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Revision of the whitefly genus *Martiniella* Jesudasan and David (Hemiptera: Aleyrodidae) with a new record of *Martiniella sepangensis* (Martin and Mound) from India

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ABSTRACT: The whitefly genus *Martiniella* Jesudasan and David is reviewed and the generic characters have been redefined. Five species of *Aleuroclava* viz., *A. baccaureae* (Corbett), *A. fici* (Corbett), *A. macarangae* (Corbett), *A. sepangensis* Martin and Mound and *A. srilankaensis* (David) have been assigned to *Martiniella* proposing new combinations. *M. sepangensis* (Martin and Mound) so far known from Malaysia is reported for the first time from India and the species is redescribed. Key to the species of the genus *Martiniella* is given.

KEYWORDS: Indian Aleyrodidae, *Martiniella sepangensis*

INTRODUCTION

Jesudasan and David (1990) proposed the whitefly genus *Martiniella* for two species of *Aleurotuberculatus* viz., *A. canangae* and *A. macarange* described by Corbett (1935), with the former being the type species. Martin (1999) synonymised *Martiniella* with *Aleuroclava* observing as follows "Jesudasan and David (1990) proposed the genus *Martiniella* for two species described by Corbett (1935), *Aleurotuberculatus canangae* and *A. macarangae*, using the presence of very much enlarged, jointed, cephalic and first abdominal setae as the diagnostic separation from *Aleuroclava*, although unusual setae of this type are sometimes present in species of *Taiwanaleyrodes* and *Dialeurodes*, and this character has also been seen to vary within samples (personal observations), *Martiniella* was therefore, considered as a junior synonym of *Aleuroclava*". In this connection Sundararaj and Dubey (2004) emphasized that the presence of very much enlarged, jointed, cephalic and first abdominal

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setae form a distinct diagnostic character in separating *Martiniella* from all known species of *Aleuroclava*. Thus placement of all the described species of *Martiniella* under *Aleuroclava* by Martin and Mound (2007) is not justifiable. In view of this Sundararaj and Pushpa (2011) reinstated the generic status of *Martiniella*. Further, no variations were observed within samples with regard to the jointed nature of setae in the species of *Martiniella* collected by different workers from 1976 onwards. A critical evaluation of the jointed nature of setae revealed that the base of the seta is nothing but an elongated extension of the cuticle in the form of elongate tubercle bearing the seta at its apex. Hence, the generic characters have been redefined and based on the original description five species of *Aleuroclava viz., A. baccaureae* (Corbett), *A. fici* (Corbett), *M. macarangae* (Corbett), *A. sepangensis* Martin and Mound and *A. srilankaensis* (David) have been assigned to *Martiniella* proposing new combinations. Further *M. sepangensis* (Martin and Mound) so far known from Malaysia is reported for the first time on *Macaranga* sp. from India and a redesscription of the species is given.

MATERIALS AND METHODS

The present study was based on the whitefly materials collected from various localities of south India during the period 2005-15 as well as the type specimens and other specimens of *Martiniella* available at the collections of Institute of Wood Science and Technology (IWST). The whitefly infested leaves were collected from the host plants and permanent mounts of the puparia were prepared by adopting the method suggested by David and Subramaniam (1976). The best mounts were obtained from puparia from which adults have emerged. Observations were made by using Nikon Optiphot T-2 EFD microscope and the identity of the whiteflies were confirmed.

RESULTS AND DISCUSSISON

Genus *Martiniella* Jesudasan and David, 1990

Type species: *Aleurotuberculatus canangae* Corbett, 1935. *J. Fed. Malay. St. Mus.* **17**: 827–828; by original designation.

Martiniella canangae (Corbett) Jesudasan and David, 1990. *FIPPAT Entomology Series,* **2**: 1-13.

Aleuroclava canangae (Corbett) Martin, 1999. *CSIRO Entomology Technical Paper,* **38**: 197 pp.

Martiniella canangae (Corbett) Sundararaj and Dubey, 2004. *Entomon*, **29** (4): 357-360.

