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A NEW CASSAVA ERIOPHYID MITE FROM BRAZIL

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ABSTRACT – A new species of eriophyid mite in the genus *Procalacarus* Mohanasundaram, 1983 (Phyllocoptinae, Calacarini) is described from cassava, *Manihot esculenta* Crantz (Euphorbiaceae), collected in the semi-arid region of the North of Minas Gerais State. *Procalacarus giustolinii* **n. sp**. is the second eriophyoid mite species reported from cassava in the world and also the second species known in the genus *Procalacarus*. Mites are vagrant on upper leaf surfaces; large populations cause chlorosis, curling of leaves, light rusting and reduction of leaf limbs in basal regions of stems.
Key words – Acari, *Manihot esculenta*, Eriophyidae, *Procalacarus giustolinii*, Neotropical, Brazil, South America.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a euphorbiaceous plant native to South America, where it is commonly cultivated. Brazil is one of the largest producers in the world, along with Nigeria and Congo, representing almost 10% of the total production (CGIAR, 2004). Cassava can be considered one of the most socially important crops in Brazil, being cultivated by farmers with small and medium farms, and represents an important carbohydrate source for the population (Torres Filho, 2002).

Phytophagous mites have assumed importance in cassava crops around the world and in some regions are considered key pests, as for example the cassava green mite, *Mononychellus tanajoa* (Bondar) (Tetranychidae), in some regions of South America and Africa. In Africa, *M. tanajoa* was accidentally introduced; it was first reported in Uganda in 1972 (Lyon, 1973) and caused losses that reached 80% (Herren and Neuenschwander, 1991; Janssen and Yaninek, 1993). Extensive plant mite surveys were conducted on cassava in Brazil aimed at discovering natural enemies, especially predatory mites, which could be introduced to Africa for the control of the cassava green mite as part of a classic biological control program. However, no eriophyoid mite was found associated with cassava in Brazil by these surveys.

Only one mite from the Eriophyoidea has been reported associated with cassava around the world, *Calacarus guerreroi* Boczek and Davis, described in 1984 from Cali, Colombia, and reported only for this country. This eriophyid mite was collected from the upper surface of leaves, especially in the basal part of the plants (Boczek and Davis, 1984).

In this paper a new eriophyid mite of the genus *Procalacarus* Mohanasundaram (Eriophyidae, Phyllocoptinae, Calacarini) (Mohanasundaram, 1983) collected on cassava, from a semi-arid region in the north of the State of Minas Gerais, Brazil, is described, as well as the symptoms associated with infestations.

MATERIALS AND METHODS

Surveys were conducted in fruit and vegetable crops of a semi-arid region of the State of Minas Gerais, Brazil (municipalities of Janaúba, Nova Porteirinha and Brasília de Minas) from September 2006 to August 2007. Samples were checked through direct observation under a dissecting microscope. Eriophyoid mites associated with cassava were preserved in vials containing 70% alcohol. They were then mounted using modified Berlese medium (Amrine and Manson, 1996) and identified using a phase-contrast microscope at the Sector of Agricultural Zoology,

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ESALQ-USP, Piracicaba, SP. Generic concepts followed Amrine *et al*. (2003).

All the measurements were made in micrometers (μm) and unless stated otherwise, they refer to the length of the structure. Measurements of the female holotype precede the corresponding range for the paratypes. Drawings were taken through a camera lucida at × 1000 magnification. Some measurements could not be taken because of their body position when mounted. In the description, the opisthosomal annulus count begins from the rear margin of the genitalia and the dorsal opisthosomal annulus count begins from the mid-rear margin of the prodorsal shield. Leg length was measured from the basal part of the trochanter through the distal part of the tarsus, excluding the empodia.

RESULTS

Family ERIOPHYIDAE
Subfamily PHYLLOCOPTINAE
Tribe Calacarini
Procalacarus giustolinii Navia and Damasceno n. sp. (Figs. 1 and 2)

Diagnosis – A *Procalacarus* Mohanasundaram, 1983 with a four-rayed empodium; tibia I with a dorsal spine on the basal third; prodorsal shield ornamentation characteristic, dorsal tubercles conspicuous; on the prodorsal shield, wax deposition follows ornamentation lines and on the opisthosoma it follows the longitudinal ridges, as flakes; epigynum with short irregular longitudinal lines and granules on the basal area and longitudinal short lines on the distal area following the posterior margin.

Female (measurements of holotype and ranges of nine paratypes) – Body fusiform, 180 (170–215) long, 70 (60–86) wide, blackish when alive.

