A new species of *Abacarus* Keifer (Acari: Eriophyidae) from Brazil

Carlos Holger Wenzel Flechtmann¹ & Aline Daniele Tassi²³

¹ Universidade de São Paulo (USP), Escola Superior de Agricultura “Luiz de Queiroz” (ESALQ), Departamento de Entomologia e Acarologia (LEA), Piracicaba, SP, Brasil. ORCID: http://orcid.org/0000-0001-7745-8544. E-mail: chwflech@usp.br (senior professor).
² Universidade de São Paulo (USP), Escola Superior de Agricultura “Luiz de Queiroz” (ESALQ), Departamento de Fitopatologia e Nematologia (LFN), Piracicaba, SP, Brasil. ORCID: http://orcid.org/0000-0002-8622-5977. E-mail: alinetassi@gmail.com.
³ Instituto Biológico, Laboratório de Biologia Molecular Aplicada, São Paulo, SP, Brasil.

**Abstract.** Zoysiagrass is an important ornamental and turfgrass cultivated in different countries. Recently, damage to this plant, characterized by a type of witch’s broom and stunting were observed in southern Brazil, suggesting possible attack by mites. A detailed examination of these plants showed the presence of a new mite species, *Abacarus zoysiae* Flechtmann & Tassi sp. nov., as responsible for the damage. The objective of this publication is to describe that new species, based on adult females and males.

**Keywords.** *Abacarus zoysiae*; Eriophyidae; Grass; *Zoysia japonica*.

**INTRODUCTION**

*Abacarus* is a mite genus described by Keifer (1944), containing the type species *A. hystrix* (Nalepa, 1896) and over 60 species are currently placed in this genus, both from monocotyledonous and dicotyledonous plants, about 36 species in monocotyledonous (Amrine & Stasny, 1994, Amrine, pers. comm.). *Abacarus hystrix* has long been associated with a broad host range, an unusual characteristic for eriophyoid mites that have obligate interactions and long evolutionary relationships within their specific host plants (Oldfield, 1996).

Despite the direct damage to their hosts resulting in leaf discoloration or rusting, *A. hystrix* is known as the vector of rye grass mosaic virus and agropyron mosaic virus (Jeppson et al., 1975; Vacante, 2015). Due to this importance as a virus vector and the unusual host range, the identification of *A. hystrix* has been questioned and studied extensively, the reviews include mtDNA COI sequences analyses, morphometric analyses, and reproductive tests (Skoracka, 2002; Skoracka, 2008; Laska et al., 2018) which demonstrated the presence of cryptic diversity within the *Abacarus* genus and a pattern of host-associated differentiation within the complex (Skoracka, 2002; Skoracka et al., 2012, 2013, 2018; Miller et al., 2013; Navia et al., 2015; Cvrtković et al., 2016; Laska et al., 2018, Duarte et al., 2019).

As many other eriophyd groups, *Abacarus* is known for the wax-like material produced over its body which has been mentioned as important for protection against water loss at times of low relative humidity (Vacante, 2015). The presence of wax-like material is also considered important for increasing total surface drag, which is relevant for wind dispersed mites of wide host-range, as *A. hystrix* (Vacante, 2015). In some parts of Europe, this is one of the most common and widely distributed eriophyid mites on grasses (Skoracka, 2004).

*Zoysia japonica* Steud., also known as zoysiagrass, is an ornamental commonly cultivated in southern Brazil and in different parts of the world. Recently, plants of this species with irregular elongation of culms were observed in São Paulo state, in southeasten Brazil. The objective of this publication is to describe a new *Abacarus* species found in association with zoysiagrass causing specific symptoms.

**MATERIAL AND METHODS**

Examination of symptomatic plants under a stereomicroscope showed the presence of dozens of eriophyid mites. These were collected and mounted in modified Berlese Medium (Amrine & Manson, 1996) on microscope slides. They were kept on a heating plate at circa 60°C for a week, for clarification and drying. The mounted mites
were then examined using a phase-contrast microscope (Leitz Dialux 20), at 1,000 × magnification (plan-apochromatic lens) in immersion oil. Mites were identified to genus level according to Amrine et al. (2003). They were determined to constitute a new species, based on an examination of the world literature, as subsequently detailed, and hence they are here described.

