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Diclidophlebia smithi sp. n., a new species of jumping plant-louse (Hemiptera, Psylloidea) from Brazil associated with *Miconia calvescens* (Melastomataceae)

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Adults and larvae of *Diclidophlebia smithi* sp. n. are described, diagnosed and illustrated. The species occurs in Brazil (Minas Gerais, Rio de Janeiro). It is monophagous on *Miconia calvescens*, an obnoxious weed on Pacific Islands, constituting a potential control agent of the latter. Information is provided on the life history of *D. smithi*.

Keywords: Psylloidea, *Diclidophlebia*, taxonomy, new species, biological control, *Miconia calvescens*.

INTRODUCTION

Psyllids or jumping plant-lice are generally very host specific plant-sap sucking insects. They can be harmful to their angiosperm hosts in removing large quantities of plant-sap, in producing honey dew and thus soiling leaves and fruits or attracting slime molds, or by transmitting diseases (Burckhardt 1994). For this reason psyllids have been used for biological control of invasive weeds. Examples include *Heteropsylla spinulosa* Muddiman *et al.*, 1992 in Australia and New Guinea for the control of *Mimosa diplotricha* C.W. Wright ex Sauvalle (= *invisa* Martius) (Muddiman *et al.* 1992; Swarbrick 1997), *Prosopidopsylla flava* Burckhardt in Australia for the control of mesquite (*Prosopis* spp.) (Van Klinken 2000) and *Boreioglycaspis melaleucae* Moore in Florida for the control of *Melaleuca quinquenervia* (Cav.) S. T. Blake (Wineriter *et al.* 2003). Recently Burckhardt *et al.* (2005) described *Diclidophlebia lucens*, which was considered for the biological control of *Miconia calvescens* Schrank and Mart ex DC. (Melastomataceae), an invasive weed in Tahiti and Hawaii (Meyer 1996, 1998; Meyer & Florence 1996; Medeiros *et al.* 1997). Here we describe *Diclidophlebia smithi* from Brazil, a species that is also associated with *M. calvescens* and which constitutes a potential control agent.

MATERIAL AND METHODS

Material is conserved dry and slide mounted as well as in 70 % alcohol; it is deposited in the Naturhistorisches Museum Basel (NHMB). Morphological terminology follows mostly Ossiannilsson (1992). Drawings and microphotographs are made from slide mounted specimens. Measurements were taken from slide mounted specimens (adults) or specimens preserved in alcohol (eggs and larvae).

TAXONOMY

***Diclidophlebia smithi* n. sp.** (Figs 1, 2, 5, 7, 9–26)

Material examined. Holotype ♂: Brazil, Minas Gerais, Viçosa, 20° 45' 48'' S, 42° 52' 18'' W, 3.viii.2004, *Miconia calvescens* (E. G. F. Morais) (NHMB, dry mounted). Paratypes: 5 ♂♂, 6 ♀♀, 8 larvae, same data as holotype (NHMB, 4 ♂♂, 5 ♀♀, dry mounted, 1 ♂, 1 ♀, 4 larvae slide mounted, 4 larvae conserved in 70 % ethanol).