GNATHOSOMA – Projects downward, 30 (25–30), pedipalp coxal dorsal (basal) setae (*ep*) 3 (3–4), dorsal pedipalp genual (antapical) setae (*d*) 15 (13–16); chelicerae 28 (25–28); oral stylets 25 (20–25).

PRODORSAL SHIELD – 62 (55–65) long, 65 (57–80) wide; frontal lobe broad, rounded, 5 (3–5) long, 20 (20–22) wide; scapular setae (*sc*) absent, (*sc*) tubercles present, conspicuous. Shield design a network: median line absent; admedian lines curved on basal two-thirds, as though delimiting a bottle body, narrowing on the anterior third where they are joined by a transverse line; on the frontal lobe area two subrectangular cells are delimited; lateral and anterolateral area with four delimited cells; wax deposition following ornamentation lines.

LEGS – Without paraxial tibial I (*l′*) and antaxial genual II (*l″*) setae. Legs I 41 (37–43); femora 12 (11–13); basiventral femoral setae (*bv*) 15 (13–17); genua 5 (5–6); antaxial genual setae (*l″*) 33 (29–37); tibiae 13 (11–13), presenting a dorsal spine on the basal third associated with a transverse line; tarsi 7 (7–8); antaxial fastigial (lateral) setae (*ft″*) 25 (20–25); paraxial fastigial (dorsal) setae (*ft′*) 22 (19–25); paraxial unguinal setae (*u′*) 6 (5–6); solenidion (*ω*) 6 (6–7), slightly enlarged distally; empodium 5, four-rayed. Legs II 39 (38–40); femora 11 (10–14), basiventral femoral setae (*bv*) 13 (12–15); genua 6 (5–7); tibiae 11 (10–11); tarsi 7 (7–9); antaxial fastigial (lateral) setae (*ft″*) 21 (17–21); paraxial fastigial (dorsal) setae (*ft′*) 7 (5–7); paraxial unguinal setae (*u′*) 5; solenidion (*ω*) 6 (5–6), as in leg I; empodium 5 (5–6), four-rayed.

COXAE – With granules and slight curved lines: anterolateral seta on coxisternum I (*1b*) 15 (13–16) apart, 13 (10–14); proximal seta on coxisternum I (*1a*) 10 (9–13) apart, 20 (19–20); proximal seta on coxisternum II (*2a*) 32 (26–34) apart, 46 (40–47). Sternal line 7 (5–8). Coxigenital area with 5 (4–5) postcoxal annuli.

GENITALIA – Presenting short irregular longitudinal lines and granules on the basal area and longitudinal short lines on the distal area following the posterior margin; 20 (19–21), 30 (25–30) wide, proximal seta on coxisternum III (genital setae) (*3a*) 15 (12–15).

OPISTHOSOMA – With five dorsal longitudinal wax-bearing ridges; wax deposition like flakes irregularly distributed on and around the ridges; median ridge distinct to dorsad of bases of opisthosomal setae (*f*), submedian ridges distinct to dorsad intermediate between bases of opisthosomal setae (*e*) and (*f*); and lateral ridges distinct to dorsad intermediate between bases of opisthosomal setae (*d*) and (*e*). Opisthosomal setae (*c2*) 40 (35–40), on annulus 3 (2–3); opisthosomal setae (*d*) 61 (60–63), on annulus 17–18 (13–20), 31 (27–31) apart and 33 (25–33) microtubercles apart; opisthosomal setae (*e*) 42 (38–45), on annulus 41–42 (35–44), 14 (12–15) apart and 16 (12–17) microtubercles apart; opisthosomal setae (*f*) 27 (23–27), on annulus 61–62 (55–67), 21 (21–25) apart and 29 (21–29) microtubercles apart. Total dorsal annuli 56 (54–62). Total ventral annuli 68 (60–73). Microtubercles small, rounded, on the posterior margin of ventral annuli and lateral opisthosoma. opisthosomal setae (*h2*) 69 (65–70); opisthosomal setae (*h1*) absent.

Male (measurements of four paratypes) – Smaller than female, 170–187, 68–75 wide.

GNATHOSOMA – 28–29. Dorsal pedipalp genual (antapical) setae (*d*)14–15; pedipalp coxal dorsal (basal) 3; chelicerae 25–28; oral stylets 21–23.

PRODORSAL SHIELD – as in female, 53–65, 65–75 wide; frontal lobe 5, 18–20 wide.

