A new species and first record of the genus *Tuberaleyrodes* Takahashi (Hemiptera Aleyrodidae) from India

Anil Kumar Dubey
Zoological Survey of India, Andaman and Nicobar Regional Centre, Andaman and Nicobar Islands, Port Blair, India

Abstract

The whitefly genus *Tuberaleyrodes* Takahashi is reported for the first time from India with description of a new species, *Tuberaleyrodes monpa* sp. nov. The new species was found infesting leaves of *Macaranga peltata* (Roxburgh) Muller (Euphorbiaceae) in the State of Arunachal Pradesh in North-East India. Euphorbiaceae is a new host family record for *Tuberaleyrodes* species. The new species differs from its Malaysian congener *Tuberaleyrodes aequalis* Dubey et Martin in having fewer submarginal setae, prominent thoracic tracheal pores, large median tubercles on abdominal segments I-VII and in the shape of vasiform orifice.

**Key words:** Arunachal Pradesh, *Macaranga*, monpa, new record, whitefly.

Introduction

Whiteflies are exclusively phloem sap-sucking hemipteran insects and some of them are pests of agricultural crops. The taxonomy of this group is based on morphology of the fourth larval stage pupal case (puparium). Currently, the family Aleyrodidae includes 1705 species belonging to 192 genera and placed in four subfamilies including one fossil subfamily Bernaeinae Schcherbakov (Schcherbakov, 2000; Evans et al., in press). The whitefly genus *Tuberaleyrodes* Takahashi was established for a single species, *Tuberaleyrodes machili* Takahashi from the Oriental region (Takahashi, 1932). *Tuberaleyrodes* was established based on the presence of dorsal setae on elevated cuticle or elongate tubercles. So far, the genus was comprised of 13 species worldwide with distribution in Brunei (Borneo), China, Hong Kong, Japan, Malaysia, Sulawesi and Taiwan (Dubey and Martin, 2018); it is reported here for the first time from India with description of a new species, *Tuberaleyrodes monpa* sp. nov. bringing the total number of species to 14, worldwide. The new species was found infesting leaves of *Macaranga peltata* (Roxburgh) Muller (Euphorbiaceae) in Arunachal Pradesh, India. The type locality is the largest state in North East India and shares its borders with adjoining countries Bhutan, China and Myanmar. Previous and present records of the genus indicate that it is distributed in Indo-China, Indo-Myanmar to South East Asia. *Tuberaleyrodes* shares characteristics of the dorsal tuberculate setae with *Acanthaleyrodes* Takahashi which is distributed in China, Hong Kong, India and Taiwan, but the latter differs in having posteriorly elevated vasiiform orifice (Takahashi, 1931). *Tuberaleyrodes* species prefer to feed on lauraceous hosts (Lauraceae), but other host plant families such as Annonaceae, Anacardiaceae, Myristicaceae, Symplocaceae are also recorded (Dubey and Martin, 2018). The discovery of *T. monpa* on *M. peltata* adds Euphorbiaceae as a new host plant family for the genus *Tuberaleyrodes*. Line drawings, images of holotype and SEM microphotographs on leaf surfaces are provided with description. An identification key to puparia of all the *Tuberaleyrodes* species included here is updated from Dubey and Martin (2018).

Materials and methods

The pupal cases of the new species, *T. monpa* were collected on the leaves of *M. peltata* from Sago forests in Arunachal Pradesh, northeastern India. Puparia were mounted on slides following Dubey and David (2012). A DM500 Leica compound microscope with DFC500 digital camera configuration was used for identification and imaging of the holotype. SEM images were taken with an EVO MA 10 microscope (Carl Zeiss, Jena, Germany; 20 kV/ EHT, 20 Pa, 130× to 101,000× magnifications) (24 nm Au-Pa alloy coat) following Dubey and Ramamurthy (2013). SEM imaging was done at Division of Entomology, Indian Agricultural Research Institute, New Delhi. Standard terminologies are used for puparial morphology, following Bink-Moenen (1983), Martin (1985) and Gill (1990). The holotype and 2 paratypes are deposited in the Zoological Survey of India, Kolkata and one paratype in the National Forest Insect Collection, Forest Research Institute, Dehradun, India.

Results

**Genus Tuberaleyrodes** Takahashi 1932

Type species: *Tuberaleyrodes machili* Takahashi 1932: 29.