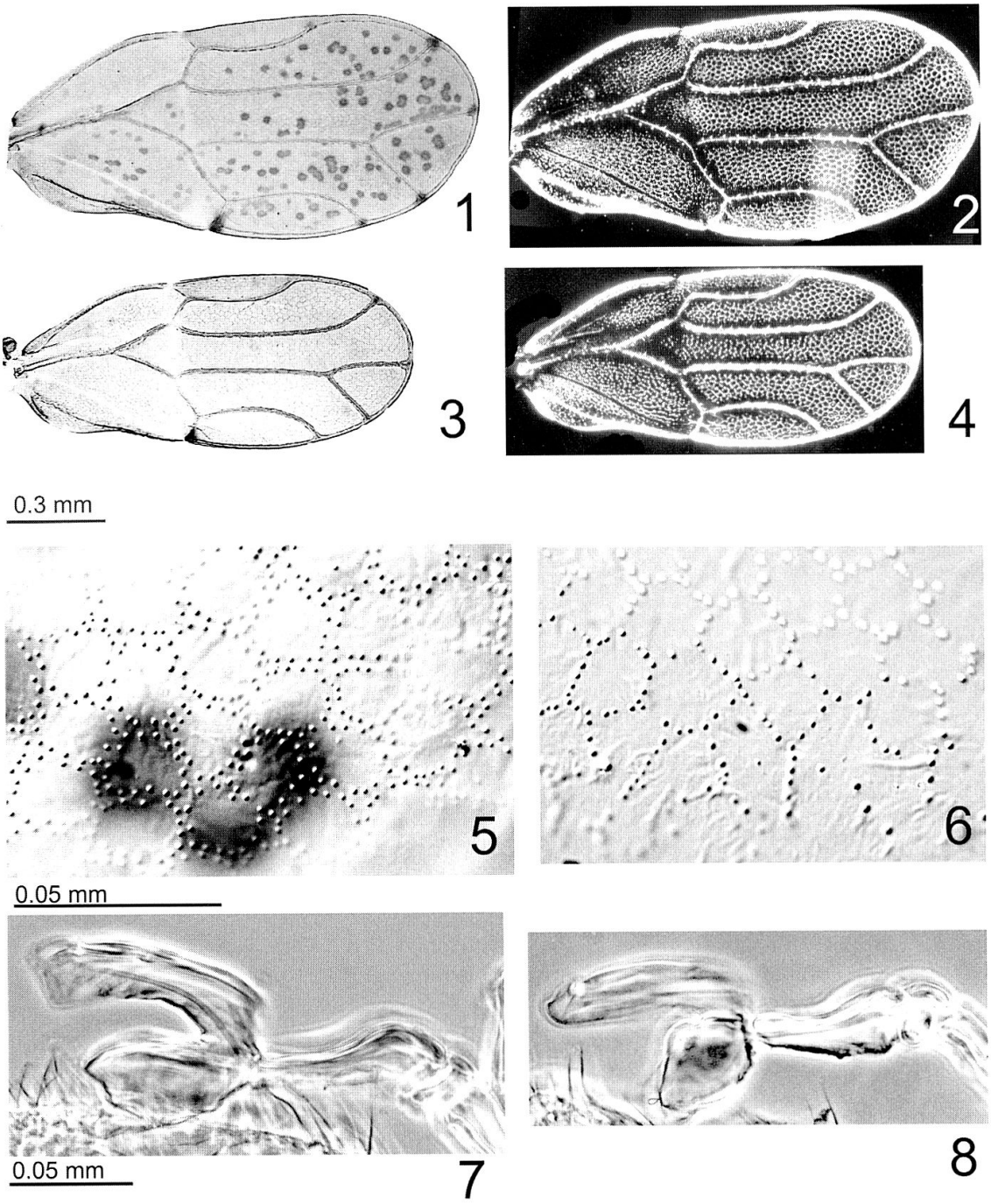
Etymology. The species is dedicated to Dr. Clifford Smith who initiated the project and helped a lot.

Diagnosis. Adult: Body colour reddish to yellowish brown or ochreous with small dark spots (Fig. 23); forewing dull orange with scattered brown dots on membrane and tips of the veins (Fig. 1). Forewing oval; median third of vein Rs and vein M straight and subparallel (Fig. 1); surface spinules forming cellular pattern consisting of double rows of spinules (Figs 2, 5). Metatibia weakly expanded apically with an irregular crown of sclerotised apical spurs. Male proctiger broadly tubular (Fig. 9), paramere broadly lamellar (Fig. 10), aedeagus 2-segmented with a large bilobed ventral process in the middle of the distal segment, apex tubular, weakly widening to apex (Figs 7, 11). Female terminalia (Fig. 13) cuneate, short, pointed apically, circumanal ring cruciform.

Fifth instar larva (Fig. 14): Antenna 10-segmented. Forewing bud relatively large, with 4–5 marginal subacute sectasetae. Legs moderately long, tarsal arolium only slightly longer than claws. Caudal plate angular posteriorly; area of extra pore fields extended, separated into two curved rows of distinct oval patches (Fig. 15). Sectasetae subacute. Caudal plate laterally near fore margin with 3 sectasetae on either side, and near the circumanal ring with 3+3 sectasetae.

