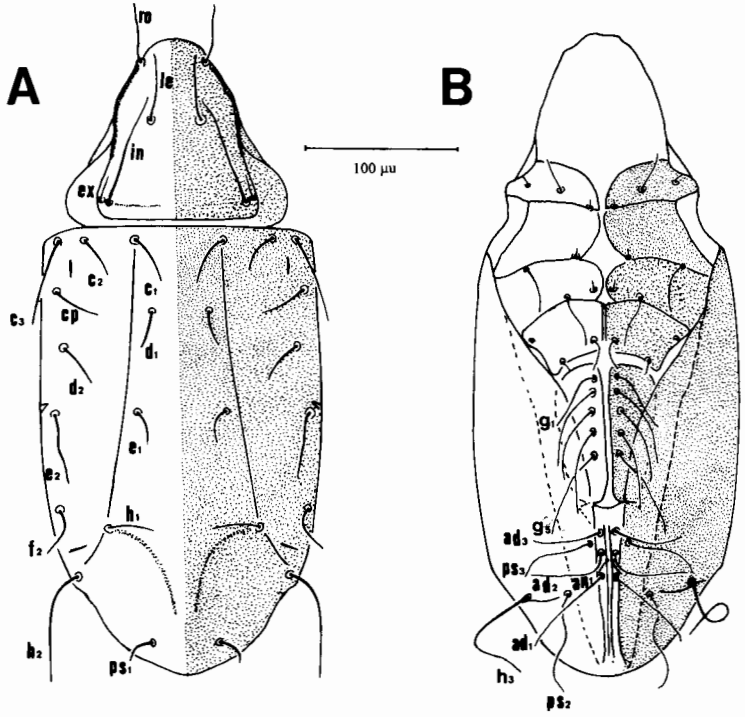

Fig. 1. *Trimalaconothrus pitentzin* sp. nov. A: dorsal aspect; B: ventral aspect.

Type material: Holotype female on slide is deposited in Laboratorio de Ecología y Sistemática de Microartrópodos (LESM).

Type locality: MEXICO, Veracruz, Almagres; 18° 14' N and 95° 56' W; 200 m above the sea; *ex*-soil from forest; 29- IV- 1994. A. Gomez col.

Etymology: Proceeding from Nahuatl *pitentzin* (= small), denoting the small size of this species.

Discussion: ***Trimalaconothrus*** *pitentzin* sp. nov. is similar to *Trimalaconothrus blancus* Hammer, 1961. Both present a pair of ridges on the notogaster and the setae are also similar, *h1* and *h2* are of the same size approximately, and *h3* is very small in *T. blancus*. On the contrary, setae *ps1* and the anal setae are very small in the new species.

Trimalaconothrus almagrensis sp. nov.
(Fig. 2 A-C)

Dimensions: Length 423(414-433) μm, width 207(187-226) μm.
Color: greyish green
Prodorsum: Rostrum rounded. There is a transverse ridge situated just posterior to interlamellar setae. Lamellar ridge goes from above interlamellar setae toward rostral setae. Rostral setae are thin and smooth. inserted just on final part of lamellar ridge. Both, interlamellar and lamellar setae directed toward the lateral margin of prodorsum. Length and relative measure between setae are as follows: *in* > *le* > *ro* > *ex*; *ro* < (*ro-ro*), *le* > (*le-le*); *in* < (*in-in*); *in* = 2.8 X *ex*; *ex* < (*ex-ex*). Integument with distinct granulation.
Notogaster: Elliptical in shape, without ridges. All setae are smooth. The length and relative distance between the notogastral setae are as follows: *h2* > *c3* = *e2* > *ps2* = *h1* > *e1* = *cp* = *h3* > *d1* > *f2* < *c1* = *ps3* > *d2* = *ps1* > *c2*; (*h1-h1*) > (*e1-e1*) > (*c1-c1*) > (*d1-d1*). Setae *h3* are inserted on ventral part. The lyrifissure *ip* is longer than *ia* and *im*. Integument distinctly granulated (Fig. 2A, 2C).
Ventral region: Anal plates with a pair of small setae. The adanal plates present three pairs of long setae. Both, anal and adanal setae are smooth. Anal setae are inserted between *ad1* and *ad2*. Genital plate with five pairs of long setae, thin and smooth. The length and relative distance between genital setae are as follows: *g4* = *g3* > *g2* = *g5* > *g1* ; (*g5-g4*) > (*g4-g3*) = (*g3-g2*) > (*g2-g1*). All epimeres are separated medially. Epimeral formula is 3-1-3-3. The granulation of the epimera is fine. Legs tridactylous (Fig. 2B).