Diagnosis: Puparium elliptical or oval, with distinct tubercles on the dorsum, often some or all of them elevated, with some dorsal and other setae fixed in a socket located on elevated tubercles, referred to as tuberculate setae. Longitudinal moulting suture reaching anterior margin and transverse moulting suture reaching submedian area. Thoracic tracheal pores and clefts usually indicated. Cephalic, first, eighth abdominal and caudal setae present. Vasiform orifice rounded or elongate. Operculum filling most of the orifice. Lingula tip slightly exposed. Ventrally, paired ventral abdominal setae and a submarginal ventral fold may be present (see more details in Dubey and Martin, 2018).

Distribution. Taiwan (Takahashi, 1934; 1935); Japan (Takahashi, 1958); Hong Kong (Martin and Lau, 2011); Malaysia, Brunei (Borneo), Sulawesi (Dubey and Martin, 2018); China (Wang et al., 2013); India (new record).

Remarks. The genus is reported for the first time from...
India. Puparia of the two whitefly genera, Acanthleyrodes and Tuberaleyrodes, only are known to have the elevated dorsal tubercles bearing setae (tuberculate setae). Acanthleyrodes differs from Tuberaleyrodes in having the vasiform orifice placed on a prominent protuberance. Sometimes this elevation is longer than the distance between the base of orifice and the puparial caudal margin, and the caudal furrow does not connect the posterior end of the orifice and the puparial caudal margin. (Dubey et al., 2014).

### Key to the puparia of Tuberaleyrodes species described worldwide

(Updated from Dubey and Martin, 2018)

1. Puparium subcircular; eighth abdominal setae nearly twice the length of vasiform orifice or longer; caudal furrow ridges/margins made up of prominent tubercles and overlapping with caudal fold; a prominent submarginal ventral fold demarcating ventral submarginal area with two parallel lines or a groove; caudal fold margins merging with submarginal ventral fold; Malaysia ............................................................... T. ordo Dubey et Martin 2018

2. Submargin with 12 or 14 pairs of tuberculate setae (including caudal pair); apex of all of these setae reaching beyond margin, submedian and/or subdorsal setae absent ................................................................. 3

3. Submargin with less than 10 pairs of tuberculate setae, apex of these setae may reach beyond margin, submedian and/or subdorsal setae present ................................................................. 4

4. Tuberculate setae present near termination of abdominal segment sutures II/III-VII 8

5. Median length of abdominal segment VII shorter than VI, almost half the length of segment VI 6

6. Six pairs of long subdorsal tuberculate setae present; eight pairs of simple submarginal setae present along the bases of tuberculate setae; mesothoracic setae absent; China ............................................................... T. lauri Dubey et Wang 2013

7. Nine pairs of long submarginal tuberculate setae present; simple submarginal setae absent; mesothoracic setae present; Malaysia ............................................................... T. rambutana Takahashi 1955

8. Thoracic tracheal pore area deeply invaginated and marked with C-shaped internal rim, shallow indent likely but without internal chitinised rim; both meso- and metathoracic or at least mesothoracic setae present; Malaysia ............................................................... T. variabilis Dubey et Martin 2018

9. Four pairs of tuberculate setae present near termination of abdominal segment sutures II/III to posterior to segment VIII and one pair of simple setae present near caudal furrow; median tubercules and minute tubercules absent on cephalothorax and abdominal segments; apex of antennae reaching beyond the base of prothoracic legs; Borneo ............................................................... T. bruneiensis Dubey et Martin 2018

10. Puparia of the two whitefly genera, Acanthleyrodes and Tuberaleyrodes only are known to have the elevated dorsal tubercles bearing setae (tuberculate setae). Acanthleyrodes differs from Tuberaleyrodes in having the vasiform orifice placed on a prominent protuberance. Sometimes this elevation is longer than the distance between the base of orifice and the puparial caudal margin, and the caudal furrow does not connect the posterior end of the orifice and the puparial caudal margin. (Dubey et al., 2014).
Figure 1. Tubereleyrodes monpa sp. nov., line drawings, holotype puparium: 1A) Puparium; 1B) Thoracic tracheal pore; 1C) Vasiform orifice. FAS- First abdominal setae.

Taxonomic description
Tubereleyrodes monpa sp. nov. (figures 1-3)

Puparium: White, with secretion of little wax deposits; oblong (figure 1A, 3A); widest from metathorax to abdominal segment II region; 1700-1750 µm long, 1300–1400 µm wide; found singly on the underside of leaves, one puparium per leaf.

Margin - smooth or faintly irregularly crenulate; 23 crenulations in 0.1 mm. Caudal and thoracic tracheal pores (figure 1B, 2C, 3B) indicated with C-shaped invaginations. Anterior and posterior marginal setae 15-25 and 28 µm long, respectively.

