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A NEW GENUS, TWO NEW SPECIES AND TWO NEW RECORDS OF WHITEFLIES (ALEYRODIDAE: HEMIPTERA) FROM INDIA

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ABSTRACT
A study on the systematics of whiteflies from the campus of Madras Christian College, Tambaram, Tamil Nadu, India was conducted between August 1999 and December 2002. From the study two new species of whiteflies have been determined - one species named *Dialeurodes megaspina* and the other assigned to a new genus *Milleraleurodes* with a new species *illuminata*. *Dialeurodes radiipuncta* (Quaintance and Baker) and *Dialeuropora murrayae* (Takahashi) are reported for the first time from India.

INTRODUCTION

The present field of study is restricted to Tambaram and its adjoining areas within Kancheepuram District and the specific areas of study are the forest regions, represented by the Madras Christian College campus and the adjoining Air Force campus, the cultivated areas and the urbanized regions in and around the forest area. The forest type is of the tropical dry evergreen forest. This area has a wide range of trees and shrubs, which makes this region a unique jungle in term of its faunal and floral composition. Investigations on whiteflies in this region have not been systematically attempted. Hence a study on the systematics of whiteflies was conducted in Tambaram between August 1999 and December 2002. Chhakchhuak and William (2011) have listed out all world and Indian literature on whitefly taxonomy. The present study adds further knowledge to our understanding of whitefly fauna of India.

MATERIALS AND METHODS

Tambaram is situated about 25km southwest of Chennai city and densely covered with plants of the tropical dry evergreen forest. The average elevation of the study area is a little over 30 meters above sea level. The average minimum temperature ranges between 20ºC to 22ºC during November-December and the average maximum between 40ºC to 42ºC during May-June. The average annual rainfall is about 130cm. Puparia of whiteflies from various host plants were collected and studied for species determination.

The collected leaves were brought to the laboratory and observed under a Nikon stereozoom dissection microscope. With the help of a fine needle, the puparial cases were removed from the leaves and processed following the procedure of Martin (1987) and Jesudasan and David (1991). Care was taken to mount one specimen per slide to avoid more than one species on a slide. Slides were adequately dried at 35ºC - 45ºC for about 2 months prior to permanent storage. Based on the structural features of the typical aleyrodid puparial case depicted in David and Subramaniam (1976), Jesudasan and David (1991) and Martin (1999), the whiteflies collected during the survey were systematically studied. Morphological illustrations of selected puparial cases of aleyrodids have been prepared using Camera Lucida. Observations and micro-measurements were made using Nikon Alphaphot YS 2 light microscope. All measurements are recorded in microns unless otherwise specified. In the present study, about 500 specimens were examined in detail.

RESULTS AND DISCUSSION

The study revealed occurrence of two species of whiteflies *viz.*, *Dialeuropora murrayae* (Takahashi) and *D. radiipuncta* (Quaintance and Baker) for the first time in India. In addition a new species of *Dialeurodes* and a new genus and species have been described with illustrations.

1. *Dialeurodes megaspina* Phillips and Jesudasan sp. nov.

(Fig. 1)

***Puparium*.** Cuticle opaque, larger specimens 1.26 - 1.30 mm long and 1.05 -1.10mm wide and smaller specimens 0.93-0.95mm long and 0.70 – 0.73 mm wide; all broadly oval, closely attached to the undersurface of leaf; widest at abdominal segment I - II. Margin fine and irregularly crenulate, indented at caudal and thoracic tracheal openings at margin as distinct pores surrounded by a differentiated area; each with 4 - 5 minute irregular internal teeth. Anterior and posterior

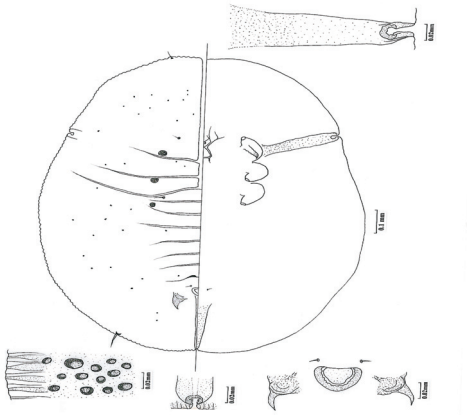

Figure 1: *Dialeurodes megaspina* Phillips and Jesudasan sp. nov. A. Puparium, B. Thoracic tracheal pore, C. Margin, submargin and subdorsum, D, Caudal tracheal pore, E. Vasiform orifice with claw-like structures on either side

marginal setae present on small tubercle, 17.57 - 20.08 and 30.12 - 32.63 long, respectively.

