



First record of three exotic whitefly pests (Hemiptera, Aleyrodidae) from Andaman and Nicobar Islands, India

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ABSTRACT: Three exotic whitefly pest species, *Aleurodicus rugioperculatus* Martin, *Aleurothrixus floccosus* (Maskell) and *A. trachoides* (Back) have been recorded for the first time from the Andaman and Nicobar Islands, India. Severe infestation of *A. floccosus* on guava; *A. rugioperculatus* on coconut and *Cinnamomum* and *A. trachoides* on tomato, guava and glory bower was observed. Tomato and glory bower are new host plant records for *A. trachoides*, and *Cinnamomum* for *A. rugioperculatus*. Puparial diagnosis and photographs of habitus are provided to facilitate identification of these species.

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KEY WORDS: New hosts, *Aleurodicus rugioperculatus*, *Aleurothrixus floccosus*, *A. trachoides*, SEM, puparium

More than 110 exotic insect species had been reported from India, of which, whiteflies and mealybugs constitute a major part (Mandal, 2011). The immatures of whiteflies are small sized and often overlooked on leaf surfaces, and their accidental introduction with associated host plants is likely in newer areas by anthropogenic activities. Of the eighth exotic whitefly species known from India (Sundararaj *et al.*, 2017, 2021) viz., *Aleurodicus dispersus* Russell feeds on more than 500 host plants, *Aleurodicus rugioperculatus* Martin on 40 host plants, *Aleurotrachelus atratus* Hempel on 4 host plants, *Aleurothrixus floccosus* (Maskell) and *Aleurothrixus trachoides* Back on 37 host plants, *Paraleyrodes bondari* Peracchi on 34 host plants, *Paraleyrodes minei* Éaccarino on 25 host plants and *Tetraleurodes acaciae* (Quaintance) on 5 host plants, the latter *T. acaciae* is not considered as a pest, and *A. floccosus* is reported severely infesting guava only. Among

these, *P. bondari* and *P. minei* (Dubey, 2019; Vidhya *et al.*, 2019) were reported recently invaded in Andaman and Nicobar Islands (*A. dispersus* was previously recorded). Here, three whiteflies, *A. rugioperculatus*, *A. floccosus* and *A. trachoides* are reported for the first time from the Andaman and Nicobar Islands. All the species of the subfamily Aleurodicinae with Neotropical origin, viz., *A. dispersus*, *A. rugioperculatus*, *P. bondari* and *P. minei* are highly polyphagous, and the latter three extensively feed on monocot hosts, arecanut and coconut (Mohan *et al.*, 2019).

The whitefly species belonging to subfamily Aleurodicinae have large sized puparia compared to *Paraleyrodes* species, and possess a single wing vein in adults. Adult whiteflies of the genus *Paraleyrodes* Quaintance, 1909 have a median ocellus, an ancestral character described in Cretaceous taxa (Drohojowska and Szewo, 2015).

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An invasive whitefly of the subfamily Aleyrodinae, commonly known as the woolly whitefly, *Aleurothrixus floccosus* (Maskell) is severely infesting guava only (Fig. 1d) in Andaman and Nicobar Islands, and population of *A. trachoides* was high on *Volkameria inermis* L. (known as the glory bower, is flowering plant in the family Lamiaceae), covering entire ventral surface of the leaves (Fig. 1g), but much less on guava and tomato crops. Adults and immatures of these species secrete copious amount of wax that leads to sooty mold development on leaf surfaces, particularly in coconut, causing yellowing of leaves and fungal growth. The host plants and biology of these species are already given in detail (Selvaraj *et al.*, 2020; Sundararaj *et al.*, 2021). Awareness on invasion of exotic whiteflies was brought to notice through several publications, but economic losses caused by these whiteflies have not yet been assessed for India. The host plants list published by Sundararaj *et al.* (2021) clearly indicates low to moderate level of infestation of exotic whiteflies and mostly on the tree species. The objective of this study is to authenticate occurrence of these pest whiteflies in Andaman and Nicobar Islands and provide differential diagnoses for identification purpose. A brief diagnosis for each newly reported exotic whitefly is provided with photographs of puparial habitus on leaves and scanning electron microscope (SEM) microphotographs. Biological observations on habitus are also given for differentiating intermingled co-existing exotic whitefly species. All of these species feed on agricultural or horticultural crops, and fruit crops, which are directly consumed, and use of natural enemies could be better choice than synthetic insecticides. These observations and diagnosis will help in diagnosing invaded whitefly pests and explore their natural enemies through rearing for implementation of pest management practices.

