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Tuthillia myrcianthis n. sp. (Hemiptera, Psylloidea): a new psyllid species on Guabiju (*Myrcianthes pungens*, Myrtaceae) from Brazil

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Tuthillia myrcianthis n. sp. is described, diagnosed and illustrated from Brazil (Rio Grande do Sul) and Argentina (Misiones). Its larvae induce blister galls on the leaves of Guabiju (*Myrcianthes pungens*, Myrtaceae). A single specimen from Argentina (Jujuy) probably also belongs to this species. The phylogenetic position of the Neotropical genus *Tuthillia* within the Euphyllurinae is confirmed. *T. myrcianthis* is, as far as known, monophagous on *M. pungens* with a polyvoltine life cycle. Some biological features of *T. myrcianthis* are compared to those of *T. cognata*.

Keywords: Euphyllurinae, galls, systematics, phylogeny, biology, host plant damage, Neotropis.

INTRODUCTION

Psyllids are phloem feeding sap-suckers. Many species develop on a single or a few related host plants, and closely related psyllids tend to occur on closely related hosts. In the tropics and south temperate regions, where psyllid diversity is highest, hosts are generally woody dicotyledons. White & Hodkinson (1985) suggested that modern psyllids evolved from an ancestor associated with Rutales (= Sapindales) in Gondwana. Today, apart from Sapindales, also Malvales, Fabaceae, Myrtaceae and some other plant taxa host many psyllid species. Myrtaceae have been colonised by psyllids apparently several times independently: the Spondyliaspidinae in the Australian Region, some genera of Diaphorinini in the Neotropical Region and several lineages of Triozidae throughout the tropics and Southern hemisphere.

Myrtaceae is a large family consisting of 131 genera and 4620 species (Stevens 2001), many of which are used by man. Of major economic importance are the Australian eucalypts providing source for fuel, paper pulp, timber, etc. In suitable habitats they are planted worldwide. Myrtaceae also provide a range of much appreciated fruits such as the Common Guava (*Psidium guajava*) or Malay Apple (*Syzygium malaccense*). Many species, though less known and more restricted, are locally important.

Myrcianthes contains about 30 tree species in the American tropics (Mabberley 2008). Guabiju (*Myrcianthes pungens*), an evergreen, semideciduous small tree, is common in southern Brazil occurring naturally from São Paulo to Rio Grande do Sul (Lorenzi 2008) as well as in Argentina, Bolivia, Paraguay and Uruguay (Rotman 2008, Bolivia Checklist 2012). In Brazil it is planted in orchards and streets for its tasty fruits appreciated by humans and native animals. Recently, conspicuous leaf deformations were detected on *M. pungens* trees in Passo Fundo, Rio Grande do Sul, Brazil, induced by an undescribed species of the jumping plant-louse genus *Tuthillia*.