Dorsum: Submargin not differentiated from remainder of dorsal disc. Longitudinal moulting suture reaching puparial margin, transverse moulting suture terminating at subdorsum. Pro-meso and meso-metathoracic and abdominal segmentation thickened and distinct; presence of three pairs of small globular tubercles on the submedian region, one each on pro-thoracic and meso-thoracic suture and one on the second abdominal segment, pores and porettes randomly distributed on the dorsal disc. Located on the laterad of the vasiform orifice is a unique, curved sharp claw like spine 40.16 long and 30.12 wide at the base.

Chaetotaxy: Cephalic, first and eighth abdominal setae present; cephalic setae 5.02 long, first abdominal setae 10.04 long, eighth abdominal setae 7.53 long.

Vasiform orifice: Cordate, 37.65, as long as wide, with 13 - 15 well defined fimbriae or teeth, operculum similarly shaped but indented on lateral margin, obscuring the lingula, thoracic and caudal furrow long and punctuated by coarse stipples.

Venter: Ventral abdominal setae small 5.02 long; caudal and thoracic tracheal folds stippled, thoracic stippling extending around the peripheries of forelegs, antennae short mesal to fore legs.

Materials examined. Holotype: India: Tamil Nadu: Tambaram, on *Tarenna asiatica*, 23.vi.2000, Annie Phillips. Deposited in the collections of Division of Entomology, IARI, New Delhi.

Paratypes: Tamil Nadu: Tambaram, 6 large puparia on *Tarenna asiatica*, 23.vi.2000, Annie Phillips; 4 small puparia on *Tarenna asiatica*, 3.iv.2001; Annie Phillips; data as of holotype.

Distribution: India: Tamil Nadu: Tambaram.

Host plant: *Tarenna asiatica* (Rubiaceae).

Comments: This species is unique in having a claw like spine on either side of vasiform orifice. It closely resembles *Dialeurodes conocephali* Corbett (Corbett, 1935) in shape, structure and the presence of small globular tubercles.

Etymology: The species name is attributed to the large dorsal claw like spines, apparently unique among known whiteflies of the genus *Dialeurodes*.

2. *Dialeurodes radiipuncta* Quaintance and Baker (Fig. 2)

Dialeurodes (Dialeurodes) radiipuncta Quaintance and Baker, 1917, Proc. U.S. Natn. Mus., **51:** 418

Dialeurodes radiipuncta Quaintance and Baker, Mound and Halsey, 1978, Whitefly of the World: 147

Lankaleyrodes radiipuncta, (Quaintance and Baker), David, 1993 Fredrick Institute of Plant Protection and Toxicology, Entomol. Ser., **3:**23

Dialeurodes radiipuncta Quaintance and Baker, Martin, J. H. and Mound, L. A. 2007. Annotated checklist of the World's whiteflies (Insecta : Hemiptera: Aleyrodidae), Zootaxa **1492 :** 1-84.

This species was originally reported from Sri Lanka and was first described and illustrated by Quaintance and Baker (1917). The occurrence of this insect in Sri Lanka: Peradeniya, was confirmed by David (1993). This species is recorded for the first time from India on the same host plant *Memecylon* sp. It is re-described and illustrated with additional details.

Puparium: This species is found to occur sporadically and is confined to the under surface of the leaves in shallow but pronounced pit galls, visible as blisters on the upper surfaces. Living material has a distinctive orange or dark brown shading on the median area on the dorsal disc. Puparia pale yellowish to translucent white, outline almost circular, 1.40 - 1.50mm long and 1.30 - 1.40mm wide, widest at abdominal segment II - III. Margin with 9 - 11 irregular crenulations per 0.1mm, indented at thoracic and caudal openings at margin. Tracheal pores distinct, situated a short distance from the margin with 4 - 5 irregular teeth internally.

Dorsum: Submargin defined by a series of closely striate deep furrows forming a distinct zone. The whole of the dorsal surface is densely punctuated by simple pores and the subdorsum submedian and median area tassellated. Longitudinal moulting suture reaching margin; transverse moulting sutures curving anteriorly at the level of meso-thoracic region, just before reaching margin. Pro-mesothoracic and meso-metathoracic

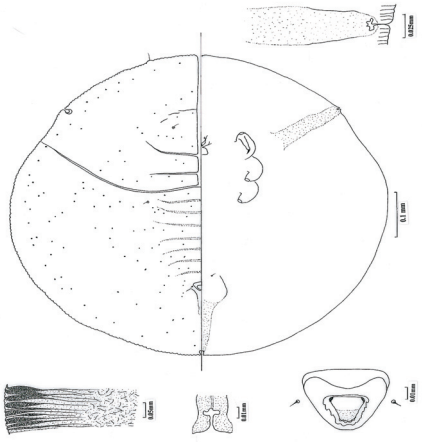

Figure 2: *Dialeurodes radiipuncta* (Quaintance and Baker) A. Puparium, B.Margin, submargin and part of reticulate sculpturing of dorsal disc, C. Thoracic tracheal pore, D. Caudal tracheal pore, E. Vasiform orifice

and all abdominal segmentation well marked.