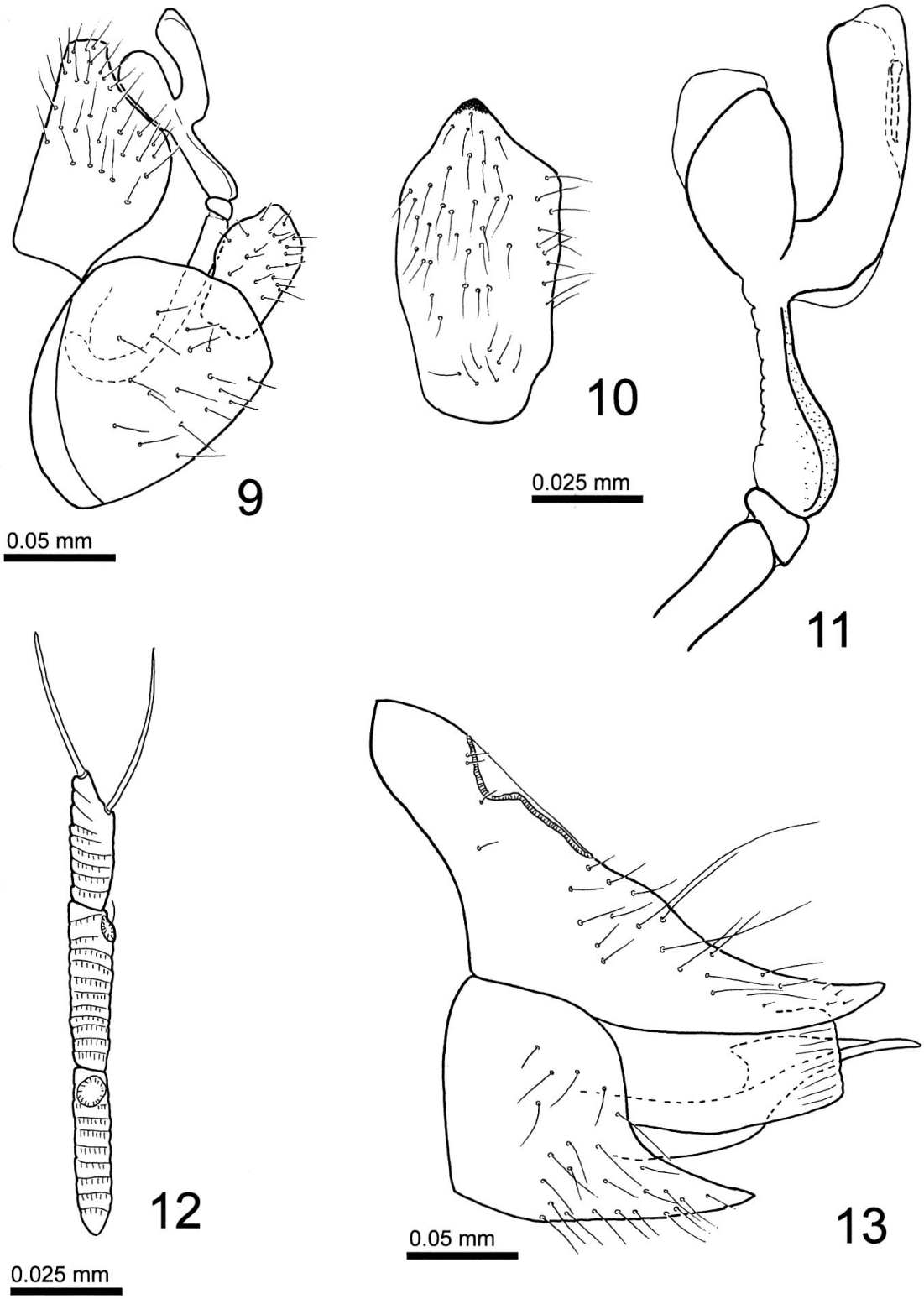
Description. Adult: Coloration (Figs 23–26): Males reddish brown, females ochreous or yellowish brown. When emerging yellow with transparent wings, body becomes brown some hours later (Figs 22, 23). Vertex and thoracic dorsum covered in small dark spots which form longitudinal chains on mesonotum. Eyes reddish or greyish. Antenna yellowish with apices of segments 4, 6, 8 and 9, and entire segment 10 dark brown or black. Legs pale orange or yellowish with brown spots on femora; tarsi lighter. Forewing dull orange or ochreous with semitransparent membrane und almost concolorous veins; tips of veins Rs, M_{1+2}, M_{3+4} and Cu_{1a}, as well as almost entire length of vein Cu_{1b} brown; membrane bearing scattered brown dots (Fig. 1). Hindwing whitish, C+Sc light orange. Abdominal sclerites ochreous or brown, membranes yellowish.