Aleuroclava canangae (Corbett) Martin and Mound, 2007. *Zootaxa*, **1492**: 10.

Martiniella canangae (Corbett) Sundararaj and Pushpa, 2011: 509. In: *Advancements in Invertebrate Taxonomy and Biodiversity.* Gupta, Rajiv K. (Ed.), Agrobios (International), 552 Pp.

Diagnosis. Puparia small, ≤ 0.66 mm long and white with dorsal tubercles and granules; margin finely crenulate, caudal tracheal pore distinct while thoracic tracheal pore regions either distinct or slightly differentiated from margin; submargin often separated from the dorsal disc by a thin submarginal fold; thoracic and caudal tracheal folds distinct; cephalic and first abdominal setae on elongated tubercles (tuberculate setae) which are generally mistaken as jointed setae. Vasiform orifice subcordate, notched at hind end; operculum filling the orifice, obscuring the lingula.

The puparia of *Martiniella* are easily distinguishable from *Aleuroclava* Singh by the smaller size and having cephalic and first abdominal setae on elevated long tubercles similar to the tuberculate setae of *Tuberaleyrodes* Takahashi and *Acanthaleyrodes* Takahashi. It also differs by presence of submarginal ventral fold from *Aleuroclava* though some of the species placed presently under *Aleuroclava* have submarginal ventral fold but they are not typical of the genus *Aleuroclava*. Further many included taxa which are initially placed under *Aleurotuberculatus* are not congeneric with the type species *A. complex* Singh.

The genus *Martiniella* differs from *Acanthaleyrodes* Takahashi in having only tuberculate cephalic and first abdominal setae and submarginal ventral fold and by not having vasiform orifice on an eminent elevated protuberance and by the absence of submarginal and subdorsal tubercualte setae. It also differs from *Tuberaleyrodes* Takahashi in having only the tuberculate cephalic and first abdominal setae and submarginal ventral fold and by the absence of submarginal and subdorsal tubercualte setae. Further it is observed beyond doubt that tuberculate nature of cephalic and first abdominal setae is not a variable character in the natural breeding populations of *M. indica* on *Michelia champaca*.

Key to puparia of the species of *Martiniella*

(Based on the puparial observation of Indian species and the original description of species reported from outside India)

1. Thoracic tracheal pores/clefts/folds indicated 2

-. Thoracic tracheal pores/clefts/folds not indicated. 6

2. Dorsal area not smooth, with papillae or tubercles 3

-. Dorsal area smooth, without papillae or tubercles . . . . . ***ayyari*** Sundararaj and David

3. Entire dorsum not smooth, with papillae, granules and tubercles; vasiform orifice cordate 4

-. Submedian area smooth, without papillae or granules, only subdorsum with papillae and granules; vasiform orifice subrectangular . . . . . ***lefroyi*** Sundararaj and David

4. Submedian area of cephalothorax without three pairs of enlarged tubercles; subdorsum only with microtubercles. 5

-. Submedian area of cephalothorax with three pairs of enlarged tubercles; entire dorsum with microtubercles. . . . . ***canangae*** (Corbett)

5. Abdominal segment sutures with thick corrugations; .....***macarangae*** (Corbett)

-. Abdominal segment sutures without corrugations; three rows of small pores absent in the abdomen; microtubercles along the segment sutures absent; inner subdorsum without microtubercles, outer subdorsum along the submargin with microtubercles . . . . . .***papillata*** Sundararaj and Dubey

6. Submargin without large subcircular lobes 7

-. Submargin with three pairs of large sub circular lobes.. . . . . .***tripori*** (Dubey and Sundararaj)

7. Abdominal segments with median tubercles. 8

-. Abdominal segments without median tubercles 10

8. Median tubercles on abdominal segments not extending along the segment sutures; subdorsum without microtubercles 9

-. Median tubercles on abdominal segments extending along the segment sutures; subdorsum with microtubercles. . . . . ***fletcheri*** (Sundararaj and David)

9. Abdominal segments II to IV with median tubercles; caudal furrow not closed at its anterior end . . . . . ***srilankaensis*** (David)