Dorsum - submargin not demarcated from the dorsal disc with a faint crease. Submargin with transverse ridges, reaching subdorsal area. Submarginal setae reaching beyond margin (figure 2D, 3C). Longitudinal moulting suture reaching margin and transverse moulting sutures reaching submedian area, curving anteriorly and terminating on metathorax. Submedian tubercles present in longitudinal rows on cephalothorax and abdomen (figure 2A, 2B). Median tubercles present on abdominal segments I-VII (figure 2B). Pro-meso-, meso-metathoracic and abdominal intersegmental sutures prominent. Submedian depressions present. Cephalothorax (725-755 µm) was smaller than the abdomen (969-1020 µm), medially. Median length of mesothorax (80-88 µm) slightly longer than metathorax (67-85 µm). Median length of abdominal segments I-VIII subequal to the segment VII. Median length of abdominal segments I-VIII (A1-A8) measured as: A1 100-102, A2 75-85, A3 77-88, A4 90-95, A5 87-95, A6 70-82, A7 70-82, A8 42-48 µm. Geminate pores present, pore/porette spacing approximately 5 µm. Five pairs of geminate pores between the first abdominal setae. Thoracic furrows absent. Caudal tracheal furrow narrow, 225-240 µm long, 7-13 µm wide; caudal ridges present, apically bearing a pair of caudal setae. Pockets continuous.

Vasiform orifice - circular in mounted puparia (figure 1C, 2F), subcircular in SEM images (figure 3D), not elevated posteriorly, inner margin smooth, 67-75 µm long, 70-73 µm wide; operculum subcordate, almost filling the orifice in length, upper surface with 3-4 fine grooves, inner apical margin with microtrichia, 50-58 µm long, 42-50 µm wide, broadest at middle, apical end 25 µm wide; apex of lingula visible.
Figure 2. *Tuberaleyrodes monpa* sp. nov., holotype puparium: 2A) Cephalothorax; 2B) Abdomen; 2C) Thoracic tracheal pore; 2D) Submarginal setae; 2E) Submedian tubercles, legs; 2F) Vasiform orifice.

_Venter_ - paired ventral eighth abdominal setae 37–40 μm long, 57-70 μm apart. Thoracic and caudal tracheal folds absent. Antennae reaching the base of the prothoracic legs (figure 2E), 122-137 μm long (including keel, 12 μm long). Microsetae at base of prothoracic legs 3-7 μm long, meso-, and metathoracic legs 7-10 μm; microsetae also present near apical pads. Spiracles and adhesive sacs present.

_Chaetotaxy_ - cephalic, first, eighth abdominal and caudal setae, 95-33, 57-60, 7-13 and 165 μm long respectively. Caudal setae in row of submarginal setae. Submarginal tuberculate setae 12 pairs, 155-185 μm long.

Host plant: Euphorbiaceae: *Macaranga peltata* (Roxburgh) Muller.

_Type material_

Holotype: one puparium on a slide. INDIA: Arunachal Pradesh, Basar, Sago forests, 5 km from Basar, one puparium on slide, on *Macaranga peltata*; 24.v.2013; 27°96.14'N, 94°78.70'E, A. K. Dubey (Deposited in the ZSI, Head Quarter, Kolkata, India).

Paratypes: 3 puparia on 3 slides, collection data same as for the holotype (ZSI 2, NFIC-FRI 1).
Figure 3. *Tuberaleyrodes monpa* sp. nov., SEM microphotographs: 3A) Puparium, dorsal view; 3B) Thoracic tracheal pore; 3C) Submarginal setae; 3D) Vasiform orifice.

**Etymology**

The species is named in honour of the ‘Monpa’ tribes of Arunachal Pradesh, the only tribes in the state known for nomadic life.

**Distribution**

India: Arunachal Pradesh.

**Comments**

Puparia of the new species are similar to those of *T. aequalis* Dubey et Martin but differ in the shape of the vasiform orifice and in having 12 pairs of submarginal tuberculate setae (including caudal setae), prominent thoracic tracheal pores and large median tubercles on abdominal segments I-VII. The record of *Tuberaleyrodes* from India confirms its natural distribution range in the Indo-Pacific region.

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Author’s address: Anil Kumar DUBEY (corresponding author: anil.2kd@gmail.com), Zoological Survey of India, Andaman and Nicobar Regional Centre, Andaman and Nicobar Islands, Port Blair, India 744102.

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