Structure: Head hardly inclined from longitudinal body axis, about as wide as mesoscutum. Vertex trapezoidal with indented foveae; surface finely sculptured with microscopical setae visible at 50 times magnification; median suture fully developed. Eyes subglobular. Genae evenly rounded, with a pair of long setae on either side of frons. Frons forming large triangular sclerite. Antenna 10-segmented, with a single, large subapical rhinarium on each of segments 4, 6, 8 and 9; margin of rhinaria bearing a wreath of moderately long spines; terminal setae slightly longer than segment 10 (Fig. 12). Clypeus flattened, pyriform. Thorax weakly arched, with fine microsculpture and microscopical setosity visible at 50 times magnification; mesoscutellum swollen, metascutellum with small subacute tubercle. Fore-

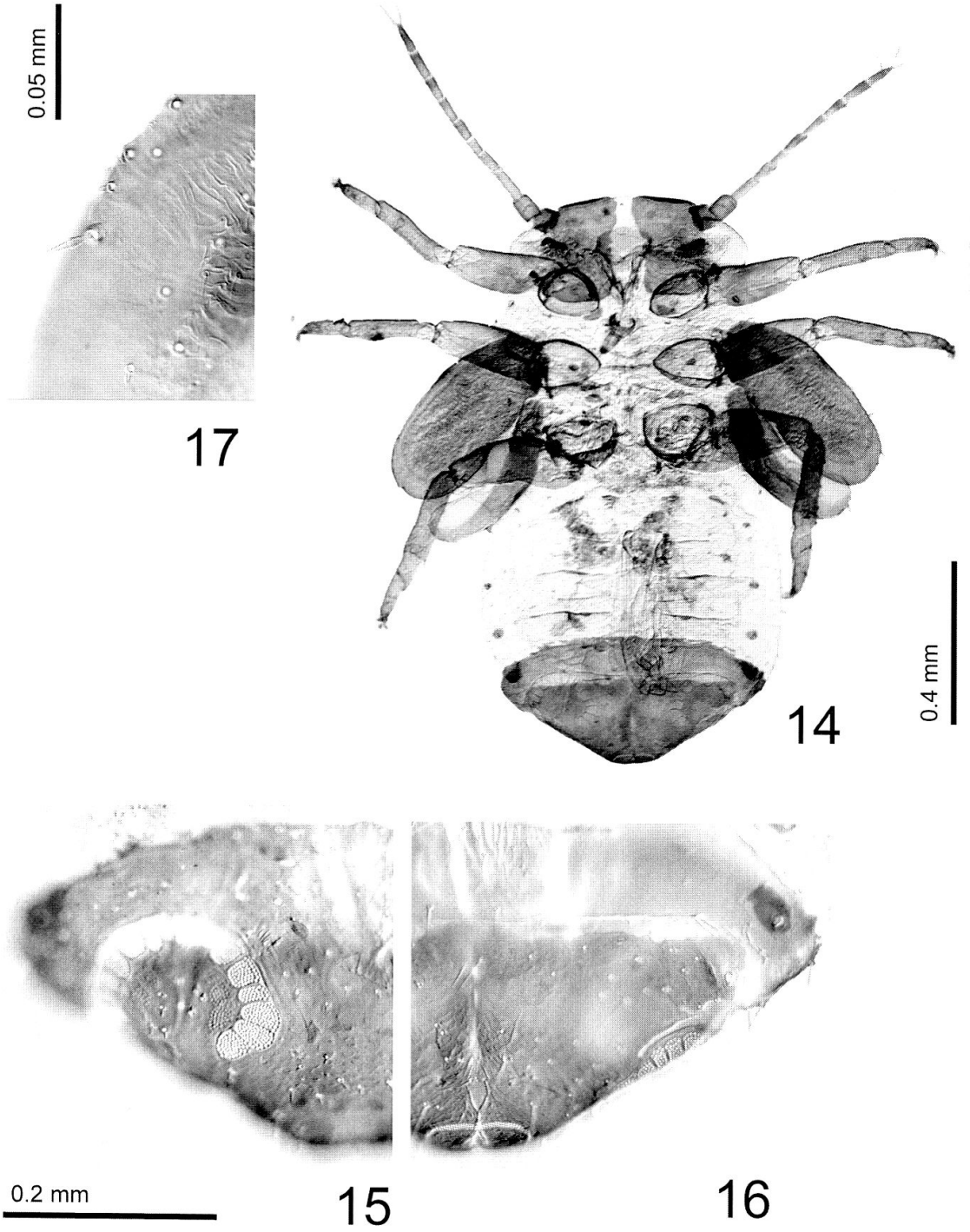


Figs 1–8. *Diclidophlebia* spp. – 1–4, Forewing; 5, 6, surface spinules; 7, 8, distal portion of aedeagus. – 1, 2, 5, 7, *D. smithi*; 3, 4, 6, 8, *D. lucens*.

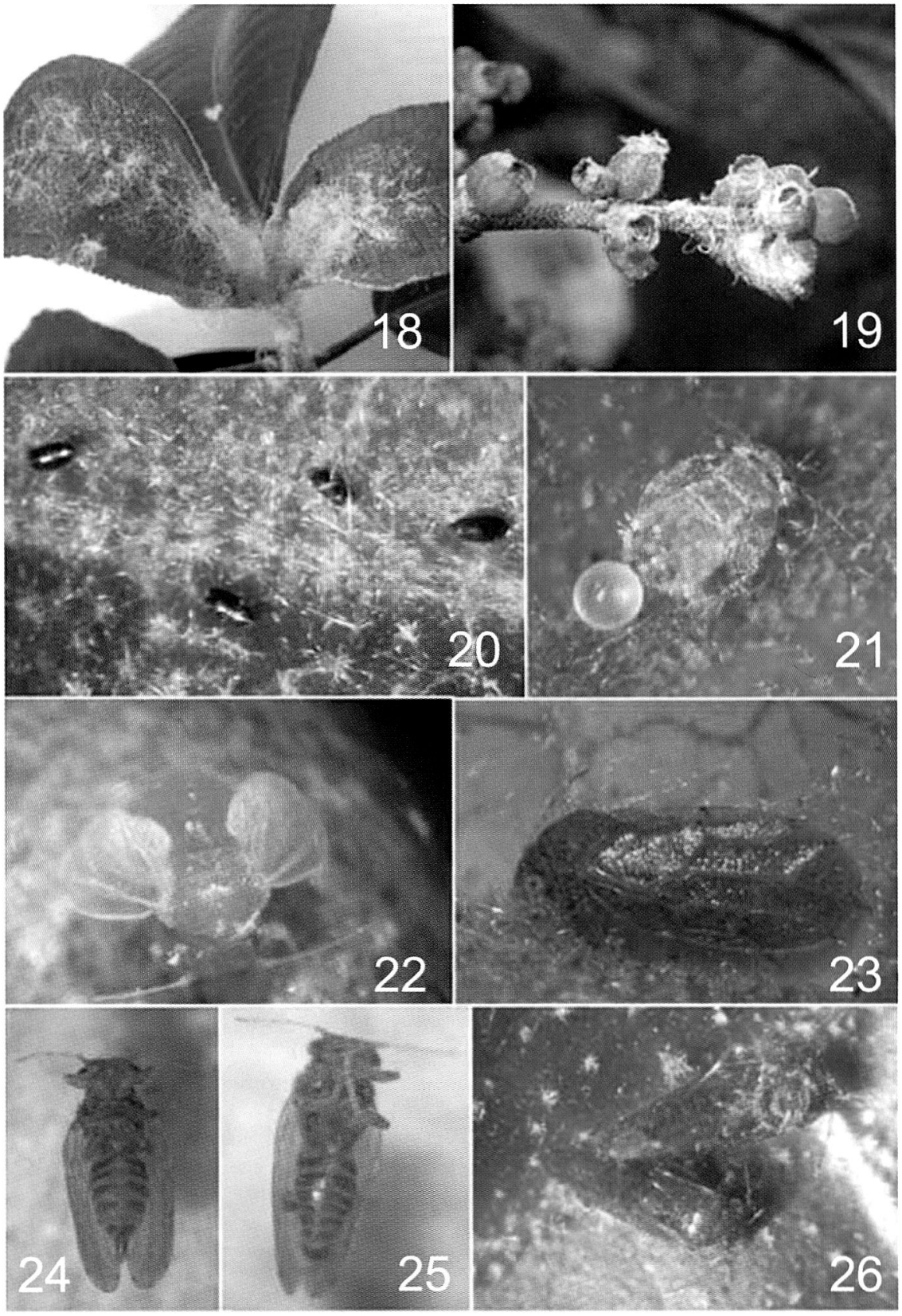
wing (Figs 1, 2) oval, widest in apical fifth; pterostigma ending beyond the middle of vein Rs; vein Rs relatively straight in the median third, curved in a 45° angle towards the fore margin apically; vein M straight, subparallel to the basal two thirds of vein Rs; veins M_{1+2} and M_{3+4} moderately long; vein Cu_{1a} unevenly curved, relatively straight basally, weakly curved apically, moderately long; surface spinules leaving spinule-free stripes along the veins, absent from basal half of cell c+sc