-. Abdominal segments II-V and VII with chitinised thickenings and extending into subdorsal area; caudal furrow closed at its anterior end . . . . . .***sepangensis*** (Martin and Mound)

10. Basal tuberculate and apical setae of the cephalic and I abdominal setae are not equal in length. 11

-. Basal tuberculate and apical setae of the cephalic and I abdominal setae are about equal in length . . . . . ***indica*** (Singh)

11 Apical setae of the tubeculate cephalic and I abdominal setae are about twice as long as the basal tuberculate. . . . . ***fici*** (Corbett)

-. Basal tuberculate of the tubeculate cephalic and I abdominal setae are very long, more than double the length of the apical setae. . . . . ***baccaureae*** (Corbett)

Species of the genus *Martiniella*

1. ***Martiniella ayyari*** Sundararaj and David

Martiniella ayyari Sundararaj and David, 1993. *Entomon* **18** (1&2): 95-98.

Aleuroclava ayyari (Sundararaj and David) Martin, 1999. *CSIRO Entomology Technical Paper,* **38**: 31.

Martiniella ayyari: Sundararaj and Dubey, 2004. *Entomon*, **29** (4): 357-360.

Aleuroclava ayyari (Sundararaj and David) Martin and Mound, 2007. *Zootaxa*, **1492**: 9.

Martiniella ayyari: Sundararaj and Pushpa, 2011. *Advancements in Invertebrate Taxonomy and Biodiversity*: 510

Material examined: India: Tamil Nadu, paratype puparium, on *Mussaenda* sp., 4.viii.1987, R.Sundararaj.

Hosts: *Mussaenda* sp. (Sundararaj and David, 1993): *Litsea ghatica* (Meganathan and David, 1994).

Distribution: India: Tamil Nadu (Sundararaj and David, 1993).

2. ***Martiniella baccaureae*** (Corbett) **Comb. nov.**

Taiwanaleyrodes baccaureae Corbett, 1935: 839.

Aleuroclava baccaureae: Manzari and Quicke, 2006: 2470.

Material examined: None.

Host: *Baccaurea motleyana*. (Corbett, 1935).

Distribution: Malaya: Pudu (Corbett, 1935).

3. ***Martiniella canangae*** (Corbett) **Stat. Rev.**

Aleurotuberculatus canangae Corbett, 1935: 827.

Martiniella canangae (Corbett) Jesudasan and David, 1990: 1-13.

Aleuroclava canangae: Martin, 1999: 31.

Martiniella canangae: Sundararaj and Dubey, 2004: 357 - 360.

Material examined: None.

Host: *Cananga odorata*, *Psidium guajava* (Corbett, 1935).

Distribution: Malaya: Kuala Lumpur (Corbett, 1935).

4. ***Martiniella fici*** (Corbett) **Comb. nov.**

Taiwanaleyrodes fici Corbett, 1935: 838.

Aleuroclava fici: Manzari and Quicke, 2006: 2470.

Material examined: None.

Host: *Ficus* sp., *Euphorbia pulcherrima* (Corbett, 1935).

Distribution: Malaya: Kuala Lumpur (Corbett, 1935).

5. ***Martiniella fletcheri*** (Sundararaj and David) (Fig. 1-3)

Taiwanaleyrodes fletcheri Sundararaj and David, 1992. **29** (4):15- 20.

Aleuroclava fletcheri: Manzari and Quicke, 2006. *J. Nat. Hist.*, **40**, 2470.

Martiniella fletcheri: Sundararaj and Pushpa, 2011. *Advancements in Invertebrate Taxonomy and Biodiversity*: 510