Chaetotaxy: Three pairs of dorsal setae present; hair like with tuberculate base-cephalic setae 12.55 - 15.06 long, first abdominal setae 7.53 - 10.04 long eighth abdominal setae 2.51-5.04 long placed midway along vasiform orifice; caudal setae not evident.

Vasiform orifice: Subcordate with the cephalic margin almost straight; with a peculiar thickened area which clasps the orifice at the sides. Rim of the orifice thick and its inner caudal and lateral margin armed with 11-12 teeth, operculum similar in shape filling orifice, obscuring lingula. Caudal furrow indicated only proximally by minute tuberculate marking extending half way from vasiform orifice to puparial margin.

Venter: Ventral abdominal setae hair like located anterior to the vasiform orifice. Thoracic tracheal fold distinct with broad band of stipples extending up to the subdorsum. Caudal tracheal fold broad marked by random stippling. Antennae basal to the fore legs tapered and pointed. Legs somewhat obscured, curved with apical pads.

Materials examined: India: Tamil Nadu : Tambaram, 4 puparia on *Memecylon edule*, 10.x.2002, Annie Phillips ; 3 puparia on *Memecylon umbellatum* 20.xi 2002, Annie Phillips.

Distribution. India: Tamil Nadu: Tambaram (new distribution record).

Host plants. *Memecylon edule*, *Memecylon umbellatum* (Melastomataceae) (new host record).

3. *Dialeuropora murrayae* (Takahashi) (Fig. 3)

Dialeurodes (*Dialeuropora*) *murrayae* Takahashi, 1931: Nat. Hist. Soc. Formosa. Trans. **61:** 262-264.

Dialeuropora murrayae (Takahashi) Russell, 1959: Pro. Ent. Soc. Wash., **4:** 186.

This species was first described and illustrated by (Takahashi, 1931), from Taiwan on *Murraya koenigii*. It is redescribed and illustrated with additional details.

Puparium: Greyish white, opaque with fine discoloured waxy filaments, occasionally iridescence. Puparial case broadly oval,

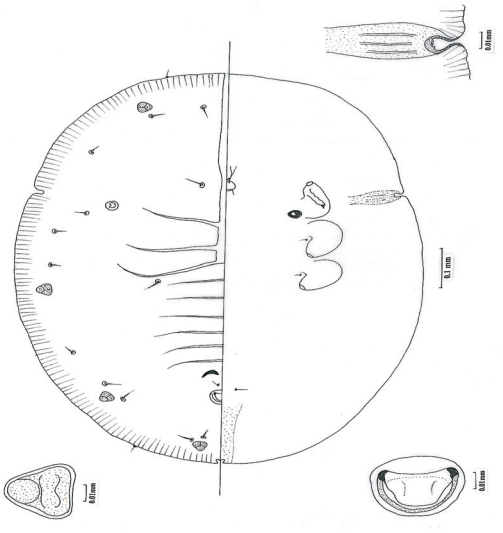

Figure 3: *Dialeuropora murrayae* (Takahashi) A. Puparium, B. Margin with thoracic tracheal pore, C. Subdorsal pore, D. Vasiform orifice

widest at metathoracic region, 0.93 - 1.14mm long and 0.69 - 0.92mm wide, found in large numbers on the undersurface of the host plants. Margin finely crenulate, 12 - 13 shallow crenulations in 0.1mm. Margin at tracheal pore area indented. Thoracic pores with irregular teeth, hardly visible but slightly thickened with a chitinised rim at the back of the margin, caudal tracheal pore provided with comb of very fine teeth. Anterior and posterior marginal setae minute, each 2.51 - 5.02 long, fine, short and relatively inserted far from the extremity of the case.