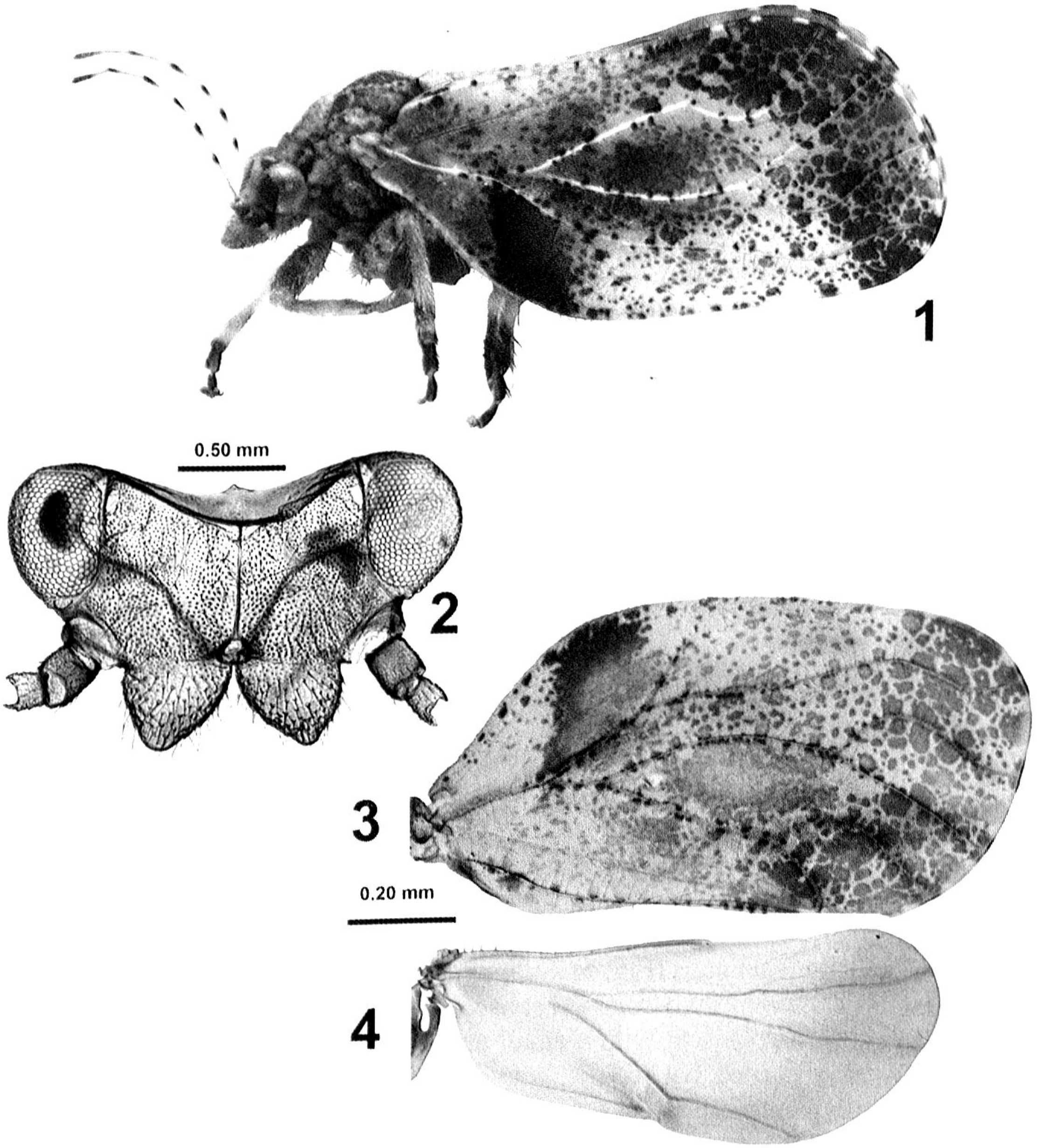
Tuthillia was described from adults of four Central and South American species (Hodkinson *et al.* 1986). At the time, apart from *T. latipennis* of which specimens had been collected from an unidentified Myrtaceae species bearing conspicuous but unoccupied roll leaf galls, no information on hosts was available. Mostly for the strongly arched vein M_{1+2} in the forewing Hodkinson *et al.* (1986) assigned *Tuthillia* to the Ciriacreminae. Burckhardt & Couturier (1988) described the larva of *T. cognata*, found in leaf roll galls on *Myrciaria dubia* (Myrtaceae) in Loreto (Peru) as well as Manaus (Amazonas, Brazil) from where the species was originally described. Based on the larval morphology they discussed the phylogenetic relationships of *Tuthillia* and transferred it to the Anomoneurinae. Barbosa *et al.* (2004) considered *T. cognata* a key pest in plantations of camu-camu (*M. dubia*) in Manaus, and Pérez & Iannacone (2009) reported the psyllid from Ucayali (Peru). These authors added valuable information on the biology of this species. In a preliminary list of Psylloidea known from Costa Rican cloud forests, Hollis (2000) reported *Tuthillia latipennis* from *Myrcianthes fragrans* as well as *Tuthillia* sp. without host information. He listed the two psyllid species under the Diaphorininae.

Here we describe the new *Tuthillia* species from *Myrcianthes pungens*, provide information on its biology and discuss the phylogenetic relationships of *Tuthillia*.

MATERIAL AND METHODS

Larval and emerging adult psyllids, which were taken from apical branches of *Myrcianthes pungens* placed into plastic bags, were preserved in 70 % ethanol. Some adult specimens were subsequently mounted dry on card points, and some adults and larvae were cleared in KOH and mounted in Canada balsam as permanent slide preparations. Material examined or mentioned here is deposited in the Entomology Laboratory of Embrapa Florestas, Colombo, PR, Brazil (ELEF); Museu de Zoologia, Universidade de São Paulo, SP, Brazil (MZSP); Muséum d'histoire naturelle, Genève, Switzerland (MHNG); Natural History Museum, London, United Kingdom (BMNH); Naturhistorisches Museum, Basel, Switzerland (NHMB). Morphological terminology follows mostly Ossiannilsson (1992) and Yang *et al.* (2009).

The degree of infestation was estimated on a single tree planted for its fruits in an orchard in the city centre of Passo Fundo. From each quadrant of the tree (North, East, South, West) the following parameters were counted. The number of infested shoots was counted on 10 randomly chosen branches of about 35 cm length, the number of infested leaves on 20 infested shoots, the number of larvae on 15 and that of eggs on 10 infested leaves, respectively. In total counts were made on 40 branches, 80 shoots and 100 leaves (60 for the larvae and 40 for the eggs).



Figs 1–4. *Tuthillia myrcianthis*, adult. 1, Habitus, in profile; 2, head, in dorsal view; 3, forewing; 4, hindwing.

TAXONOMY

Tuthillia myrcianthis n. sp.