Structures of taxonomic interest were measured using a graded eyepiece. Measurements are given in micrometers and unless otherwise specified correspond to the length of the structure. The terminology and description used for this mite follows mainly Amrine et al. (2003). For each female structure, the first number refers to the measurement of the holotype, which is followed (in parentheses) by the range of the paratype. For males, measurements of each structure refer to the range of the paratypes.

Dorsal annuli were counted from the first annulus behind the prodorsal shield rear margin; ventral semi-annuli, from the first annulus behind caudal end of genitalia. Line drawings were made with the aid of a lucid chamber.

Slides are deposited in the Mite Reference Collection of Escola Superior de Agricultura “Luiz de Queiroz”, Piracicaba, São Paulo, Brazil. Holotype position is marked on the slide.

For scanning electron microscopy (SEM) studies, additional mites were kept in 70% ethanol for 24 h, and transferred to stubs with a double carbon tape, dried at room temperature, sputter coated with gold in a Baltec SDC 050, and examined on a JEOL JSM IT300. Photomicrographs were recorded digitally.

RESULTS AND DISCUSSION

Taxonomic analysis
Family Eriophyidae Nalepa, 1898
Subfamily Phyllocoptinae Nalepa, 1892
Tribe Anthocoptini Amrine & Stasny, 1994
Genus Abacarus Keifer, 1944
**Abacarus zoysiae** sp. nov. (Figs. 1-7)

**Holotype:** female, Brazil, São Paulo, Ribeirão Preto (21°11'35.3"S, 47°48'03.2"W), col. Flávio Figueiredo, 25 Sep 2020.

Figure 1. *Abacarus zoysiae* sp. nov. (A, B) Scanning electron micrographs (SEM) of dorsal view of specimens covered with wax-like secretion. Scale bar: 2 µm.
Paratypes: 24 female, 10 males on 14 microscopic preparations, collected with holotype, same locality and collector as holotype.

Diagnosis

The new species is unique in presenting the prodorsal shield shaped as the profile of a five-sided diamond in dorsal view, with a prominent frontal lobe containing eight irregular longitudinal ridges. Shield ornamentation only represented by two admedian lines. With three coxigenital annuli and a short opisthosomal ventral seta II, e, 5-7 long.

Description

Female (N = 6): Body elongate, 182 (171-202) length, 43 (41-50) wide, whitish, frequently covered with abundant white wax-like secretion (Figs. 1A, 1B and 7).

Gnathosoma: projecting obliquely downwards, basal pedipalp coxal seta (ep) 4 (3-4), apical dorsal pedipalp genital seta (d), 5 (5-6), chelicerae 18 (16-18).

Prodorsal shield: a five-sided diamond shaped in dorsal view, 40 (38-43) length, 39 (35-43) wide, prominent frontal lobe with 8 (8) longitudinal, irregular, scorings (Fig. 2). Shield ornamentation limited to two sub-median, parallel lines, with a slight median constriction, extending over entire shield length; otherwise smooth. With elongate anterolateral scorings. Scapular seta tubercles on shield rear margin, 22 (22-23) apart; scapular setae, (sc) 9 (9-10), projecting backwards, extending over 4 (4-5) dorsal opisthosomal annuli.

Coxisternal region: coxisternal plates and cervical plate with a few scattered elongate coarse dashes. Coxal seta I, 1b, 7 (6-8), 11 (9-11) apart; coxal seta II, 1a, 13 (11-13), 4 (5-6) apart; coxal seta III, 2a, 21 (21-27), 19 (19-22) apart; internal coxisternal apodeme (sternal line) 7 (7). Coxisternal annuli 3 (3), with fine, elongate, faint delicate microtubercles (Figs. 3B and 5B).