Material examined: India: Karnataka: Sakleshpura, 4 puparia, on *Helicteres isora*, 15.x.05, R. Pushpa; Yellapur, 6 puparia, on *Michelia champaca*, 14.xii.05, R. Sundararaj; Kerala: Pandalam, 11 puparia, on *Macaranga peltata*, 27.iii.07, R. Pushpa; Singampara (Palakkad), 2 puparia, on *Dillenia pentagyna*, 22.x.06, R. Sundararaj; Palakkad, 2 puparia, on *Mallotus philippensis*, 23.x.06, R. Sundararaj; Palode, 13 puparia, on *Macaranga peltata*, 25.iii.07, R. Pushpa; Tamil Nadu: Kuppam, 1 puparium, on *Ficus hispida*, 23.xi.07, R. Pushpa; Courtalam, 4 puparia, on *Mallotus philippensis*, 22.iii.07, R. Pushpa; Unnamalaikadai, 10 puparia, on *Croton malabaricus*, 16.x.06, P. Philomena; Unnamalaikadai, 4 puparia on *Tectona grandis*, 11.xi.06, R. Pushpa.

Hosts: *Mallotus* sp., *Tectona grandis, Hemidesmus indicus* (Sundararaj and David, 1992), *Lannea coromandelica, Litsea bourdilloni* (Dubey and Ko, 2008). *Croton malabathrum. Dillenia pentagyna, Helicteres isora, Macaranga peltata*, *Mallotus*

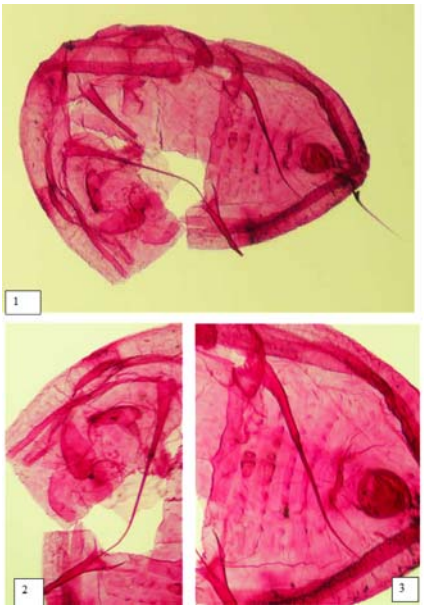

Fig. 1-3: *Martiniella fletcheri* (Sundararaj and David): 1. Puparium; 2. Cephalothorax with tuberculate cephalic setae; 3. Abdomen with tuberculate first abdominal setae

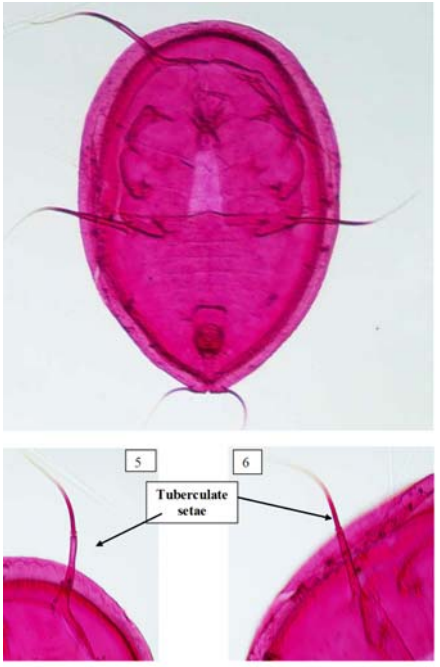

Fig. 4-6: *Martiniella indica* (Singh): 4. Puparium; 5. Tuberculate cephalic setae; 6. Tuberculate first abdominal setae

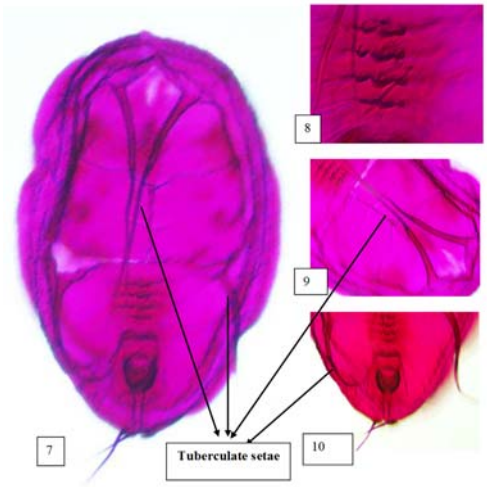

Fig. 7-10: ***Martiniella sepangensis*** **(Martin and Mound): 7. Puparium; 8. Abdominal segments with corrugated sutures; 9. Tuberculate cephalic setae; 10. Tuberculate first abdominal setae with vasiform orifice**