LEGS – As in female. Leg I 35–40; femora 10–12; basiventral femoral setae (*bv*) 12–13; genua 5; antaxial genual setae (*l″*) 30; tibiae 10–13; tarsi 6–7; antaxial fastigial (lateral) setae (*ft″*) 20; paraxial

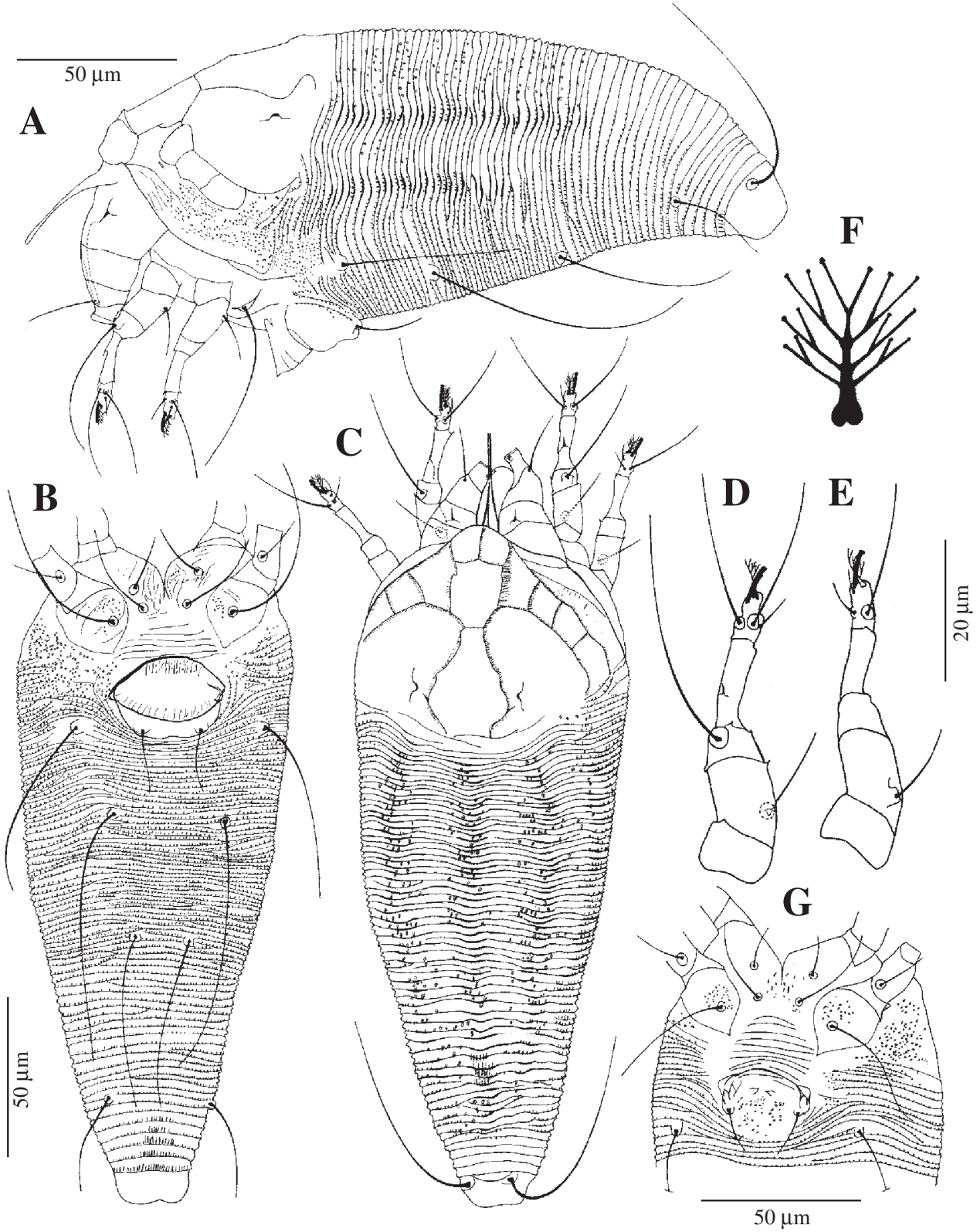

Fig. 1. *Procalacarus giustolinii* sp. nov. – A. lateral habitus of female; B. ventral habitus of female; C. dorsal habitus of female; D. leg I; E. leg II; .F. empodium (enlarged); and G. coxi-genital area of male.