Type material: Holotype female and two paratypes on slides deposited in LESM

Type locality: MEXICO, Veracruz, Almagres; 18° 14' N and 95° 56' W; 200 above the sea; *ex*-litter from forest; 29-IV-1994; A. Gomez col.

Etimology: Related to the locality, town Almagres, where was collected the new species

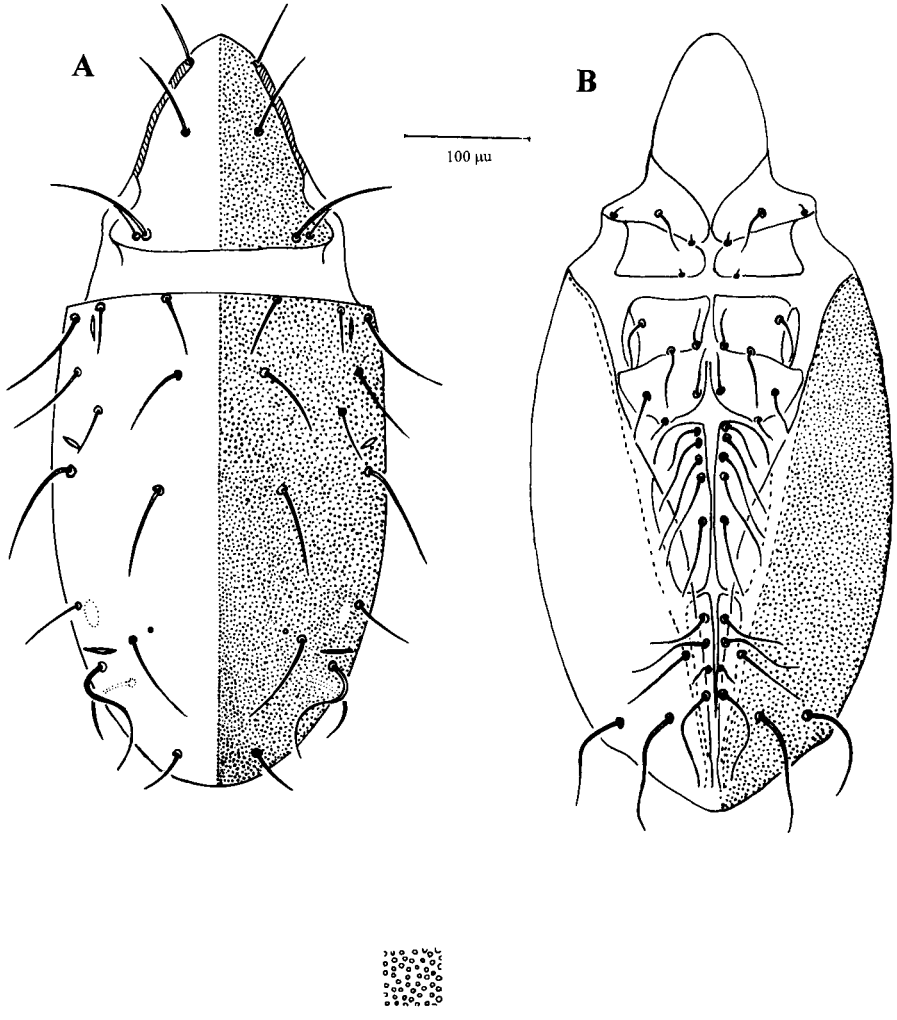

Fig. 2. *Trimalaconothrus almagrensis* sp. nov. A: dorsal aspect; B: ventral aspect; C: integument of notogaster

Discussion: *Trimalaconothrus almagrensis* sp. nov. is similar to *T. montanus* Hammer, 1958 and *T. hakonensis* Yamamoto, 1977. The most conspicuous differences of *T. almagrensis* with *T. montanus* is the lack of the dorsal ridge on notogaster, and the length of rostral setae, shorter in *montanus*. The exobothridial seta in the new species is longer that of *T. hakonensis*.

Trimalaconothrus canopeus sp. nov.
(Fig. 3 A-D).