(Figs 1–21)

Material examined. Holotype ♂: Brazil, Rio Grande do Sul, Passo Fundo, City centre, near Rua Teixeira Soares 175, S 28° 15' 20.4" W 52° 25' 01.3", 683 m, 6 February 2012, *Myrcianthes pungens* (A. L. Marsaro Júnior) (MZSP, dry mounted). Paratypes: 101 ♂♂, 126 ♀♀, 580 larvae, same data as holotype (18 ♂♂, 17 ♀♀ dry mounted; 9 ♂♂, 7 ♀♀, 18 larvae slide mounted; 74 ♂♂, 102 ♀♀, 562 larvae preserved in 70 % ethanol); 1 ♂, 2 ♀♀, 9 larvae, same as holotype but Passo Fundo, Zoológico da Universidade de Passo Fundo, S 28° 13' 56.1" W 52° 22' 40.2", 635 m, 8 October 2011, *Myrcianthes pungens* (preserved in 70 % ethanol). (BMNH, ELEF, MHNG, MZSP, NHMB). Argentina: 1♂, Misiones Province, El Dorado, 5.x.1967 (A. Kovacs) (MHNG).

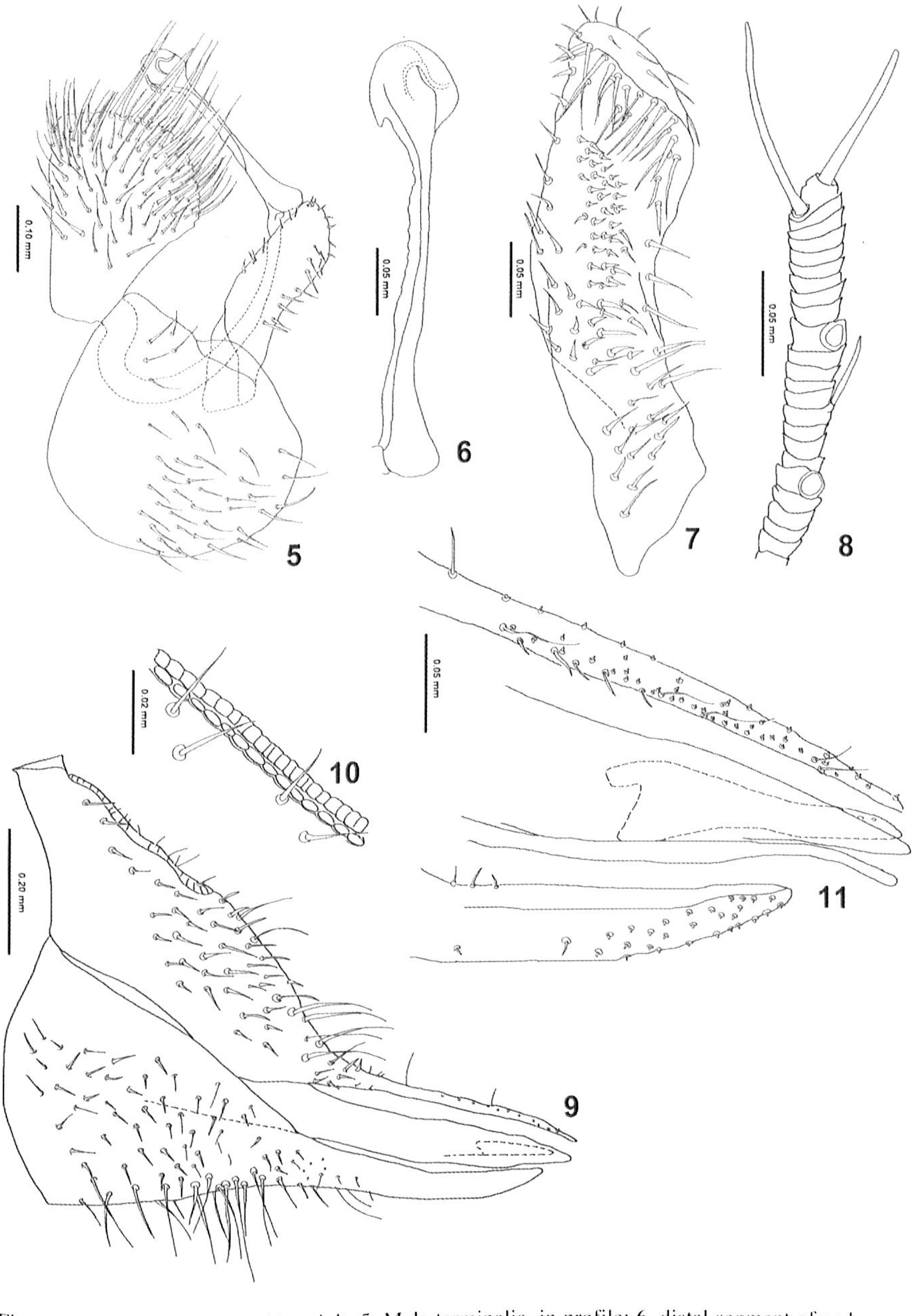
Material not included in type series. Brazil: many larval skins, same data as holotype (NHMB). Argentina: 1♀, Jujuy Province, Abra Pampa, 3500 m, 22–25.xii.1987, sandy puna grassland, carrion trap (S. & J. Peck) (MHNG).

Etymology. The species is named after its host plant *Myrcianthes pungens*.