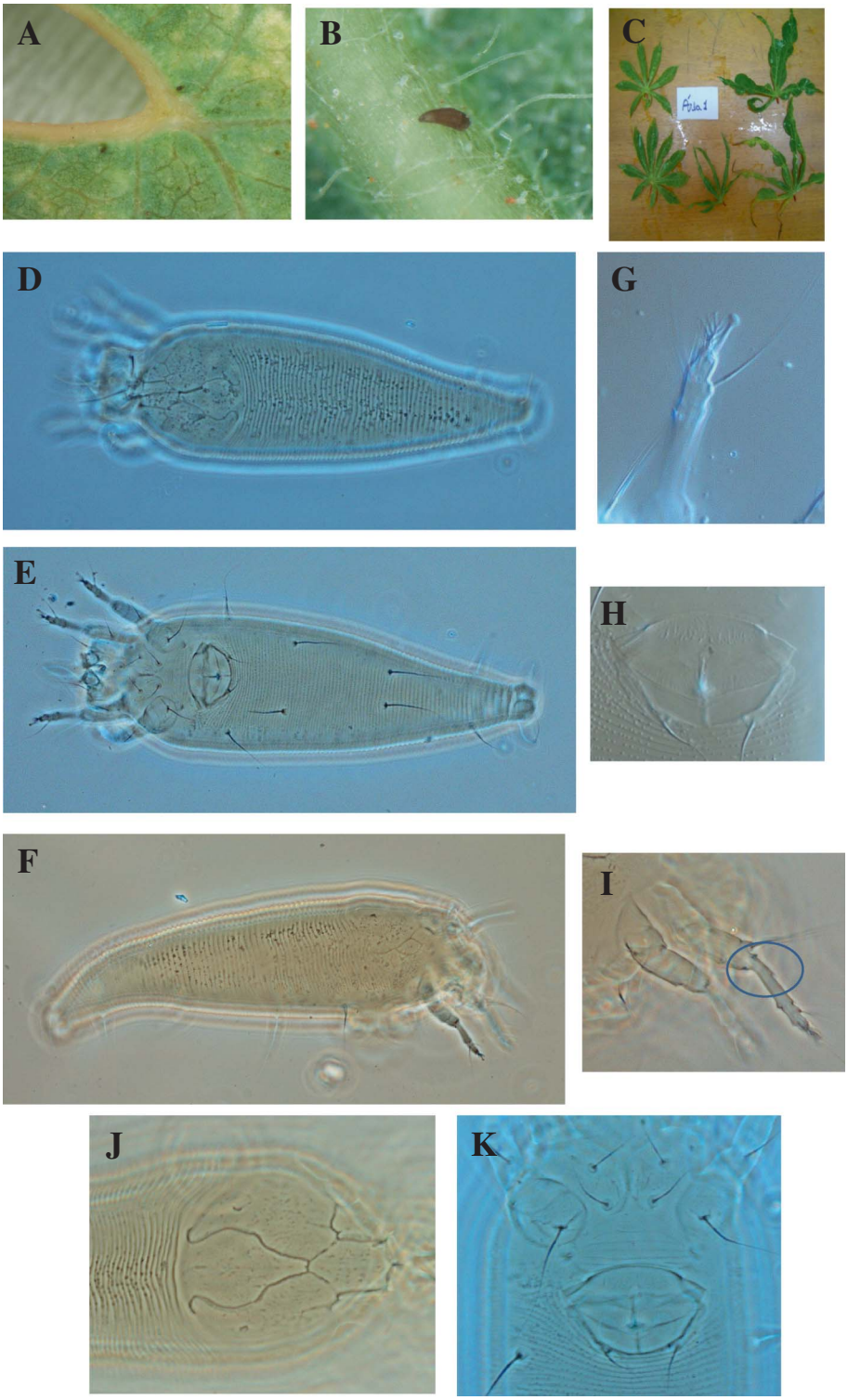

Fig. 2. *Procalacarus giustolinii* sp. nov. – A, B. Vagrants on the upper surface of cassava leaves; C. symptoms of infestation on cassava leaves; D–F. micrographs of dorsal, ventral and lateral habitus of female, respectively (phase contrast, × 40); G. detail of solenidion and empodium of leg I (DIC, × 100); H. epigynium (DIC, × 100); I. tíbia I with a dorsal spine in the 1/3 basal (phase contrast, × 100); J. prodorsal shield ornamentation and anterior opisthosoma (phase contrast, × 100); K. coxigenital region of female (phase contrast, × 100).

fastigial dorsal setae (*ft′*) 16–18; antaxial unguinal setae (*u′*) 6; solenidion (*ω*) 7; empodium 5, four-rayed. Legs II 33–35; femora 10, basiventral femoral setae (*bv*) 10–15; genua 5; tibiae 9–12; tarsi 6–7; antaxial fastigial (lateral) setae (*ft″*) 18–20; paraxal fastigial (dorsal) setae (*ft′*) 5–7; paraxial unguinal setae (*u′*) 5; solenidion (*ω*) 6–7; empodium 5, four-rayed.