Dimensions: Length 463(453-473) μm, width 246(237-256) μm.
Color: Yellowish.
Prodorsum: Rostrum slightly rounded. Rostral setae inserted laterally directed toward anteriorly. Lamellar setae reaching bases of rostral setae. The interlamellar setae directed toward laterals margins. The rostral setae are weakly barbulated (Fig. 3D), the other setae of prodorsum are smooth and thin. The length and relative distance are follows: *in* > *le* > *ro* > *ex*; *ro* > (*ro-ro*); *le* > (*le-le*); *in* > (*in-in*); *in* = 4.1 X *ex*; *ex* < (*ex-ex*). Integument is granular.
Notogaster: With one pair of ridges running from between setae *c*1 and reaching *h*1. There is other transverse ridge between *h*1-*h*1. The *c3*, *e2*, *f2*, *h2* and *ps1* are slightly sinuate. The length and relative distance are as follows: *e2* = *ps2* > *ps3* > *ps1* = *h2* > *c3* = *h3* > *h1* > *c1* = *e1* > *cp* = *d2* = *d1* > *c2*; (*h1-h1*) > (*e1-e1*) = (*c1-c1*) > (*d1-d1*). Lyrifissure *ip* near the insertion of *h2* ; *ia* are situated more closely to *c3* rather than to *c2*. Integument of notogaster is granular (Fig. 3C), which are bigger than those of the prodorsum (Fig. 3A).
Ventral region: Anal plates presents two pairs of small, thin setae. Adanal plate with three pairs of long, thin setae. Genital plate with five pairs of long, thin setae. The length and relative distance between genital setae are as follows: *g5* = *g4* > *g3* > *g2* > *g1* ; (*g5-g4*) = (*g4-g3*) = (*g3-g2*) > (*g2-g1*). All anal and genital setae are smooth. Epimeral formula is: 3-1-3-3. Integument of epimera is finely granular (Fig. 3B).

Type material: Holotype female and one paratype on slide are deposited in LESM.

Type locality: MEXICO, Jalisco, Estación de Biología de Chamela, 19° 30' N and 105° 03' W; 200 m above the sea; *ex*-canopy of tropical dry forest; 17-VII-1992; G. Castaño col.

Etymology: The name of the new species refers to tree canopy, the habitat where it lives.

Discussion: *Trimalaconothrus canopeus* sp. nov. is similar to *T. pitentzin* sp. nov. and *T. lisosetosus* sp. nov. in the presence of longitudinal ridges on notogaster, however *T. canopeus* is clearly differentiated because the length of the notogastral setae (much bigger and curling) and the presence of two pairs of anal setae, instead of one pair. *T. canopeus* sp. nov. lives in the canopy, while *T. pitentzin* sp. nov. and *T. lisosetosus* sp. nov. live in soil.