Figs 9–13. *Diclidophlebia smithi*. – 9, Male terminalia, lateral view; 10, paramere, lateral view, inner face; 11, distal portion of aedeagus; 12, antennal segments 8–10; 13, female terminalia, lateral view.



Figs 14–17. *Diclidophlebia smithi*, fifth instar larva. – 14, Habitus; 15, caudal plate, dorsal view; 16, caudal plate, ventral view; 17, detail of forewing pad.



Figs 18–26. *Diclidophlebia smithi*. – 18, 19, Wax filaments in terminal buds and infrutescence; 20, eggs; 21, fifth instar larva with spherical excrement; 22, teneral adult; 23, adult; 24, female, ventral view; 25, male, ventral view; 26, female and male mating.

(Fig. 2), forming a hexagonal pattern (Figs 2, 5) consisting of two rows. Hindwing slightly shorter than forewing, with indistinctly grouped costal setae; vein $M+Cu_1$ developed. Metacoxa with large, horn-shaped, subacute meracanthus; metatibia long, slender, weakly expanded apically, bearing an anteriorly and posteriorly open crown of 7–9 sclerotised apical spurs which are laterally slightly larger than anteriorly. Abdominal tergites with a tubercular bump in the middle increasing in size from the base to the apex of abdomen. Male terminalia (Fig. 9) with broadly tubular proctiger; subgenital plate subglobular. Paramere short, lamellar, anterior margin weakly curved, posterior margin angular subapically, outer and inner face (Fig. 10) covered in long setae; ending in sclerotised tooth. Aedeagus 2-segmented, distal portion (Figs 7, 11) with a large bilobed ventral process in the middle, apex tubular, weakly widening to apex; sclerotised end tube of ductus ejaculatorius long and almost straight. Female terminalia (Fig. 13) cuneate, short; dorsal margin of proctiger concave, apex pointed; subgenital plate shorter than proctiger, abruptly narrowed in apical third, pointed; circumanal ring cruciform.

Measurements in mm and ratios (1 ♂, 1 ♀): head width (HW) 0.58–0.63; antenna length (AL) 0.71–0.73; forewing length (WL) 1.46–1.74; male proctiger length (MP) 0.18; paramere length 0.14; length of distal portion of aedeagus 0.18; female proctiger length (FP) 0.63; AL/HW 1.15–1.22; antennal segment 3/antennal segment 4 length ratio 2.15; WL/HW 2.51–2.76; WL/forewing width ratio 2.08; metatibia length/HW 0.77–0.82; MP/HW 0.32; FP/HW 1.00; FP/circumanal ring length ratio 2.82; FP/female subgenital plate length ratio 2.39. Total length (5 ♂♂, 5 ♀♀) females 1.99 ± 0.04 mm, males 1.71 ± 0.03 mm.