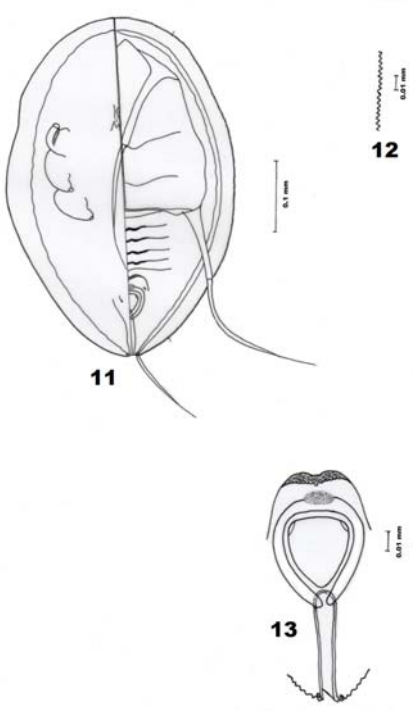

Fig. 11-13: Line diagram, ***Martiniella sepangensis*** **(Martin and Mound): 11. Puparium; 12. Margin; 13. Vasiform orifice**

philippensis, *Michelia champaca* (Sundararaj and Pushpa, 2011).

Distribution: India: Tamil Nadu, Kerala (Sundararaj and David, 1992); Karnataka: (new distribution record).

6. ***Martiniella indica*** (Singh) (Fig. 4-6)

Aleurothrixus indica Singh, 1931. *Mem. Dept. Agric. India, Ent. Ser.*, **12** (1): 84-85.

Taiwanaleyrodes indica (Singh) Takahashi, 1935. *Rec. Dept. Agric. Govt. Res. Inst. Formosa,* **66**: 55; David and Subramaniam, 1976. *Rec. Zool. Surv. India,* **70**: 212-213.

Aleuroclava indica: Manzari and Quicke, 2006. *J. Nat. Hist.*, **40**, 2470.

Martiniella indica: Sundararaj and Pushpa, 2011. *Advancements in Invertebrate Taxonomy and Biodiversity:* 510

Material examined: India: Andhra Pradesh: Rajendra Nagar (Hyderabad), 13 puparia, on *Ficus* sp., 5.iii.07, R. Sundararaj; Karnataka: Bangalore, 11 puparia, on *Michelia champaca*, 17.v.07, R. Pushpa; Moodabidri, 11 puparia, on *Ficus hispida*, 14.x.05, R. Pushpa; Sakleshpura, 6 puparia, on, *Ficus exasperata*, 15.x.05, R. Pushpa; IWST Campus (Bangalore), 12 puparia, on *Michelia champaca*, 22.v.2012, T. Amuthavalli; Yelahanga (Bangalore), 4 puparia, on *Michelia champaca*, 21.ii.2014, R. Sundararaj; IWST Campus (Bangalore), 3 puparia, on *Holigarna arnottiana*, 8.xii.2014, R. Sundararaj; IWST Campus (Bangalore), 21 puparia, on *Michelia champaca*, 7.xii.2014, R. Sundararaj; Varthahalli, 7 puparia, on *Ficus hispida*, 2.ii.2015, D. Vimala; Kerala: Pullanikadu (Thrissur), 10 puparia, on *Litsea* sp., 24.x.06, R. Sundararaj.

Hosts: *Michelia champaca* (Singh, 1931); *Dillenia indica* (Corbett, 1935); *Machilus* sp. (Takahashi, 1935); *Celtis tetrandra, Elaeocarpus tuberculatus, Ficus carica, Helietres isora, Litsea bourdillonii, L. ghatica, Scolopia crenata* (Meganathan & David, 1994); *Ficus* sp., *Ficus exasperata*, *Ficus hispida, Litsea* sp. (Sundararaj & Pushpa, 2011); *Castanopsis indica* (Lalneihpuia and William, 2011); *Alseodaphne semicarpifolia, Palaquium ellipticum* (Dubey and David, 2012); *Holigarna arnottiana* (new host record).