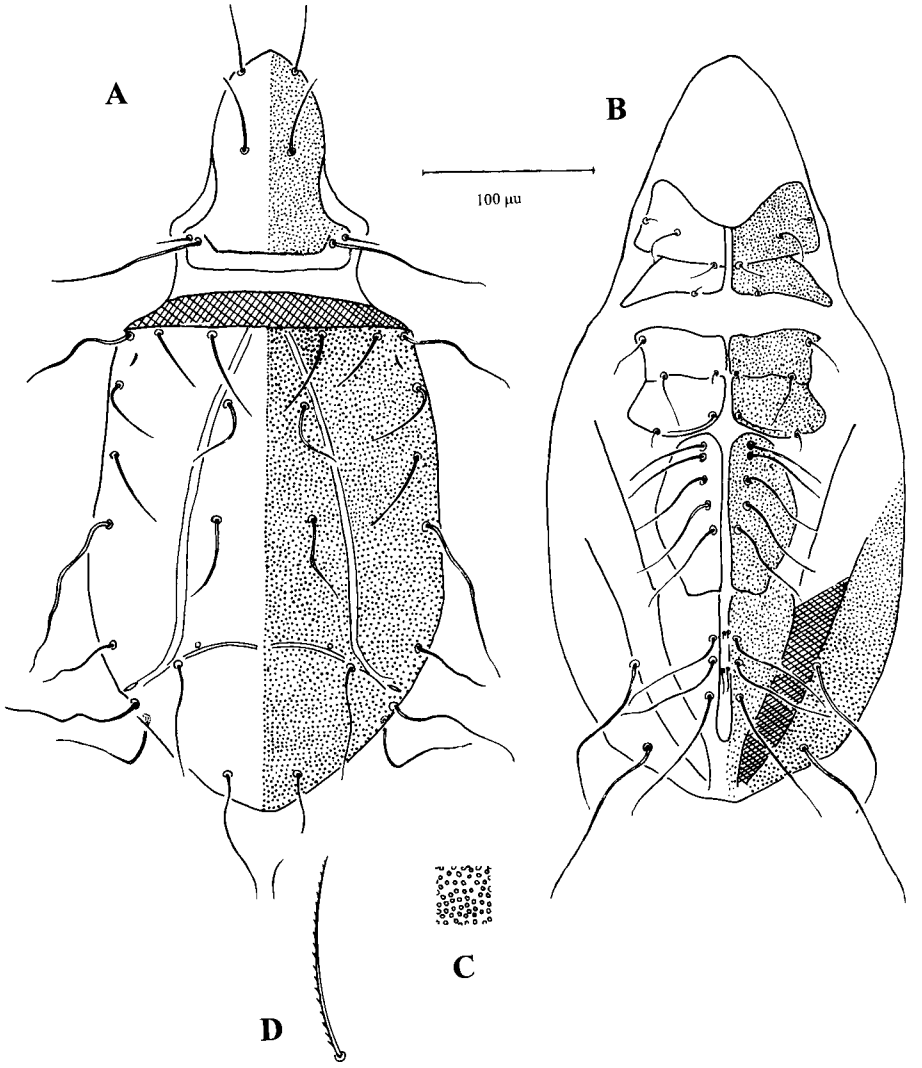

Fig. 3. *Trimalaconothrus canopeus* sp. nov. A: dorsal aspect; B: ventral aspect; C: integument of notogaster; D: rostral setae.

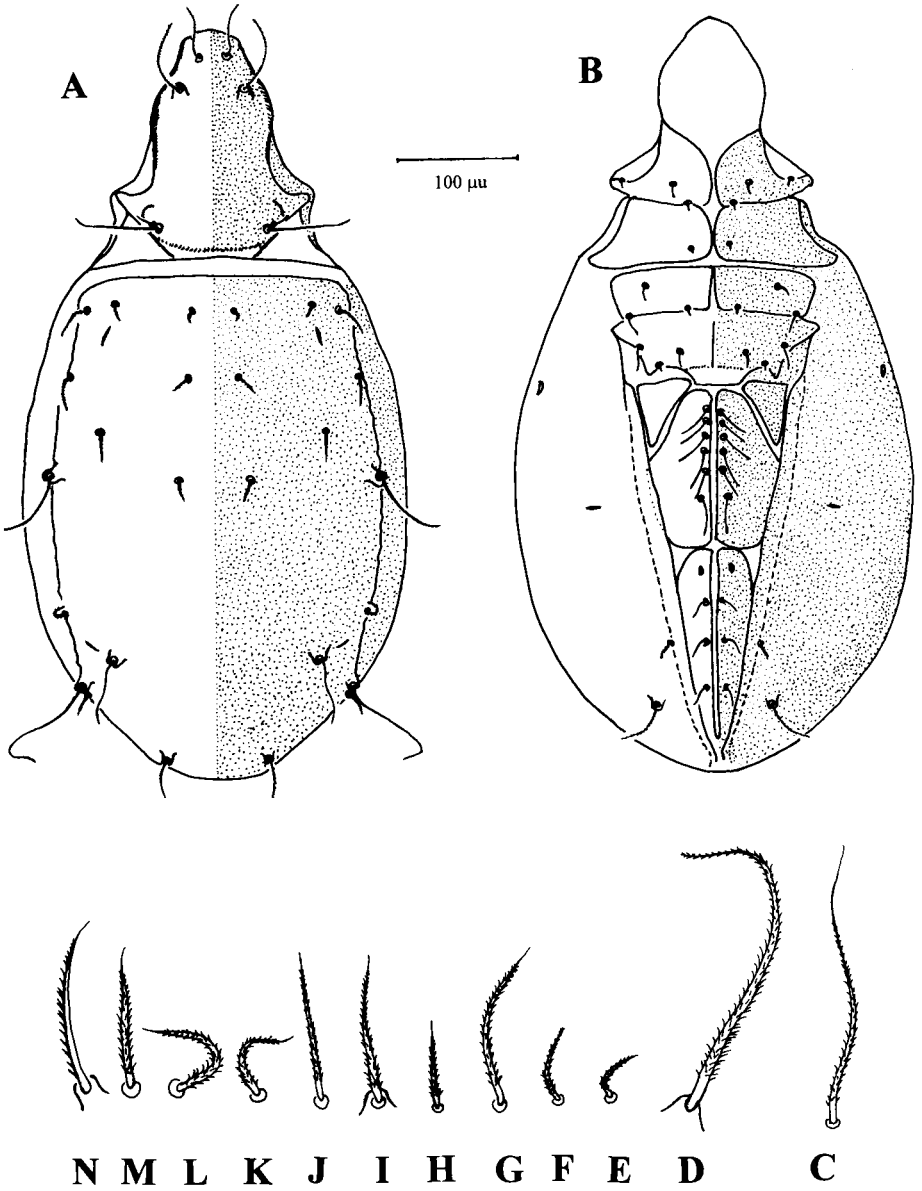

Fig. 4. *Trimalaconothrus eichhornicus* sp. nov. A: dorsal aspect; B: ventral aspect; C: *ro*; D: *le*; E: *cl*; F: *c2*; G: *c3*; H: *dl*; I: *d2*; J: *cp*; K: *el*; L: *f2*; M: *h3*; N: *psl*.