Egg: Coloration: Pale yellow after oviposition, becoming shiny black (Fig. 20). Structure: Elliptic with pointed apex, pedicel short; length 0.24 ± 0.009 mm, width 0.13 ± 0.003 mm.

Larval instars: Yellow, with reddish eyes; in the fifth instar cephalothoracic sclerite, wing buds and the caudal plate brown (Fig. 21); body oval, flattened (Fig. 14). Upon eclosion, first instar larva is light yellow becoming yellowish orange after some time; length 0.26 ± 0.003 mm, width 0.16 ± 0.003 mm, antennal length 0.11 ± 0.003 mm, yellow at base, brown at apex. The second instar larva also yellowish orange; length 0.32 ± 0.007 mm, width 0.20 ± 0.004 mm, antennal length 0.14 ± 0.006 mm, apex brown. Measurements (in mm) of the third, fourth and fifth instars: length 0.42 ± 0.006, 0.63 ± 0.025 and 1.00 ± 0.021, width 0.25 ± 0.003, 0.36 ± 0.010 and 0.48 ± 0.009, antennal length 0.20 ± 0.006, 0.37 ± 0.01, 0.52 ± 0.02 respectively (for each instar 20 larvae were measured).

Structure of fifth instar larva (Fig. 14): Body elongate, sparsely covered in microscopic rod and normal setae. Antenna 10-segmented with a subapical rhinarium on each of segments 4, 6, 8 and 9, and following numbers of subacute sectasetae on each segment from 1 to 10: 1 (0), 2 (2), 3 (0), 4 (1-2), 5 (0), 6 (2), 7 (1), 8 (1), 9 (0), 10 (0). Dorsal thoracic sclerites small. Forewing bud moderately large with 4-5 marginal subacute sectasetae (Fig. 17); hindwing pad with 1-2 marginal subacute sectasetae. Legs moderately long with subacute sectasetae on tibiae; tarsal arolium slightly longer than claws. Caudal plate angular posteriorly with 3 subacute sectasetae laterally near the anterior margin on either side and 3+3 subacute sectasetae dorsally near circumanal ring. Extra pore fields extended consisting of two curved rows of distinct oval patches on either side of caudal plate (Figs 15, 16).

RELATIONSHIPS

Within *Diclidophlebia*, *D. smithi* is a member of the possibly monophyletic species group associated with Melastomataceae defined by Burckhardt *et al.* (2005). The group contains the following described species: *D. fava* (Brown & Hodkinson), *D. longitarsata* (Brown & Hodkinson) (both on *Miconia argentea*), *D. lucens* Burckhardt *et al.* (on *Miconia calvescens*), *D. paucipunctata* (Brown & Hodkinson), *D. tuxtlaensis* (Conconi) (both on *Conostegia xalapensis*, the latter also on *Miconia* sp.), and *D. heterotrichi* (Caldwell & Martorell) (on *Heterotrichum cymosum*). The group is characterised by the oblong-oval forewing with partially subparallel veins Rs and M (Figs 1–4), the hexagonal pattern of the surface spinules (Figs 2, 4–6), the short, narrowly or broadly lamellar paramere with long setae on the outer and inner face, the short, cuneate female terminalia with the short abruptly narrowed subgenital plate, and the cruciform circumanal ring. *D. smithi* shares with *D. fava*, *D. longitarsata* and *D. lucens* the presence of a ventral process on the distal portion of the aedeagus (Figs 7, 8, 11). It differs from *D. lucens* in the presence of dark dots on the forewings (Fig. 1) rather than the absence of dots (Fig. 3), in the surface spinules of the forewing forming a hexagonal pattern with cells defined by two rows of spinules (Fig. 5) rather than one (Fig. 6), in the posteriorly more produced male proctiger (Fig. 9), and in the ventral process of the distal aedeagal segment, which is long and subparallel to the dorsal apical part (Fig. 7) rather than oval and pointing away from the dorsal part (Fig. 8). It differs from *D. longitarsata* in the two rows of surface spinules forming the cellular forewing pattern, in the posteriorly more produced male proctiger, the broader paramere, and the much larger ventral process of the distal portion of the aedeagus. *D. smithi* differs from *D. fava* in the posteriorly more produced male proctiger, the broader paramere, the larger ventral process and the dorsal part of the distal portion of the aedeagus, and the slightly longer female terminalia. Both *D. smithi* and *D. lucens* develop on *Miconia calvescens*, whereas the other two species are associated with *M. argentea*.