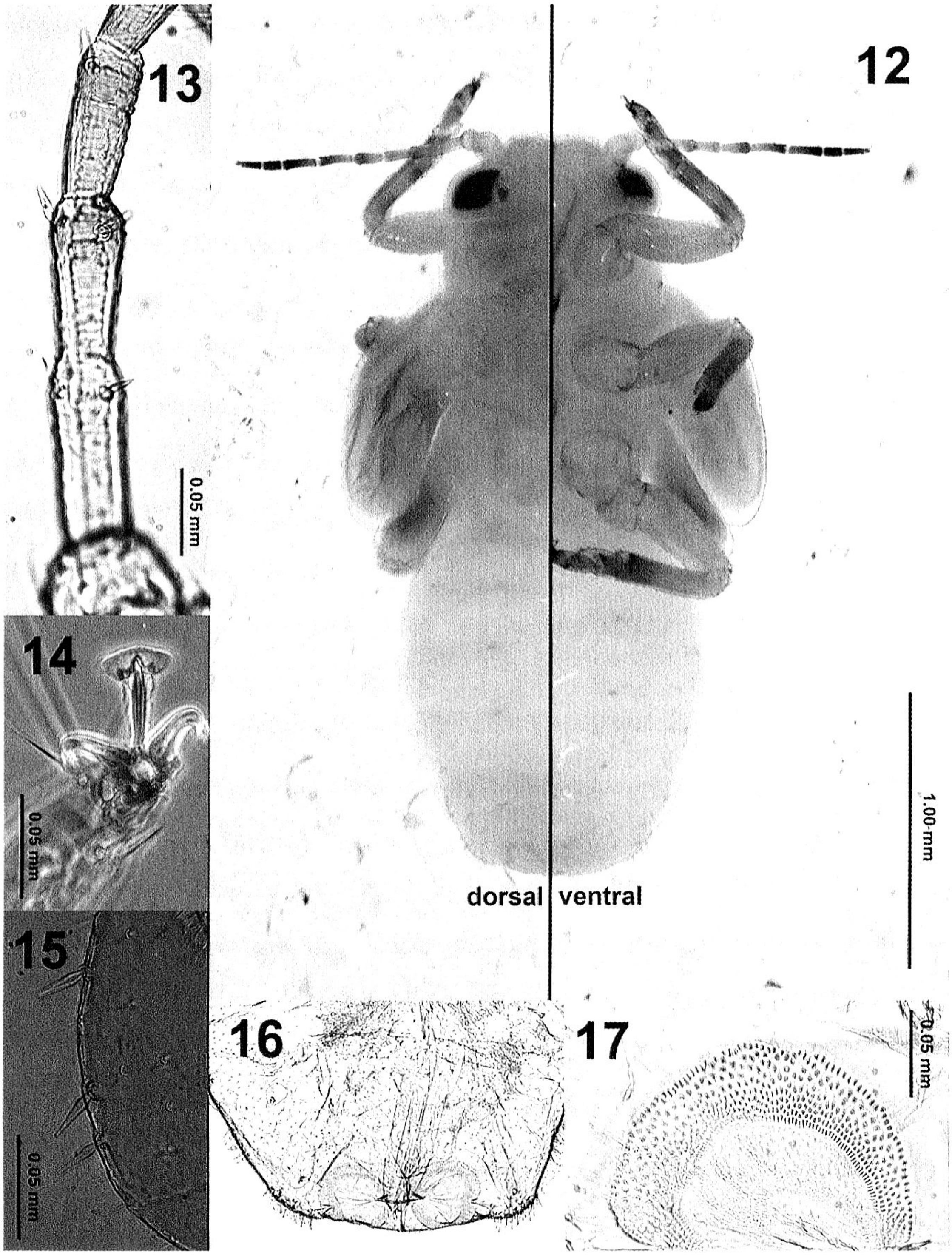
Description. Adult (Fig. 1): Coloration: General body colour whitish yellow with ochreous, dark brown and almost black pattern. Antenna yellow with apices of segments 4–8 almost black, segments 1, 2 brown, and 9, 10 black. Legs yellow, apices of femora brown, apices of tibiae and tarsi black. Metatibia dark brown to black with yellow subapical band. Forewing pattern consisting of brown to dark brown dots as in Figs 1, 3, dots darker and denser along apical wing margin forming a transverse band; apical two thirds of cell c+sc almost black getting lighter towards apex; dark pigmentation quite variable, possibly depending on the age, in some specimens forewing almost completely dark. Hindwing whitish with brown veins (Fig. 4).