***Trimalaconothrus eichhornicus* sp. nov.**
(Figs. 4 A-N).

Dimensions: Length 621 μm; width 325μm.
Color: Yellowish
Prodorsum: There is a ridge parallel to margin of prodorsum running from anterior part toward posterior, the mid-point of prodorsum. There is also a slight transverse ridge behind interlamellar setae. Rostral setae are thin and slightly barbulate (Fig. 4 C), adjacent from each other and directed toward anterior part. The lamellar setae are slightly barbulate and inserted on separate tubercles (Fig. 4 D). Interlamellar setae, thin and smooth, are directed toward the lateral margin. The length and relative distance are as follows: *in* > *le* > *ro* > *ex*; *ro* > (*ro-ro*); *le* > (*le-le*); *in* < (*in-in*); *in* = 4 X *ex*; *ex* < (*ex-ex*). Integument is finely granular.
Notogaster: There is a weak lateral ridge, very near to margin of notogaster that goes from *c3* and reaches *h2*. Only setae *e2*, *h1* and *h2* are smooth, inserted on a small tubercles, the other notogastral setae slightly barbulate (Fig. 4 E-N). The length and relative distance of them are as follows: *h2* > *e2* > *h1* > *ps2* > *ps1* = *c3* > *d2* = *cp* > *f2* = *h3* > *e1* > *d1* > *ps3* > *c2* > *c1* ; (*h1-h1*) > (*e1-e1*) > (*d1-d1*) = (*c1-c1*). Integument of notogaster is finely granular as on prodorsum (Fig. 4A).
Ventral region: No anal setae observed. Genital plate with six pairs of short, smooth and thin setae. The length and relative distance between genital setae are as follows: *g4* = *g3* > *g6* > *g2* = *g1* > *g5* ; (*g6-g5*) > (*g5-g4*) > (*g4-g3*) > (*g3-g2*) > (*g2-g1*). The epimeral formula as follows: 3-1-3-3. Integument finely granular.

Type material: Holotype female on slide deposited in LESM

Type locality: MEXICO, Veracruz, San Andres Tuxtla; 18° 34' N and 95° 04' E; 200 above the sea; *ex*- aquatic lily (*Eichhornia crassipes*); 28-XII-1994; A. Cadena, *col.*

Etymology: The name origin from of the genus of the lily on which the species was found.

Discussion: *Trimalaconothrus eichhornicus* sp. nov. is similar to *Trimalaconothrus aquatilis* Fain *et al.*, 1990. Both present barbulated lamellar and rostral setae ; notogaster and prodorsum granulated; setae *e2*, *h1* and *h2* of the same length and smooth; rostral setae far from each other; lamellar setae and sensillus of the same size. Differences are as follows: setae *c* are smaller than setae *d* in *T. eichhornicus* while in the second species they are about the same size. *T. eichhornicus* sp. nov. has six genital setae and *T. aquatilis* eight. The new species has no anal setae and *T. aquatilis* has one pair.