Opisthosoma: annuli about equal dorso-ventrally. Dorsal annuli with three longitudinal ridges: middorsal ridge ending about 13th annulus from rear and extending in a short trough; lateral ridges ending at about 10th annulus from rear. Caudal 9-10 dorsal annuli evenly arched. Dorsal annuli smooth, without microtubercles. Total dorsal annuli, 54 (54-60). Total ventral annuli, 52 (52-60), with narrow microtubercles, short in anterior annuli and becoming increasingly longer caudally. Lateral seta (c2) 40 (22-40), on annulus 3 (2-3) counting from genitalia rear margin. Ventral seta I (d) 36 (32-44), 27 (27-31) apart, on annulus 12 (12-14); ventral seta II (e) 6 (5-7), 12 (10-13) apart, on annulus 28 (28-35); ventral seta III (f) 24 (19-25), 19 (18-21) apart, on annulus 47 (47-56) or fifth from rear. Accessory seta (h1) 4 (4-5), caudal seta, h2, 40 (38-47). Genitalia 18 (18), 19 (19-10) wide, coverflap basally with two transverse lines of small beadlike granules and one line of larger, elongate, coarse granules; distal part with 10 (10) longitudinal ridges. Genital seta (3a) 14 (13-22) (Figs. 3A, 3B, 5A, and 5B).

Figure 2. Abacarus zoysiiae sp. nov. SEM of prodorsal shield, frontal lobe. Scale bar: 2 µm.
Figure 3. *Abacarus zoysiae* sp. nov. (A) ventral habitus of female; (B) Dorsal view of female. Scale bar: 20 µm.

Figure 4. *Abacarus zoysiae* sp. nov. (A, B) SEM of legs I and II; (C) Drawing of legs I and II; (D) detail of empodium. Scale bar: A and B: 20 µm; C and D: 5 µm.
Figure 5. *Abacarus zoysiae* sp. nov. (A) Dorsal view of female; (B) Ventral view of female. Scale bar: 20 µm.
**Legs:** leg I 27 (26-28); femur 10 (8-10), ventral basifemoral seta (bv) 9 (8-10); genu 5 (4-5), genual seta (l’) 23 (22-25); tibia 6 (5-6), tibial seta (l’) 6 (5-8), medio-distally; tarsus 5 (5-6), dorsal seta (ft’) 15 (13-15), lateral seta (ft”) 22 (21-14), unguinal seta (u’) 5 (4-5), solenidion (ω) 7 (7-8), distally blunt, empodium simple 6 (6-7), 7-rayed. Leg II 25 (22-27); femur 7 (5-8), seta (bv) 14 (12-15); genu 4 (3-5), seta (l’) 11 (9-12); tibia 4 (3-4); tarsus 5 (5-6), seta (ft’) 6 (5-8), seta (ft”) 22 (21-23), seta (u’) 4 (4-5), solenidion (ω) blunt distally, 7 (7-8), empodium 6 (6-7), 7-rayed (Figs. 4A, 4B and 4C).

**Male (n = 3):** Similar to but smaller than female, 148-166 length; 34-40 wide (Figs. 6A and 6B).

**Gnathosoma:** seta d 4-6, seta ep 3, chelicerae 15-16.

**Prodorsal shield:** 36-37 length, 31-38 wide; sc 9-10, 18-20 apart. Frontal lobe and shield ornamentation as in female.

**Coxisternal region:** coxal plates and cervical plate with a few coarse dashes. Seta 1b 6-7, 9-10 apart; 1a 13-15, 5-6 apart. 2a 22-24, 17-20 apart. Internal coxisternal apodeme 5-7; coxisternal annuli 3.

**Opisthosoma:** seta c2 17-23, on annulus 2; seta d 27, 23-25 apart, on annulus 8-12; seta e 5-6, 10-12 apart, on annulus 23-26; seta f 18-20, 14-16 apart, on annulus 31-38, 18-20 apart.

**Figure 6.** Abacarus zoysia sp. nov. (A) Drawing ventral view of male; (B) DIC ventral view of male. Scale bar: 20 μm.
Relation to host: Causing damage of the type witch's broom and stunting, similar to what was reported for another eriophyid species, known as the bermudagrass stunt mite (*Eriophyes zoysiae* Baker, Kono & O'Neill, 1986), in parts of the USA (Baker et al., 1986; Chong, 2013). Possible relation of a virus with this process cannot be disregarded, and should be later evaluated.