Structure: Head (Fig. 2) with subacute genal processes and weakly concave hind-margin; vertex almost rectangular; anteoccipital sclerite small, flattened, not forming tubercle; antennal socket prominent. Longer terminal seta of antenna slightly longer than segment 10, shorter seta about as long as segment 10 (Fig. 8). Forewing (Fig. 3) broad, truncate apically; vein C+Sc strongly bent in apical third, cell c+sc therefore wide; pterostigma wide at base, ending at about apical third of vein Rs; vein Rs strongly sinuous, apex directed towards wing fore margin; surface spinules present in all cells, densely and irregularly spaced, restricted to pigmented areas. Hindwing (Fig. 4) with costal setae not grouped. Metatibia bearing small knee spines. Terminalia as in Figs 5–7, 9–11. Male proctiger broadly rounded posteriorly, with large and elongate anus (Fig. 5). Subgenital plate short, subglobular. Proximal segment of aedeagus narrowly rounded at base, distal segment widened at base, dilated apically, almost spherical with a small apical hook (Fig. 6). Paramere (Fig. 7) lamellar, weakly curved backwards, rounded apically; inner surface covered in thick, moderately long yellowish setae. Female terminalia styliform (Fig. 9); dorsal margin of proctiger strongly concave; circumanal ring (Fig. 10) oval consisting of 2 unequal rows of pores. Valvula dorsalis cuneiform, valvula ventralis very weakly curved, valvula lateralis narrow, elongate and subacute apically (Fig. 11).

Measurements in mm and ratios (9 ♂♂, 7 ♀♀), range (mean±standard deviation): Head width (HW) 0.78–0.91 (0.85±0.03); antenna length (AL) 1.34–1.50 (1.40±0.04); forewing length (WL) 2.66–3.09 (2.86±0.16); male proctiger length (MP) 0.25–0.31 (0.28±0.02); paramere length (PL) 0.34–0.38 (0.35±0.01); length of distal aedeagus segment (AEL) 0.28–0.34 (0.32±0.02); female proctiger length (FP) 1.00–1.06 (1.05±0.02); relative length of antennal flagellar segments 1.0, 0.6, 0.7, 0.7, 0.9, 0.6, 0.2, 0.3. — Genae/vertex length 0.67–1.20 (0.87±0.12); AL/HW 1.46–1.78 (1.66±0.09); metatibia length/HW 0.76–0.89 (0.85±0.04); WL/HW 3.04–3.67 (3.37±0.17); WL/forewing width 1.73–2.02 (1.91±0.07); cell cu_1 width/height 2.81–3.36 (2.98±0.14); MP/HW 0.30–0.37 (0.34±0.02); FP/HW 1.14–1.26 (1.20±0.05); FP/circumanal pore ring length 1.18–1.55 (1.34±0.12); female subgenital plate length/FP 0.65–0.85 (0.75±0.07).



Figs 5–11. *Tuthillia myrcianthis*, adult. 5, Male terminalia, in profile; 6, distal segment of aedeagus; 7, paramere, in profile, inner face; 8, apical two antennal segments; 9, female terminalia, in profile; 10, detail of circumanal ring on female proctiger; 11, detail of apex of female terminalia with valvulae.



Figs 12–17. Last instar larva of *Tuthillia myrcianthis*. 12, Body, left dorsal, right, ventral view; 13, antennal segments 3–5; 14, apex of tarsus with tarsal arolium; 15, detail of forewing bud outer margin; 16, caudal plate; 17, detail of circumanal ring.

Egg (Fig. 20): Coloration: Yellowish. Structure: Narrowly elliptical, slightly asymmetrical, apex narrowly rounded with a small point, pedicel 0.04 mm long. Length (n = 50) 0.21–0.26 mm (0.23±0.01 mm), width 0.10–0.13 mm (0.11±0.01 mm).