***Trimalaconothrus lisosetosus* sp. nov.**
(Figs.5 A-B)

Dimensions: Length 463 μm; width 237 μm.
Color: Greyish green

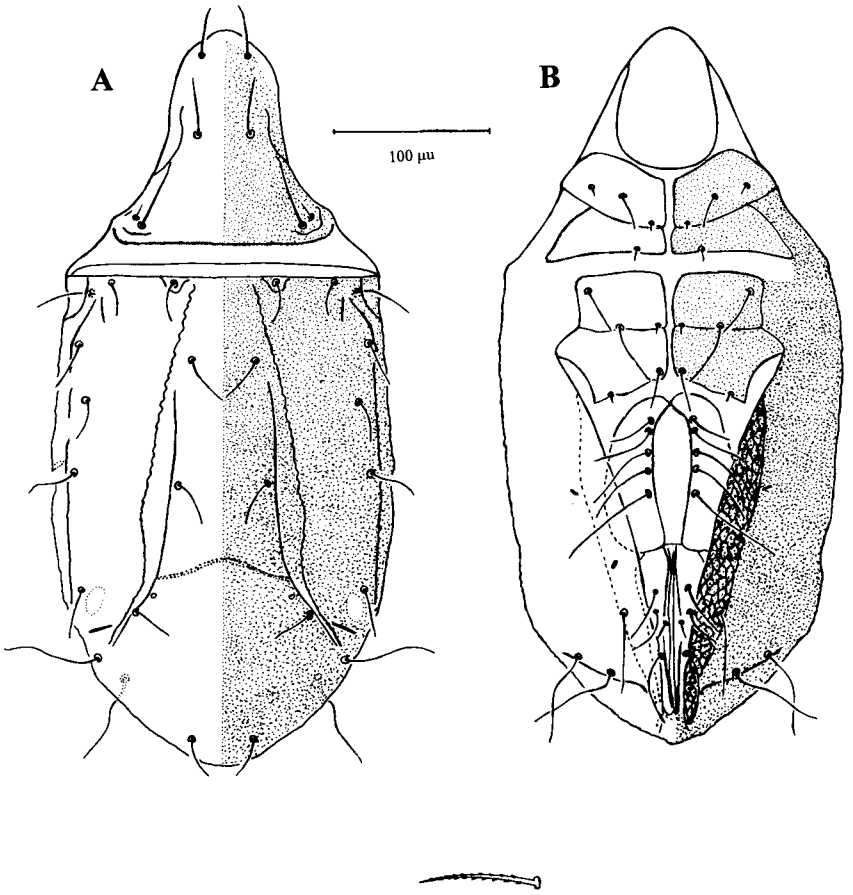

Fig. 5. *Trimalaconothrus lisosetosus* sp. nov. A: dorsal aspect; B: ventral aspect; C: rostral setae

Prodorsum: Rostrum broadly rounded. There is a slight ridge that runs parallel to the margin of anterior half of prodorsum; there is also a transversal ridge situated immediately behind of the insertion of interlamellar setae. The rostral setae are slightly barbulated and inserted laterally projecting forward, the other setae of prodorsum are smooth and thin. The lamellar setae are inserted on half prodorsum part projecting forward. The length and distance between prodorsal setae as follows: *in* > *le* > *ro* > *ex*; *in* = 4.5X *ex*; *ro* = (*ro-ro*); *le* > (*le-le*); *in* < (*in-in*). Only rostral setae are barbulated, the other setae of prodorsum are smooth and thin. Integument is granular.
Notogaster: There is a pair of longitudinal ridges that originate between setae *c1-c1* and runs towards bases of setae *h2*. All setae are smooth and thin. The length and relative distance of them as follows: *h2* = *h3* = *ps2* > *ps3* > *c3* > *d1* > *f2* = *e2* > *c1* = *cp* = *d2* > *e1* > *h1* = *ps1* > *c2*. (*h1-h1*) > (*c1-c1*) > (*e1-e1*) > (*d1-d1*). The setae *c1* are inserted on a small tubercle. Integument is granular, similar to prodorsal. The margin of anterior region of notogaster anterior to setae *e2*. The margin of notogaster is slightly sinuate (Fig. 5A).
Ventral region: Anal plates are provided with one pair of minute, thin setae; adanal plates have three pairs of long, thin setae. Genital plate with five pairs of long, thin setae. Relative length and mutual distance of them as follows: *g5* > *g4* = *g3* > *g2* > *g1*; (*g5-g4*) > (*g4-g3*) = (*g3-g2*) > (*g2-g1*). The setae *g5* are longer than other genital. All anal and genital setae are smooth. Epimeral formula of the setae as follows: 3-1-3-2. Setae 1*b*, 3*b*, 3*c* and 4*b* of epimeres are very long. Integument slightly granular (Fig. 5B).

Type material: Holotype female on slide is deposited in LESM.

Type locality: MEXICO, Jalisco, Estacion de Biologia Chamela; 19° 30' N and 105° 03' W; *ex* soil; 14-III-1992; B. E. Mejía *col.*

Etymology: Related to the smooth shape (Spanish = *liso*) of the notogastral seta

Discussion: *Trimalaconothrus lisosetosus* sp. nov. is similar to *T. montanus* Hammer, 1958. Both species present a pair of ridges on notogaster and the setae are thin and smooth; the interlamellar setae are much shorter than the distance *in-in*. However, the notogastral lateral margins in the first species are parallel, while in the second species are convex. The rostral setae are longer in the new species and the notogastral ridges are better developed.

Trimalaconothrus magnisetosus sp. nov.
(Figs. 6 A-B)

Dimensions: Length 601(591-611) μm, width 319 (306-345) μm..
Color: Brownish
Prodorsum: Subtriangular in shape. One pair of arched ridges is visible in dorsal aspect going from interlamellar setae towards rostral setae. At large magnification the interlamellar and exobothridial setae are slightly barbulated. Length and relative measure between setae are as follows: *in* > *le* > *ro* > *ex*; *ro* > (*ro-ro*); *le* > (*le-*

le), *in* > (*in-in*), *in* = 3.8 X *ex*.