The last instar larvae of *Diclidophlebia* have been treated monographically only for the Afrotropical Region (Burckhardt *et al.* 2006). From the Neotropical Region we have examined material of *D. fava*, *D. fremontiae* (Klyver), *D. lucens* and *D. nebulosa* (Brown & Hodkinson). In addition there are published descriptions (Brown & Hodkinson 1988; Conconi 1972) of *D. longitarsata*, *D. paucipunctata* and *D. tuxtlaensis*. *D. smithi* differs from *D. fava* in the longer legs, the lower number of lateral sectasetae on the forewing bud (in *D. fava* 7–8) and the larger extra pore fields on the caudal plate; from *D. fremontiae* it differs in the 10-segmented antennae (in *D. fremontiae* 9-segmented); from *D. nebulosa* it differs in the tarsal arolium which is longer than the claws (in *D. nebulosa* shorter); from *D. lucens* it differs in the larger body dimensions; e.g. antenna longer than 0.4 mm (in *D. lucens* shorter); from *D. longitarsata*, *D. paucipunctata* and D. *tuxtlatensis*, *D. smithi* differs in the host plant association.

DISTRIBUTION

Diclidophlebia smithi was found at four locations in Brazil, three of which in the State of Minas Gerais: Viçosa, Dionísio and Guaraciaba, and one in the State of Rio de Janeiro: Mangaratiba.

HOST PLANTS AND LIFE HISTORY

Diclidophlebia smithi is monophagous on *Miconia calvescens*. Specificity tests were conducted with the following additional species of Melastomataceae: *Clidemia capitellata*, *C. hirta*, *Miconia mendoncaii*, *M. albicans*, *M. ibaguenscens*, *Leandra lacunosa*, *Ossala confertiflora*, *Tibouchina granulosa* and *T. moricandiana*. The tests demonstrate that *D. smithi* is unable to develop on any of these species.

The populations of *Diclidophlebia smithi* are highest from April to October, a period with less rain and lower temperatures. The larvae form often dense colonies and feed on young leaves, flowers or fruits as well as terminal buds. They are very conspicuous by their white waxy secretions appearing as small cottony mass (Figs 18, 19). The females lay the eggs on terminal buds, young leaves, infrutescences and inflorescences. Usually they are laid on the lower leaf surface, often near the vein. Upon eclosion, the first instar larvae begin to feed near the leaf veins, usually in the main vein of expanded leaves or hide between the stem and the buds which are being formed. All larval instars produce whitish waxy filaments which are important for protection and against humidity loss. When population densities are high, these cottony masses of wax become very extensive, covering the entire larva. The first instar larvae can be best detected in the field by the waxy secretions, which are covering them soon after eclosion. The larvae also excrete honey dew in spherical wax coated globules of whitish coloration. The mixture of the wax with honey dew covers their bodies, rendering them white and cottony in appearance (Figs 18, 19, 21). The duration of each life stage depends on the temperature and can vary as follows: egg – 5–15 days, first instar larva – 3–6 days, second instar larva – 4–6 days, third instar larva – 5–7 days, fourth instar larva – 7–10 days and fifth instar larva – 7–10 days. The complete life cycle ranges from 40–67 days. In laboratory conditions (25° C), a female lays 25–45 eggs during its entire life which varies from 10–15 days. The pre-oviposition period is 1–2 days and the oviposition peak is on the 6th day. The adults remain on the young leaves, usually without much movement. Copulation starts in the first days.

Several colonies were collected from all localities, but no parasitoid was observed associated to this species. However, predation of the larvae by Syrphidae larvae was frequently observed. In the greenhouse, when scales are on the plants, predation by ants which are associated with the scales may occur.

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