Distribution: India (Singh, 1931); Hong Kong, Taiwan and Malaya (Takahashi, 1941).

7. ***Martiniella lefroyi*** Sundararaj and David

Martiniella lefroyi Sundararaj and David, 1993. *Entomon* **18** (1&2): 97-99.

Aleuroclava lefroyi: Martin, 1999. *CSIRO Entomology Technical Paper,* **38**: 31.

Martiniella lefroyi: Sundararaj and Dubey, 2004. *Entomon*, **29** (4): 357-360.

Martiniella lefroyi: Sundararaj and Pushpa, 2011. *Advancements in Invertebrate Taxonomy and Biodiversity:* 511

Material examined: India: Maharashtra: Mahableshwar, paratype puparium on *Elatostemma* sp., 28.iii.1987, B. V. David.

Host: *Elatostemma* sp. (Sundararaj and David, 1993).

Distribution: India: Maharashtra (Sundararaj and David, 1993).

8. ***Martiniella macarangae*** (Corbett) **Stat. Rev.**

Aleurotuberculatus macarangae Corbett, 1935. *J. fed. Malay. St. Mus.,* **17**: 829.

Martiniella macarangae (Corbett) Jesudasan and David, 1990. *FIPPAT Entomology Series,* **2**: 1-13.

Aleuroclava macarangae (Corbett) Martin, 1999. *CSIRO Entomology Technical Paper,* **38**: 31.

Material examined. Nil.

Host. *Macaranga* sp. (Corbett, 1935).

Distribution: Malaya: Kuala Lumpur and Rawang (Selangor) (Corbett, 1935).

9. ***Martiniella papillata*** Sundararaj and Dubey

Martiniella papillata Sundararaj and Dubey, 2004. *Entomon*, **29** (4): 357-360.

Aleuroclava papillata: Martin and Mound, 2007. *Zootaxa*, **1492**: 11.

Martiniella papillata: Sundararaj and Pushpa, 2011. *Advancements in Invertebrate Taxonomy and Biodiversity:* 511

Material examined: India: Goa: Volpoi, paratype puparium, on *Xeromphis spinosa*, 27.ii.2001, A. K. Dubey.

Host: *Xeromphis spinosa* (Sundararaj and Dubey, 2004); *Buettneria aspera*, *Schima wallichii* (Lalneihpuia and William, 2011).

Distribution: India: Goa (Sundararaj and Dubey, 2004).

10. ***Martiniella sepangensis*** (Martin and Mound) **Comb. nov.** (Fig. 7 – 13)

Taiwanaleyrodes macarangae Corbett, 1935: 840.

Aleuroclava sepangensis: Martin and Mound, 2007: 11.

This species is reported for the first time from India. A detailed redescription of the species is given.

Puparium: Small, broadest across I abdominal segment; 0.45-0.50 mm long, 0.30-0.33 mm wide; oval, narrowing posteriorly; white, without secretion of wax; found singly on the under surface of leaves.

Margin: Finely crenulate, 40-42 crenulations in 0.1 mm. Anterior and posterior marginal setae respectively, 8 µm and 10 µm long. Thoracic tracheal pore regions not indicated while caudal tracheal pore distinct.

Dorsum: Submargin separated from the dorsal disc by a thin submarginal ventral fold, without striations; abdominal segments II-V and VII with chitinised thickenings and extending into subdorsal area, dorsum smooth without any granules or wavy markings. Longitudinal moulting suture reaching margin, transverse moulting suture reaching outer subdorsum.

Chaetotaxy: Two pairs of long tuberculate setae- cephalic setae 280-300 µm long (basal long elevated tubercle 105-108 µm long and the seta at apex 175 to 192 µm long) and first abdominal setae 225-240 µm long (basal long elevated tubercle 75-80 µm and the seta at apex 150 to 160 µm long); a pair of minute eighth abdominal setae cephalolaterad of vasiform orifice 5 µm long and a pair of submarginal caudal setae 115-125 µm long.