Puparia of the pest whiteflies were collected in zip-lock covers from the Andaman and Nicobar Islands (Dubey and David, 2012). Photograph of the puparial habitus of *A. rugioperculatus*, *A. trachoides* and *P. bondari* on the leaf was taken using Nikon Cool Pix 9 camera. *Aleurothrixus floccosus* images on guava leaves were taken using

Redmi 9 pro mobile camera. The identity of the whiteflies was confirmed after mounting of the puparia. SEM images were taken using EVO MA 15 microscope (Carl Zeiss, Jena, Germany) at 180× magnification (20 kV/EHT; 20 Pa; 24 nm; Au–Pa coat). SEM imaging was done from the Zoological Survey of India (ZSI), Kolkata, India, following the procedure given in Dubey and Ramamurthy (2013).

***Aleurodicus rugioperculatus* Martin, 2004** (Figs. 1a-c)

Diagnosis: In life, the puparia have cloudy cuticular pigmentation on dorsal surface. Puparium of this species is identifiable in having atypically narrowly acute lingula with four setae placed close to the apex; lingula reaches near puparial caudal margin, and the band of submarginal pores is interrupted immediately posterior to lingula apex.

Host plants: Sundararaj *et al.* (2021) provided a list of host plants. *Cinnamomum malabattrum* (new record).

Distribution: India: Karnataka, Kerala (Sundararaj *et al.*, 2021); Andaman and Nicobar Islands (new record).

Material examined: INDIA- Andaman and Nicobar Islands, 2 puparia, on coconut, 9.viii.2019, Kishori Nagar, 13°16.268' N; 92°57.573' E (ZSI/ ANRC/ T/13552); 5 puparia Karnataka, Kerala (Sundararaj *et al.* (2021), 1.iii.2021, Port Blair, 10°37.241' N; 92°43.353' E (ZSI/ ANRC/T/13359); 2 puparia, on coconut, 18.ii.2022, Haddo, 11°37.241' N; 92°43.353' E (ZSI/ ANRC/T/16180); 7 puparia, coconut, 13.iii.2019, Tugapur, 12°49.525' N; 90°50.117' E (ZSI/ ANRC/T/14781); 6 puparia, coconut, 3.ii.2020, Kalipur, 10°36.219' N; 92°31.209' E (ZSI/ ANRC/T/14782); 6 puparia, on *Cinnamomum malabattrum*, 20.i.2022; Port Blair, 11°38.803' N; 92°43.659' E (ZSI/ ANRC/T/15940) (deposited in the ZSI, India).

Remarks: This whitefly is severely infesting underside leaves of the coconut plant (Fig. 1a-c). The copious amount of wax secretion from immature and adults' leads sooty mold development on underside of leaves. The leaves develop yellow chlorotic spots on feeding sites which gradually



Fig. 1 - Whitefly infestation. a-c *Aleurodicus rugioperculatus* Martin, 2004 on coconut; d-f *Aleurothrix floccosus* (Maskell, 1896) on guava; g-h *Aleurothrix trachoides* (Back, 1912) on glory bower



Fig. 2 - SEM microphotograph of puparium of *Aleurothrixus floccosus*



Fig. 3 - SEM microphotograph of puparium of *Aleurothrixus trachoides*

increases with population build-up, then weakens and gradually dries. The infestation was more severe on matured leaves, which appears smoky brown to black on underside. This species was observed colonising with other invasive whitefly, *Paraleyrodes bondari* Peracchi (Fig. 1c). Puparia of *P. bondari* can be identified being housed in wax nest made by radiating wax threads' deposits, and the adults have two rows of smoky black spots on forewings.

***Aleurothrixus floccosus* (Maskell, 1896)** (Figs. 1d-f, 2)

Diagnosis: Puparia of this species differ from *Aleurothrixus trachoides* (Back) in having creamy white colour and covered with dull brown covering of wax deposit.

Host plants: Sundararaj *et al.* (2021) provided a list of host plants.

Distribution: India- Kerala, Karnataka, Lakshadweep, Tamil Nadu (Sundararaj *et al.*,

2021), Andaman and Nicobar Islands (new record).

Material examined: INDIA- Andaman and Nicobar Islands, 7 puparia, 31.i.2020, Hut bay, 16 km, 10°42.449' N; 92°32.946' E (ZSI/ ANRC/T/13758); 10 puparia, 3.ix.2018, R. K. Dam, 10°42.686' N; 92°31.396' E (ZSI/ ANRC/T/13759); 9 puparia, 10.v.2021, Haddo, 10°37.241' N; 92°43.353' E (ZSI/ ANRC/T/13760); 5 puparia, 8.v.2021, Bhatu Basti, 11°36.905' N; 92°45.805' E (ZSI/ ANRC/T/13761); 12 puparia, 2.v.2021, Sippighat, 11°36.669' N; 92°40.502' E (ZSI/ ANRC/T/13762) (deposited in the ZSI, India).