Dorsum: Submargin indicated by well defined irregular furrows running mesad from margin and effectively defining a broad submargin area. Longitudinal moulting suture poorly defined in the cephalic region, transverse moulting suture only extending a short distance into subdorsum; the dorsum is without any special sculpturing or papillae. Pro-mesothoracic and meso-metathoracic and abdominal segmentation distinct; abdominal segments sub-equal and abdominal segment VII not significantly reduced medially; abdominal pockets distinct on the sutures, not contiguous. There are five pairs of pores and arrangement and size of pores differ - 4 pairs of pores are situated on the submarginal region and 1 pair on the prothoracic subdorsal region. The 4 submarginal pores are borne on a round base, the surfaces are strong and thickened, diameter 40 - 45. Prothoracic subdorsal pore smaller 18-20, less chitinised.

Chaetotaxy: 10-11 pairs of small submarginal setae 5 - 6 long (2 between the anterior suture and first wax secreting pore, 3 between the submarginal pores 1 and 2, 2 between the 2nd and 3rd pore and 3 between the 3rd and 4th pore); in some specimens there is the presence of a short seta at the base of the pro-thoracic pore in the subdorsum. The cephalic setae is well developed and normal 12.55 - 15.06 long, the first abdominal setae slightly reduced 10.04 - 12.55 long, the eighth abdominal setae well developed almost adjacent to the anterior side of vasiform orifice 7.53 - 10.04 long, caudal setae not evident.

Vasiform orifice: Subcordate, small and chitinised, operculum fills almost the entire orifice; lingula obscured; caudal furrow faint and slightly enlarged posteriorly.

Venter: A pair of fine ventral abdominal setae present, placed at the anterior rim of vasiform orifice. Antennae with bases mesal to fore legs. Thoracic and caudal tracheal folds marked as faint pairs of boundary lines by fine stipplings. A small spine present at the base of each middle and hind leg.

Materials examined: India: Tamil Nadu: Tambaram, 20 puparia on *Glycosmis mauritiana*, 9.xii.2000, Annie Phillips; 4 puparia on third instar stage on *Glycosmis mauritiana,* 05.ii.2001, Annie Phillips.

Distribution. India: Tamil Nadu: Tambaram.

Host plant. *Glycosmis mauritiana* (Rutaceae) (new host record).

Comments: This species is recorded for the first time from India and is also known to possess characters similar to *Dialeupora papillata* (an African species) described by Cohic (1966) and Bink-Moenen (1983), but differs in the size of wax secreting pore, length, shape, position, number of setae, and the dorsal sculpturing. *D. murrayae* (Takahashi) was first recorded from Taiwan in 1931 on *Murraya koenigii* (Rutaceae).

In Tambaram sudden outbreaks were observed on the Madras Christian College campus in September 2004 and March 2005 and mass emergence of a large number of adults occurred from its host *Glycosmis mauritiana,* the most common shrub in the campus though this was generally mistaken as dust particles by the public. On an average, every leaf was found to be infested with more than 200 nymphs, which were found in clusters on the undersurface of leaves and were covered with powdery strands of wax. Translucent eggs were also found interspersed between the puparial cases. The honeydew exuded by the whitefly caused the development of sooty moulds on the leaves and this adversely affected the plant as it restricted photosynthesis and respiration. The major visible symptom of this infestation was the wilting of the affected leaves, which became chlorotic and black in appearance.

4. *Milleraleurodes* Phillips and Jesudasan gen. Nov. (Fig.4)

Type species : *Milleraleurodes illuminata* Phillips and Jesudasan gen. and sp. nov. ; by original designation.

Diagnostic characterisics. Puparial case subcircular, broadest at metathoracic segment, margin smooth, tracheal pores well defined as invaginated clefts with chitinized rim having a pair of teeth; anterio and posterior marginal setae present ; submarginal area not differentiated from dorsal disc ; transverse moulting suture curving sharply anteriorly and almost reaching above tracheal pore region and almost reaching margin and the suture between cephalic and first abdomen almost reaching margin just near transverse moulting suture; subdorsum without a row of teeth ; tracheal folds with microtubercles; first abdominal setae absent. Seta on prothorax present. Vasiform orifice oval with a comb of teeth on inner lateral and caudal margin ; operculum obscuring lingula.

This genus resembles the genus *Dialeurodes* in general characters but it differs by the typical transverse moulting suture bending abruptly forward and ending above thoracic tracheal pore almost reaching margin and the suture between cephalic and first abdomen almost reaching margin just near transverse moulting suture, absence of first abdominal setae and setae on ıt.