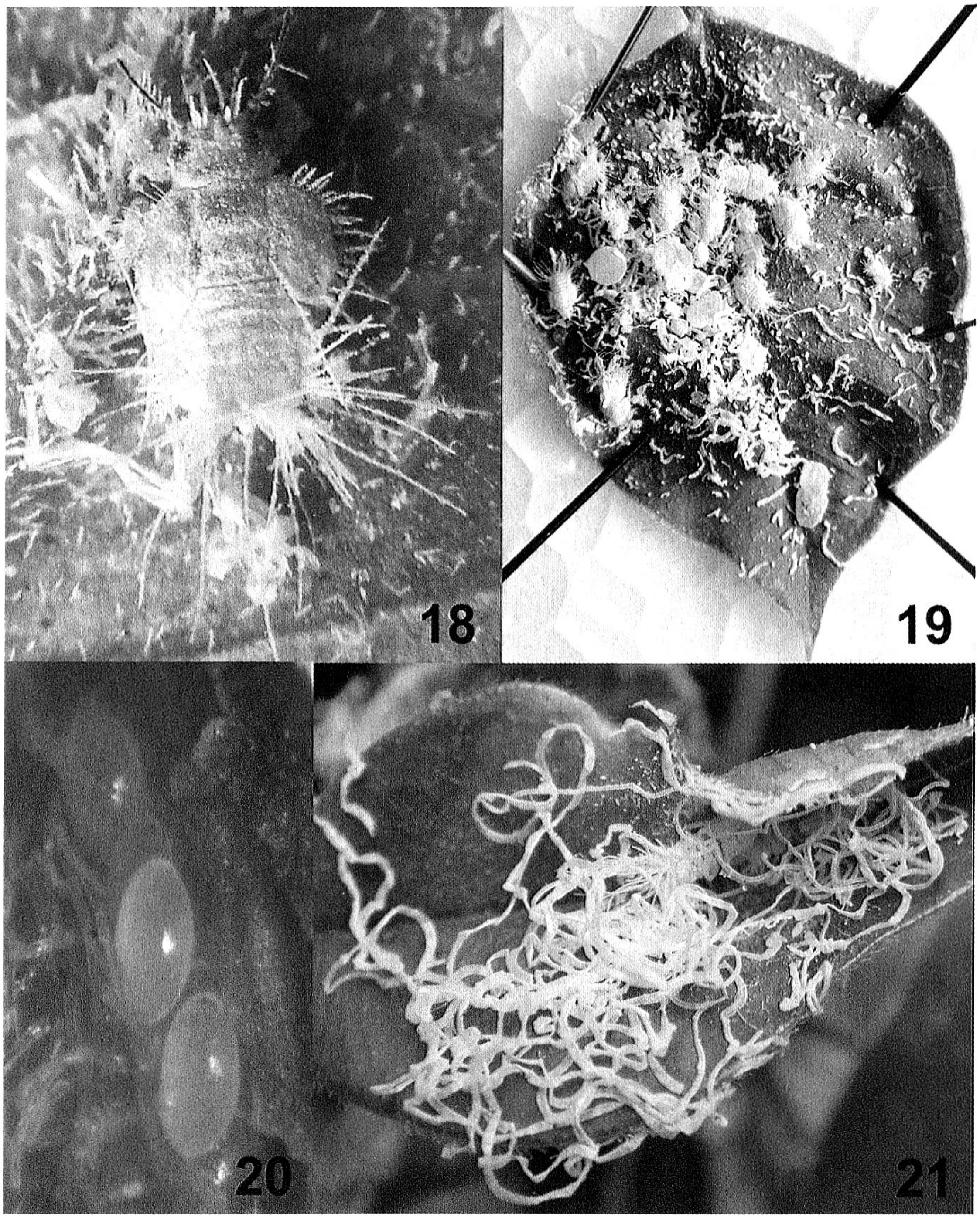
Fifth larval instar (Figs 12–18): Coloration: Whitish or yellowish, weakly sclerotised. Wing buds and caudal plate yellow. Apices of antennal segments 3–8 and entire segments 9 and 10 dark brown; tarsi yellow to light brown. Structure: Body elongate, slender, weakly flattened. Dorsal surface covered with sparse long slender simple setae and densely spaced minute, slender, subacute setae which look like lanceolate setae or sectasetae, depending on magnification and contrast. Capitate setae absent. Antenna 10-segmented, with a pair of subapical lanceolate/sectasetae (Fig. 13) on segments 3, 4 and 6, and a single lanceolate/sectaseta on segment 5; a single rhinarium on each of segments 4, 6, 8 and 9. Fore margin of head on either half bearing a group of 4–6 large lanceolate/sectasetae. One large lanceolate/sectaseta behind eye. Clypeus with a pair of long simple setae. Forewing bud lacking humeral lobe. Wing buds with larger and smaller, sparse marginal subacute lanceolate/sectasetae (Fig. 15); dorsally with small sparsely spaced lanceolate/sectasetae. Abdominal segments dorsally covered in small lanceolate/sectasetae, laterally bearing a few large lanceolate/sectasetae. Caudal plate (Fig. 16) weakly sclerotised, angular with a large group of large lanceolate/sectasetae at its fore and hind edge. Anus terminal; circumanal ring (Fig. 17) broad, forming an indistinctly 8-shaped ring on either side of anus, consisting of about 10 rows of pores. Tarsal arolium (Fig. 14) triangular, petiolate, distinctly longer than claws which are fully developed; unguitractor developed.

Measurements in mm and ratios (10 larvae), range (mean±standard deviation): Body length (BL) 2.20–2.92 (2.52±0.22); antenna length (AL) 1.40–1.76 (1.55±0.10); BW/BL 0.53–0.75 (0.62±0.06); AB/BL 0.38–0.51 (0.44±0.04); AL/FWL 0.96–1.14 (1.05±0.06); CPB/CPL 1.55–2.75 (1.96±0.33).

BIOLOGY

Observations on the biology of *Tuthillia myrcianthis* were made in two sites in Passo Fundo. The first one is located in a zoological garden where ten trees of *Myrcianthes pungens* were investigated. The trees were apparently planted in this location as they stood in a straight line mixed with other tree species. The second site is situated in the city centre. There, a single guabiju tree planted in a small orchard was studied.