Vasiform orifice: Cordate, distinctly notched at caudal end with its lateral walls ridged, 42-47 µm long, 38-42 µm wide; operculum cordate, 22-25 µm long, 21-24 µm wide, filling the orifice and obscuring lingula, a transverse elliptical porous area at the anterior end of vasiform orifice. Thoracic tracheal furrows indistinct, caudal tracheal furrow distinct, cylindrical shape, closed at its anterior end, without any markings, 50-55 µm long, 11.5-12.5 µm wide. Pores and porettes not evident.

Venter: A pair of ventral abdominal setae 6 µm long, 19 µm apart. Antennae reaching base of prothoracic legs. Thoracic tracheal folds not indicated while caudal tracheal fold distinct.

Material examined: India: Karnataka: Varthahalli, 5 puparia on *Macaranga* sp., 3.ii.2015, D. Vimala.

Host: *Macaranga megalophylla* (Corbett, 1935); *Macaranga* sp.

Distribution: Malaya: Sepang (Selangor) (Corbett, 1935): India: Karnataka: Varthahalli (new distribution record).

11. ***Martiniella srilankaensis*** (David) **Comb. nov.**

Taiwanaleyrodes srilankaensis David, 1993: 29.

Aleuroclava srilankaensis: Manzari and Quicke, 2006: 2470.

Material examined: None.

Host: *Macaranga* sp. (David, 1993).

Distribution: Sri Lanka: Yattogoda (David, 1993).

12. ***Martiniella tripori*** (Dubey and Sundararaj)

Taiwanaleyrodes tripori Dubey and Sundararaj, 2006. *Entomon*, **31** (1): 73-76.

Aleuroclava tripori: Martin and Mound, 2007. *Zootaxa*, **1492**: 10.

Martiniella tripori: Sundararaj and Pushpa, 2011. *Advancements in Invertebrate Taxonomy and Biodiversity:* 511.

Material examined: India: Karnataka: Balehonnur, 9 puparia on *Ficus auriculata*, 5.vi.2013, T. Amuthavalli.

Host: Unidentified plant (Dubey and Sundararaj, 2006); *Ficus auriculata* (new host record).

Distribution: India: Kerala (Dubey and Sundararaj, 2006).

Martiniella is not considered as a valid genus with the assumption that the tuberculate nature of cephalic and first abdominal setae is a variable character without any scientific facts (Martin, 1999). In the present study it is observed beyond doubt that it is not a variable character and hence it is fit to consider *Martiniella* as a valid genus. It is a genus of Oriental region, so far reported from Hong Kong, India, Malaysia, Sri Lanka and Taiwan. It comprises 12 species, with the inclusion of those species originally placed in *Aleurotuberculatus* viz., *Martiniella canangae* (Corbett), *M. macarangae* (Corbett), and *Taiwanaleyrodes* viz., *M. baccaureae* (Corbett) **Comb. nov.,** *M. fici* (Corbett) **Comb. nov.,** *M. fletcheri* (Sundararaj and David), *M. indica* (Singh), *M. sepangensis* (Martin and Mound) **Comb. nov.** and *M. srilankaensis* (David) **Comb. nov.** With the six already known species viz., *M. ayyari* Sundararaj and David, *M. fletcheri* (Sundararaj and David), *M. indica* (Singh), *M. lefroyi* Sundararaj and

David, *M. papillata* Sundararaj and Dubey and *M. tripori* Dubey and Sundararaj and the record of *M. sepangenis* (Martin and Mound) from Karnataka brings the number of Indian species of *Martiniella* to seven. Six species viz., *M. baccaureae* (Corbett), *M. canangae* (Corbett), *M. fici* (Corbett), *M. indica* (Singh), *M. macarangae* (Corbett) and *M. sepangensis* (Martin and Mound) are reported from Malaysia and a species *M. srilankaensis* (David) from Sri Lanka. *M. indica* (Singh) is known to occur in India, Malaysia, Hong Kong and Taiwan and *M. sepangensis* (Martin and Mound) is now known from Malaysia and India

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