Remarks: This whitefly is known to feed on *Citrus* sp. in the Neotropical region (Malumphy *et al.*, 1915), but it is severely infesting only guava leaves in India. The varied feeding preferences for this whitefly in Neotropical *versus* Oriental region is unknown. Puparial population was observed almost entirely covering the underside of the matured leaves (Fig. 1d-f) whereas the tender apical leaves were found infested with eggs and immatures. Immatures and adults population were not found

on the upper side of the leaves. This species is observed co-existing with *A. dispersus* (Fig. 1f) and *A. trachoides* on a single host tree but on separate branches. *Aleurothrix trachoides* population was much less on guava and found intermingled with *A. dispersus*. Both *A. dispersus* (large sized) and *A. floccosus* (small sized) puparia are pale white and covered with copious amount of wax secretion whereas *A. trachoides* puparia are black with small marginal wax threads.

***Aleurothrix trachoides* (Back, 1912)**

(Figs. 1g, h, 3)

Diagnosis: Puparia of *A. trachoides* are similar to *A. floccosus* in being black, in having fringe of wax around the body margin, bands of submarginal microtubercles and the abdominal segments are narrowly rhachisform. The bands of submarginal microtubercles are lacking in *A. floccosus* and in life, the puparia are pale white to dull creamy and surrounded with a fine fringe of white wax threads.

Host plants: Sundararaj *et al.* (2021) have provided a list of host plants. *Solanum lycopersicum* L. and *Volkameria inermis* L. (new records).

Distribution: India- Karnataka, Kerala (Sundararaj *et al.*, 2021); Andaman and Nicobar Islands (new record).

Material examined: INDIA- Andaman and Nicobar Islands, 7 puparia, 11.iv.2019, South Andaman, Bhatu Basti, 10°35.368' N, 92°32.115' E (ZSI/ANRC T-7915); 4 puparia, 20.ii.2019, South Andaman, Port Blair, 11°40.372' N; 92°43.509' E (ZSI/ANRC T-7561); 1 puparia, 12.i.2020, Port Blair, 10°37.241' N; 92°43.353' E (ZSI/ANRC/T/10719); 2 puparia, 12.ii.2020, Port Blair, 10°37.241' N; 92°43.353' E (ZSI/ANRC/T/10720); 1 puparium, 2.ii.2020, Little Andaman, Krishna nalah, 10°40.695' N; 92°32.511' E, (ZSI/ANRC/T/10401); 4 puparia, 3.ii.2020; Little Andaman, Kalipur forest, 10°36.219' N; 92°31.209' E (ZSI/ANRC/T/10402); 5 puparia, 9.viii.2019, Kishori Nagar, 13°16.268' N; 92°57.573' E (ZSI/ANRC/T/13553); 12 puparia, on *Capsicum annum*, 2.xii.2021, Port Blair, 11°38.803' N; 92°43.659' E (ZSI/ANRC/T/15956); 12 puparia, on *C. annum*, 2.xii.2021, Port Blair,

11°38.803' N; 92°43.660' E (ZSI/ANRC/T/15957); 12 puparia, on *C. annum*, 2.xii.2021; Port Blair, 11°38.803' N; 92°43.658' E (ZSI/ANRC/T/15958); 4 puparia, on *C. annum*, 20.ii.2022, Ranchi Basti, 11°38.801' N; 92°43.659' E (ZSI/ANRC/T/16177); 15 puparia, 18.ii.2022, Haddo, 11°37.241' N; 92°43.353' E (ZSI/ANRC/T/16181) (deposited in the ZSI, India).

Remarks: This species was first recorded from India by Dubey and Sundararaj in 2015, initially from *Duranta* plant in Bangaluru, Karnataka, which is mainly used for fencing and boundary purposes. Later, it was found colonising on chilli and tomato. This species is reported here colonising on tomato and *V. inermis* in Andaman and Nicobar Islands. It was found severely infesting *V. inermis*, but a few scattered puparia are found on tomato. Since tomato is a seasonal crop and likely to get re-infested from the population build-up on *V. inermis* which is serving as a reservoir host during non-cropping season.

Apart from the three exotic species reported here, the other four invasive whitefly species on record from the Andaman and Nicobar Islands are *A. dispersus*, *Bemisia tabaci* (Gennadius), *P. bondari* and *P. minei*. These whiteflies were observed severely infesting the matured leaves of coconut, guava and tomato, however early stage population build-up was obvious on tender leaves. Leaves fall with maturity, and new population of whitefly pests' builds on fresh leaves that vary with the weather conditions. In these circumstances coupled with occurrence of natural enemies, the economic loss remains non-evaluated. The indirect damage caused by sooty mold development could more harm to plants along with the direct damage by feeding of insects. Considering population of *A. floccosus* on guava and *A. rugioperculatus* on coconut the direct damage could be more serious, particularly on young stage plants. Further, molecular study on mitogenome could be useful in understanding evolution of these pests.

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