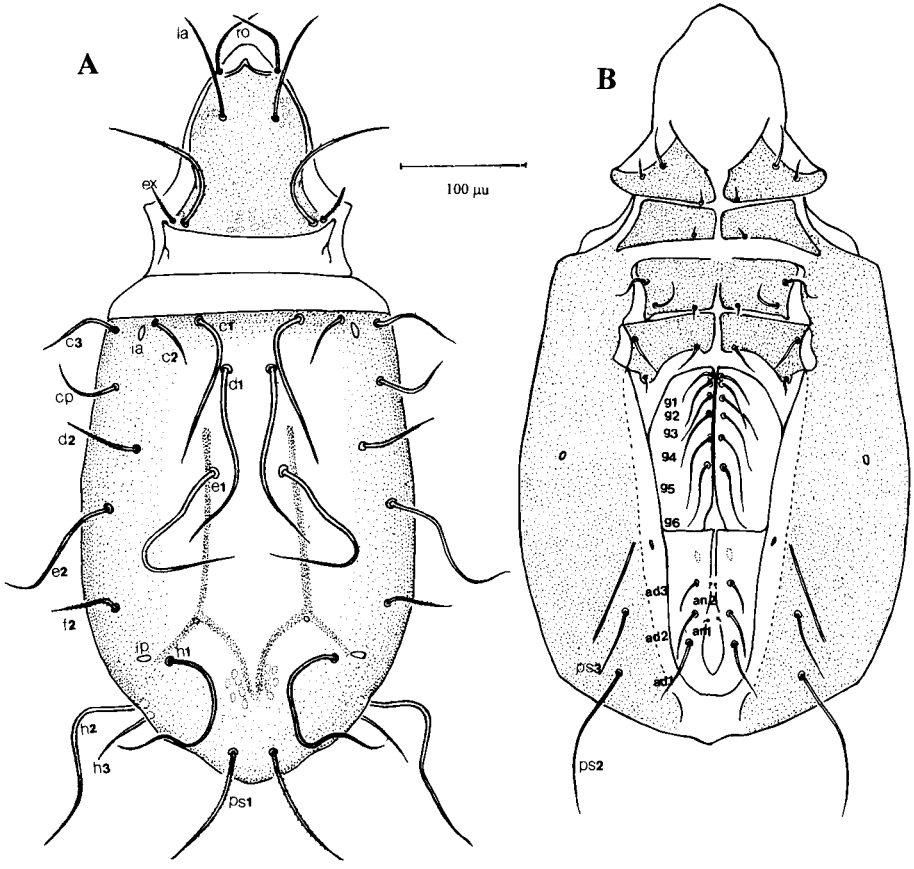

Fig. 6. *Trimalaconothrus magnisetosus* sp. nov. A: dorsal aspect; B: ventral aspect.

Notogaster: Posterior margin "V"shaped, lateral margins almost parallel. There is a small ridge running posteriorly of *d1* to the base of *h1*, where it bends to the center to form a "V" shape. Another is from alveolus of *f1* to setae *h1*. Dorsocentral setae are smooth, very long and curling. Setae *c2*, *f2* and *ps1* barbulated at high magnification. The length and relative distance between the notogastral setae are as follows: *h2* > *e1*=*h1* > *d1* > *c1* > *e2*> *ps2* > *ps1* > *c3* > *cp* = *d2* > *h3* > *ps3* > *f2* > *c2*. Integument slightly granular, mainly in lateral margins (Fig. 6A). *Ventral region*: Anal plate with two very small setae. Each adanal plate with three smooth long setae. Anogenital formula is 6, 0, 3, 2. Epimeral formula is 3-1-3-3. Epimera III fused in the anteromedian part (Fig. 6B).

Type material: Holotype female, two paratypes females from the same region, same date. All material on slides , deposited in LESM.

Type locality: MEXICO, Veracruz, Tropical Biological Station of Los Tuxtlas; 18° 34' N and 95° 04' E; 200 above the sea; *ex*-leaves of *Nectandra ambigens*, from the canopy of *Astrocarium mexicanum*. 20-X-1996, J. Alvarez col.

Etymology. The name refers to the long notogastral setae of this species

Discussion: In this new species the distance *c1-c1* is two times that of *d1-d1*. This character is suppose to be generic for *Fossonothrus* Hammer, 1962, but in our specimens the lyrifissure *ia* is located between the setae *c*2 and *c*3, which is known to be characteristic of *Trimalaconothrus*. *T. magnisetosus* sp. nov. is similar to *Trimalaconothrus wuyanensis* Yamamoto *et al.*, 1993, in the form of prodorsal crest, and "V" shaped posterior margin of the notogaster, but differs in having much longer and curling notogastral setae and only six pairs of genital setae instead of 7. Other important difference is that the length of setae *ex* is much longer in *T. wuyanensis* (ratio *in* / *ex* = 2.1) than in *T. magnisetosus* sp. nov. (ratio= 4.1). In both species there are two minute anal setae. Ratio distance *c*1-*c*1/ *d*1-*d*1 is 1.3 in *T. wuyanensis* and 2.0 in *T. magnisetosus* sp. nov. The new Mexican species is also similar to *T.canopeus* sp. nov, which differs in having longer anal setae and shorter distance between setae *c1-c1*.