Eggs laid in a small batch were observed on the adaxial surface of a petiole near the leaf blade. Groups of eggs were also found in leaf roll galls probably induced by other insects or mites, curling in the abaxial leaf surface (Figs 26, 27). The larvae feed on the adaxial leaf surface inducing irregular blister galls (Figs 23–25) on the fresh leaves. Most galls contain one colony of about a dozen larvae of similar age (Figs 19, 21) suggesting that they originate from a single egg batch. The larvae produce large amounts of flocculent wax that accumulates in the gall along with honeydew. As the mature blister galls are always partly open, numerous long wax threads can be observed covering the infested shoots (Figs 23–25). Old empty galls may persist on the plant for a long time. In October adults and larvae were observed on all ten trees in the zoological garden. On the single tree in the city centre all



Figs 18–21. Larvae and eggs of *Tuthillia myrcianthis*. 18, Larva with powder-like wax cover, wax threads and honeydew droplets; 19, opened blister gall; 20, eggs; 21, wax threads covering leaf.

stages were ascertained from February to May. These observations accord with a polyvoltine life cycle with overlapping generations.

In the first site, all ten trees were infested by *T. myrcianthis* in low levels. On the single tree in the second site, the infestation was much higher. On this tree the following counts were made: infested shoots 31–67 (51±9.3 %); infested leaves 17–100 (40±19 %); eggs/leaf 5–15 (8.3±2.5); larvae/leaf 3–14 (5.5±2.8). In both sites fresh and old galls were observed.