COXAE – With granules: proximal seta on coxisternum I (*1b*) 13–14 apart, 10–11; anterolateral seta on coxisternum I (*1a*) 10 apart, 18–21; anterolateral seta on coxisternum II(*2a*) 28–32 apart, 37–45. Sternal line 5–7. Coxigenital area with 5 postcoxal annuli.

GENITALIA – 19–20, 25–27 wide, with granules, eugenital setae conspicuous, anterolateral seta on coxisternum III (*3a*) 11–15.

OPISTHOSOMA – As in female, opisthosomal setae (*c2*) 33–40, on annulus 2–3; opisthosomal setae (*d*) 60–62, on annulus 11–17, 25–30 apart and 23–27 microtubercles apart; opisthosomal setae (*e*) 36–40, on annulus 33–37, 13–15 apart and 12–16 microtubercles apart; opisthosomal setae (*f*) 20–28, on annulus 53–59, 22–26 apart and 22–26 microtubercles apart. Total dorsal annuli 50–59. Total ventral annuli 59–65. Opisthosomal setae (*h2*) 68–70; opisthosomal setae (*h1*) absent.

REMARKS – The new species *P. giustolinii* Navia and Damasceno sp. nov. is distinct from *Procalacarus aliyarensis* Mohanasundaram, 1983 in the prodorsal shield ornamentation, being more elaborate in *P. aliyarensis*; the conspicuous scapular tubercle, being inconspicuous in *P. aliyarensis*; a four-rayed empodium, being five-rayed in *P. aliyarensis*; epigynum ornamentation restricted to the central basal area, but occupying the whole basal area in *P. aliyarensis*; tíbia I with a dorsal spine in the basal one-third, absent in *P. aliyarensis*.

Type material – Female holotype, nine female and four male paratypes, from *Manihot esculenta* Crantz (Euphorbiaceae), 'Jacarezinho', Janaúba, Minas Gerais, Brazil (22°43′0.6″ S, 43°19′0.28″ W), May and July 2007, collected by Maria Rosilene Alves Damasceno and Alan Ronei Leite; deposited as 13 microscopic preparations in the Mite Reference Collection, Laboratório de Quarentena Vegetal, Embrapa Recursos Genéticos e Biotecnologia, Brasília, DF, Brazil.

Relation to host – Mites are vagrants on the upper surfaces of leaves. Plants infested by large populations show chlorosis, curling of leaves, light rusting and reduction of leaf limbs. It is usual to find the cassava green mite in the areas infested by *P. giustolinii* n. sp. However, the main damage caused by *M. tanajoa* is in the apical region of the plant, appearing as a shortening of internodes (Moraes and Flechtmann 2008), whereas *P. giustolinii* n. sp. damage is found in the basal leaves of the plants.

Etymology – We take pleasure in naming this species after Teresinha Giustolini, Entomologist at Universidade Estadual de Montes Claros, Janaúba, Minas Gerais, Brazil, for her most valuable effort in coordinating a mite survey in the semi-arid region of Minas Gerais State, an unexplored area in relation to acarological studies.

DISCUSSION

This paper provides the description of a second species of *Procalacarus*, which was previously a monospecific genus (Amrine and de Lillo 2003). Amrine *et al*. (2003) mentioned that the main characters to distinguish *Procalacarus* Mohanasundaram from *Calacarus* Keifer were the paraxial tibial setae of leg I (*l′*) – absent in *Procalacarus* and present in *Calacarus*; and the basiventral femoral setae (*bv*) on legs I and II – present in *Procalacarus* and absent in *Calacarus*.

Calacarus guerreroi had been collected in Colombia from the upper surface of cassava leaves, especially from the basal leaves; leaves infested by this species presented upward curling and gradual shrinkage (Boczek and Davis 1984). Symptoms associated with *P. giustolinii* n. sp. seem to be similar to those described as being caused by *C. guerreroi* infestation. It will be important to evaluate whether infestations by *P. giustolinii* n. sp. have any impact on the production of cassava plants.

Quarantine measures should be applied to avoid the dissemination of *P. giustolinii* n. sp. from the area where it occurs in Brazil through cassava propagation material, by either domestic or international exchange.

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