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Table 1

COMPARATIVE TABLE OF SELECTED CHARACTERS OF *TRIMALACONOTHRUS* FROM AMERICA

sp/character	g.s.	a.s.	ad	*c*1	*d*1	*c*1-*c*1/*d*1-*d*1	in/ex	ridges "V"
australis	5	0	3	s	s	1	3.7	+
barrancensis	4	a.1	3	s	s	1.1	13	+
blancus	4	a.1	3	L	L	1.4	4.6	+
cajamarcensis	10	a.a.	3	s	s	1	12	+
glaber	7	2	1	s	s	1	10	+
montanus	4	?	3	L	L	3.6	-	-
novus	8	a.a.	3	s	s	1	9.3	+
oxyrhinchus	4	1	3	L	L	1	6.3	-
platyrhinus	4	1	3	L	L	1.1	3	-
magnissetosus	6	2-	3	vl	vl	2.0	4.1	+
almagrensis	5	2	3	L	L	1.2	3.3	-
pitentzin	5	2	3	L	L	1.7	5	+
canopeus	3	2	3	vl	vl	1.4	4.6	+
elchhornicus	6	0	3	s	s	1	7.5	-
lisosetosus	5	1	3	s	s	1.5	5	+

Explanations of abbreviations a= alveolus, g.s.= genital setae, a.s. = anal setae, ad =adanal setae, c1, d1 = seta dl c1-c1/d1-d1 = distance between setae c divided by distance between setae d, in/ex = ratio of the length of setae in divided by the length of setae ex, "V"= notogastral ridges in the form of inverted "V", vl = very long, L = long s = short.

Key for the American species of *Trimalaconothrus*

1. With 10 pairs of genital setae . . . . . *T. cajamarcensis* Hammer, 1961.
1′ With fewer than 10 pairs of genital setae 2
2. With 8 pairs of genital setae . . . . . *T. novus* (Sellnick, 1921)
2′ With less than 8 pairs of genital setae 3
3. With seven pairs of genital setae . . . . . *T. glaber* (Mich.)
3′ With fewer pairs of genital setae 4
4. With six pairs of genital setae 5
4′ With five or four pairs of genital setae 6
5. No anal setae and short notogastral setae . . . . *T. eichhornicus* sp. nov.
5′ Two pairs of minute anal setae and very long notogastral setae . . . . . *T. magnisetosus* sp. nov.
6. With five pairs of genital setae 7
6′ With four pairs of genitals setae 11
7. Notogastral setae *c* and *d* short 8
7′ Notogastral setae *c* and *d* long 9
8. No anal setae, distance between setae *c*1-*c*1 similar to *d*1-*d*1 . . . . . *T. australis* Hammer 1995
8' One pair of anal setae, distance between setae *c*1-*c*1 about 1.5 times that of *d*1-*d*1 . . . . . *T. lisosetosus* sp. nov
9. Seta *c*1 reaching and passing the insertion of seta *d*1 . . . . . *T. canopeus* sp. nov.
9' Seta *c*1 not reaching the insertion of seta *d*1 10
10. Distance *c*1-*c*1 about 1.2 the distance of *d*1-*d*1, and relatively long seta *ex* (*in/ex*=3.3) . . . . . *T. pitentzin* sp. nov.
10' Distance *c*1-*c*1 about 1.7 that of *d*1-*d*1, and shorter setae *ex* (*in/ex* =5) . . . . . *T. almagrensis* sp. nov.
11. Notogastral setae long, *ex* relatively long (*in/ex*=3-4.6) 12
11' Notogastral setae very short, *ex* very short (*in/ex* = 13) . . . . . *T. barrancensis* Hammer, 1961
12. With notogastral ridges in the form of inverted "V". One pair of anal setae and another represented by the alveolus; distance *c1-c1* 1.4 that of *d1-d1*- . . . . . *T. blancus* Hammer, 1961
12' Without notogastral ridges in the form of "V" 13
13. Seta *in* about 6.3 times length of *ex* . . . . *T. oxyrhinchus* Hammer, 1962
13' Seta *in* about 3.0 times length of *ex* . . . . *T. platyrhinus* Hammer, 1962

* *T. angulatus, T. crinitus, T. crispus, T. foveolatus, T. montanus*, and *T. simplex* are not included in the key because the lack of information about the morphology.

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