Etymology: The specific designation refers to *Zoysia*, the common and also genus name of the host plant.

Differential diagnosis: The new species is compared with all *Abacarus* species from grasses and in which ornamentation of the prodorsal shield is restricted to two admedian lines, being otherwise smooth (Table 1).

Table 1. Relevant differences between the worldwide *Abacarus* species reported from grasses and with only two admedian lines on the prodorsal shield.

<table>
<thead>
<tr>
<th>Species</th>
<th>Prodorsal shield shape</th>
<th>No. coxigenital annuli</th>
<th>Opisthosomal ventral seta II (e) length</th>
<th>Epigynial cover</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>A. arcatatus</em> Sukhareva, 1985</td>
<td>4 sided elongate diamond</td>
<td>5-6</td>
<td>30-40</td>
<td>10-12 ribs</td>
</tr>
<tr>
<td><em>A. caucasicus</em> Sukhareva, 1986</td>
<td>4 sided elongate diamond</td>
<td>8</td>
<td>35-48</td>
<td>12 ribs</td>
</tr>
<tr>
<td><em>A. compactus</em> Sukhareva, 1977</td>
<td>Nearly hexagonal</td>
<td>4-5</td>
<td>25-40</td>
<td>12 ribs</td>
</tr>
<tr>
<td><em>A. delhiensis</em> Channabasavanna, 1986</td>
<td>Triangular</td>
<td>7-8</td>
<td>14</td>
<td>10 ribs</td>
</tr>
<tr>
<td><em>A. doctus</em> Navia &amp; Flechtmann, 2011</td>
<td>Triangular</td>
<td>7</td>
<td>13-16</td>
<td>16-18 ribs + 2 basal transversal rows of microtubercles</td>
</tr>
<tr>
<td><em>A. Koli</em> Skoracka, 2009</td>
<td>Triangular, elongate</td>
<td>5</td>
<td>27-35</td>
<td>12-14 ribs + 2 basal transversal rows of microtubercles</td>
</tr>
<tr>
<td><em>A. longidolus</em> Skoracka, 2002</td>
<td>4 sided elongate diamond</td>
<td>5-7</td>
<td>30-46</td>
<td>10-12 ribs</td>
</tr>
<tr>
<td><em>A. neosacharo</em> Duarte &amp; Navia, 2019</td>
<td>Triangular</td>
<td>6-8</td>
<td>10-13</td>
<td>12-15 ribs + 2-3 basal granulated lines</td>
</tr>
<tr>
<td><em>A. phalos</em> Kuang, 1997</td>
<td>3 sided elongate Diamond</td>
<td>5</td>
<td>—</td>
<td>10-12 ribs</td>
</tr>
<tr>
<td><em>A. sacchari</em> Channabasavanna, 1986</td>
<td>5 sided, quadrangular with anterior narrowing</td>
<td>7-8</td>
<td>10</td>
<td>10-12 ribs + 2 basal transversal rows of microtubercles</td>
</tr>
<tr>
<td><em>A. spodiopogon</em> Sukhareva, 1985</td>
<td>4 sided elongate diamond</td>
<td>7-8</td>
<td>40-47</td>
<td>8-10 ribs</td>
</tr>
<tr>
<td><em>A. zoysiae</em> Flechtmann &amp; Tassi sp. nov.</td>
<td>5 sided diamond</td>
<td>3</td>
<td>5-7</td>
<td>10 ribs + 1 basal transv. line of coarse granules and 2 lines of small granules</td>
</tr>
</tbody>
</table>

38-45 or 5th from rear. Total dorsal annuli 45-51, total ventral annuli 43-49. Seta *h1* 3-4; seta *h2* 32-35. Genitalia 11-13, 14-17 wide; genital seta, 3a, 15-20, reaching to basis of ventral seta 1, d.


Type host plant: *Zoysia japonica* Steud., Poaceae, known as zoysiagrass and, in Brazil, “grama Esmeralda”.
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AUTHORS’ CONTRIBUTIONS

C.H.W.F. intercepted the specie, C.H.W.F. and A.D.T. concept the description, collected and interpreted the data. All authors discussed the results and contributed to the final manuscript.

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