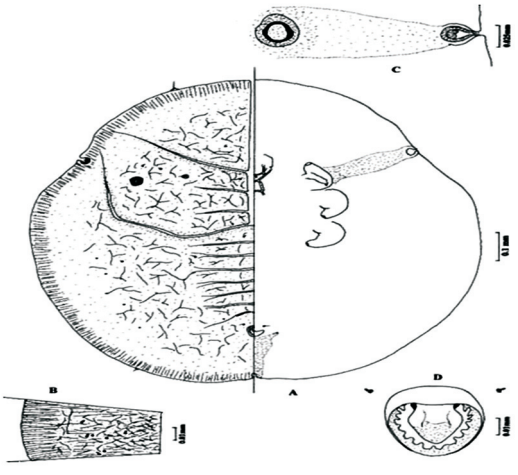

Figure 4: *Milleraleurodes illuminata* Phillips and Jesudasan gen. and sp. nov. A. Puparium, B. Details of margin and subdorsum, C, Thoracic tracheal pore with tubercle at the base, D. Vasiform orifice

Etymology. The genus is named after late Dr. William Miller, former Principal of the Madras Christian College, Tambaram.

***Milleraleurodes illuminata* Phillips and Jesudasan gen. and sp. nov.**

Puparium. White, opaque and membranous with cloudy pigmentation; subcircular broadest at meta thoracic segment region, 1.05 - 1.08mm long and 1.05 - 1.10mm wide found one or two per leaf; generally located on the main midrib of the leaf; under leaf surface. Margin smooth, anterior and posterior marginal setae present 17.57 and 25.10 long respectively. Thoracic and caudal tracheal pore regions indicated as invaginated clefts with chitnizedrim, having a pair of inner teeth.

Dorsum: Submargin with striations not separated from dorsal disc and reaching subdorsal area; dorsum with irregularly scattered pores and tassellations; the base of the thoracic tracheal fold at the meso thoracic region has a pair of globular tubercles with small translucent granules; longitudinal moulting suture reaching margin, transverse moulting suture curving sharply anteriorly, terminating near the submargin above the tracheal combs. Cephalothoracic suture curving anteriorly and reaching margin just above the transverse moulting suture; abdominal segment subequal in length, distinct. Abdominal pockets well marked and contiguous.

Chaetotaxy: A pair of minute cephalic setae present 5.02 long and second abdominal setae 10 long; eighth abdominal and caudal setae minute 5.02 long; first abdominal setae absent; median area of abdominal segment I - VII with minute setae 2.51 long, rows of microsetae present randomly on the submedian and subdorsal area.

Vasiform orifice. Cordate, 35.14 long and 42.67 wide, operculum elliptical wider than long, 35.14 and 17.51, inner margin with ridges, caudal furrow not indicated.

Venter: A pair of fine ventral abdominal setae laterad of vasiform orifice 9.15 long; antennae short their bases mesal to fore legs; caudal and thoracic tracheal folds distinct, indicated as a broad band and finely stippled; legs well formed and curved.

Materials examined. Holotype: India: Tamil Nadu: Tambaram, on *Glycosmis mauritiana*, 10.i.2000, Annie Phillips. Deposited in the collections of the Division of Entomology, New Delhi. **Paratypes:** Tamil Nadu: Tambaram, 8 puparia on *Glycosmis mauritiana,* 25.i.2001, Annie Phillips; 4 puparia on *Santalum album*, 12.x.2001, Annie Phillips; same data as of holotype.

Distribution: India: Tamil Nadu: Tambaram.

Host plants: *Glycosmis mauritiana* (Rutaceae)*, Santalum album* (Santalaceae)

Etymology: Named in view of the illuminous globular tubercles in the cephalothoracic region.

Discussion: *Dialeurodes radiipunctalis* reported for the first time in India on *Memecylon* sp, develops in shallow but pronounced pit galls under the leaf surface, which are visible as blisters on the upper surface of the leaf and are covered by a distinctive orange powder on the dorsal disc, making the colony prominent and visible (David B. V., 2012). *Dialeuropora murrayae* (Takahashi) known from Taiwan (Takahashi, 1931) on *Murraya koenigii* (Rutaceae) noticed to

occur in India on *Glycosmis mauritiana* (Rutaceae) and outbreaks of the species occurred often. An interesting observation was made on a new species of whitefly *Dialeurodes megaspina* sp. nov., which is apparently monophagous on the host plant *Tarenna asiatica*. This species is unique because of the presence of a pair of dorsal claw like spines laterad of vasiform orifice. A new genus *Milleraleurodes* was erected for a species of whitefly found infesting *Glycosmis mauritiana*. Sundararaj and David (1993) studied the tribe Dialeuodini and formed a key to the genera. Since this new genus was found to be close to the genus *Dialeurodes* detailed study justified erection of the new genus and the characteristics have been defined.

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