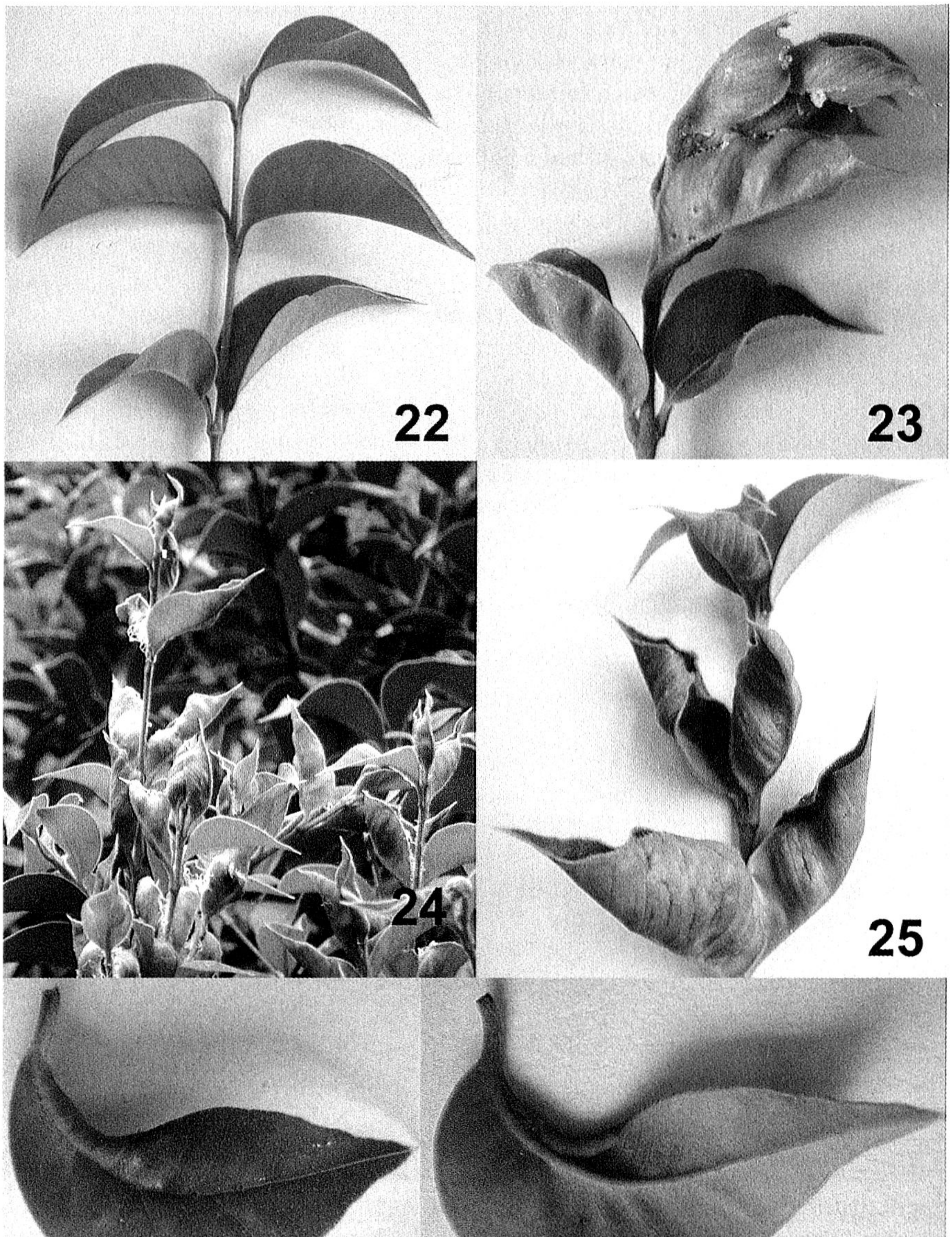
DISCUSSION AND CONCLUSION

Based on adult characters, Hodkinson *et al.* (1986) suggested an immediate phylogenetic relationship of *Tuthillia* to ciriacremine genera close to *Ciriacremum*. Burckhardt & Couturier (1988) challenged this view and listed some larval and adult characters shared by *Epipsylla* and *Tuthillia* which they thought of phylogenetic significance. They transferred, therefore, the latter to the Anomoneurinae sensu White & Hodkinson (1985). Hodkinson (1989) and Hollis (2000) listed *Tuthillia* in the Diaphorininae, and Burckhardt & Ouvrard (2012) synonymised the Euphyllurinae and Diaphorininae within the Liviidae. We agree with these authors that *Tuthillia* is an Euphyllurinae based on the presence of multiple lanceolate/sectasetae and the large, petiolate tarsal arolium in larvae as well as the open crown of sclerotised apical metatibial spurs in adults. This last character is also present in *Episylla* but not in *Anomoneura*. We therefore suggest that *Tuthillia* and *Episylla* belong to Euphyllurinae and *Anomoneura* to Psyllinae, respectively. Hosts of three of the five known *Tuthillia* species are Myrtaceae (*Myrcianthes* and *Myrciaria* spp.) suggesting a closer phylogenetic relationship of *Tuthillia* to the two Neotropical genera, *Katacephala* and *Notophorina*, which are entirely or partly associated with Myrtaceae (Hodkinson 1991; unpublished data in MHNG, NHMB).

Adult *T. myrcianthis* correspond to the generic description by Hodkinson *et al.* (1986) with one exception. Unlike the other congeners, *T. myrcianthis* bears a small knee spine on the metatibia. In their key it runs to *T. latipennis* with which it shares the broad forewing, the subglobular male subgenital plate and the styliform female terminalia. It differs from the latter in the more pointed genal processes, the distinctly extended antennal sockets, in two rather than 3 (as in *T. latipennis*) transverse dark ribbons on the forewing, the more strongely curved forewing vein C+Sc, the more sinuous and apically forward directed vein Rs, the posteriorly more rounded male proctiger, the wider and more curved paramere with yellow rather than black inner setae, the basally expanded distal portion of the aedeagus with a smaller apical hook, and the dorsally more concave female proctiger.

The last instar larva of *T. myrcianthis* resembles that of *T. cognata* which was described by Burckhardt & Couturier (1988) from Peru and Brazil associated with the myrtaceous *Myrciaria dubia*. In particular it shares the long elongate, weakly sclerotised body, lacking humeral lobes, the terminal anus and the multicellular circumanal ring, the pair of long hairs on the clypeus, the presence of lanceolate/sectasetae on the body and the lack of capitate setae. It differs from the latter, in addition to the host association, in the 10 rather than 3-segmented antenna, the presence of lanceolate/sectasetae on the antenna, the more angular caudal plate and the different distribution of the lanceolate/sectasetae on the head and abdomen.

T. myrcianthis occurs in southern Brazil (Rio Grande do Sul) and northern Argentina (Misiones), as well as possibly northwestern Argentina (Jujuy). The single ♀ from Jujuy resembles the types from Rio Grande do Sul and Misiones but without males it is not possible to decide whether they are conspecific. The occurrence of *T. myrcianthis* in northwestern Argentina would be consistent with the geographical distribution of its host plant. *T. myrcianthis* is probably monophagous on *Myrcianthes pungens* and T. *latipennis* has been reported from Panama and Costa Rica on *M. fragrans* (Brown & Hodkinson 1988, Hollis 2000).



Figs 22–27. *Myrcianthes pungens*. 22, Uninfested shoot; 23–25, blister galls induced by *Tuthillia myrcianthis*; 26, undetermined leaf roll gall, adaxial side, with egg batch of *Tuthillia myrcianthis*; 27, same but abaxial side.

The only biological studies available for *Tuthillia* concern *T. cognata*, a pest on *Myrciaria dubia* forming conspicuous leaf galls (Burckhardt & Couturier 1988, Barbosa *et al.* 2004). *T. cognata* and *T. myrcianthis* share a polyvoltine life cycle. *T. cognata* is controlled by lacewings, reduviids and syrphids (Barbosa *et al.* 2004, Pérez & Iannacone 2009). Syrphid larvae were also found among larvae of *T. myrcianthis*. Barbosa *et al.* (2004) observed egg batches of *T. cognata* on the open abaxial leaf surface of *M. dubia* as well as on the abaxial surface inside galls of a cecidomyid. They suggested that female *T. cognata* may exploit the microclimate of the cecidomyid galls for protecting their eggs. *T. myrcianthis* may have a similar behaviour laying the eggs in galls induced by other insects or mites.

T. myrcianthis affects the development of leaves and young shoots of *M. pungens* which may influence fruit production. A similar damage has been reported from *T. cognata*, an important pest of *M. dubia* (Burckhardt & Couturier 1988, Barbosa *et al.* 2004). Further studies on *T. myrcianthis* should be conducted to confirm its voltinism, to elucidate the ovipositional strategy and to quantify the impact on fruit production.

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