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Comparative studies on exotic neotropical whiteflies of coconut

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Abstract
Three exotic whiteflies appeared within a span of two years in India's coconut plantations *viz.,* Rugose Spiralling Whitefly (*Aleurodicus rugioperculatus* Martin) (Martin, *et al*) [6], two nesting whitefly species, *Paraleyrodes bondari* Peracchi (Bondar's nesting whitefly) and *Paraleyrodes minei* Iaccarino were reported in the present study (Iaccarino, *et al*) [4]. The whitefly species are polyphagous pest with more than 200 host plants such as coconut (Iaccarino, *et al*.) [4], guava (Chandrika *et al*.) [1], banana (Martin *et al*.) [7], mango (Dickey *et al*.) [2]. The prolonged during dry spell coupled with decreased relative humidity appears to favour the spread of the pest in coconut plantations (Dickey *et al*.) [2].

Keywords: Comparison, exotic whiteflies, India and coconut palm

Introduction
Whiteflies are polyphagous sucking pests of global significance because of their direct feeding damage, as vectors of plant diseases as well as inducing secondary deposits of sooty moulds on leaf surfaces by honeydew production, thus impairing photosynthesis (Dickey *et al*.) [2]. The invasive rugose spiralling whitefly (*Aleurodicus rugioperculatus* Martin) which was reported on coconutpalms from Palakkad (Kerala) (Chandrika *et al*.) [1], and Pollachi (Tamil Nadu) (Sundararaj, R *et al*., 2018) [8] during 2016.First incidence of the neotropical invasive Bondar's Nesting Whitefly (BNW), *Paraleyrodes bondari* Peracchi (Hemiptera: Aleyrodidae) in India was reported on coconut palms from Kerala during 2018 (Chandrika, *et al*.) [1]. *Paraleyrodes minei* Iaccarino, was newly recorded in the Andaman and Nicobar Islands, India (Iaccarino, *et al*.) [3]. Occurrence of the exotic neotropical nesting whitefly, *Paraleyrodes minei* Iaccarino in association with Bondar's nesting whitefly, *Paraleyrodes bondari* Peracchi on coconut leaflets was reported from Kerala ,India where these coconut palms were previously infested by the rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin, which was reported from Kerala and Tamil Nadu during 2016 (Iaccarino, *et al*.) [4].

Materials and Methods
The studies were conducted in the Department of Entomology, Anbil Dharmalingam Agricultural college and Research Institute, Tiruchirappalli and Tamil Nadu Agricultural University, Coimbatore, India during 2018-19 and 2019-20.Extensive field survey was conducted at Pollachi and Udumalpet blocks of Tiruppur district in Tamil Nadu. The samples collected were identified as Rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin, Bondar's nesting whitefly, *Paraleyrodes bondari* Peracchi, and another nesting whitefly, *Paraleyrodes minei* on the basis of distinguishing features of the neotropical whiteflies. The weather data from January to June 2019 were correlated with the longevity of neotropical whiteflies.

Aim of the study
The objective of the study is to understand the morphological characters of neotropical whiteflies and factors affecting the pre-disposition of whiteflies.

Distinguishing Morphological Characters
Rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin are very small moth and has a body length of about 2 mm. Wings of adults are white and have dark spots on the forewings. Adults have greyish eyes. (Martin *et al*.) [6]. The males are slightly smaller than females and have elongate claspers at the distal end of the abdomen. Eggs are elliptical and yellowish in

colour, with a short stalk and are laid singly and associated with irregularly spiralling deposits of white flocculent wax surrounding each egg in a semi-circular spiralling fashion (Martin *et al*.) [7] (Fig. 1).

Bondar's nesting whitefly, *Paraleyrodes bondari* Peracchi species are smaller in size (1.07 mm) than the rugose spiralling whitefly with conspicuous oblique grey bands and unique woollywax nests on the abaxial palm leaflets (Chandrika *et al*.) [1]. They possesses "X"-shaped oblique greyish bands on wings. Presence of flower-petal like ovoid facets on abdominal compound pores (33–35 µm) of the puparium (Sundararaj *et al*.) [8] and conspicuous single dorsal and ventral horn with a pair of apicolateral processes on the adult male aedaegus are the typical morphological identification features (Iaccarino, *et al*.) [4] (Fig 2)

Another nesting whitefly, *Paraleyrodes minei* closely resembles *P. bondari*, but is devoid of the oblique grey bands on the wings and it constructs loosely woven, woolly wax nests (Iaccarino *et al*.) [3]. Female *P. Minei* are white, but males are smoky grey. Male whiteflies have smoky grey wings with whip-like three-segmented antenna that are orange-tinge. (Chandrika, *et al*.) [1]. Female whiteflies are relatively white with a grey blotch at the terminal region, antenna four segmented with the swollen second segment. Cream-coloured egg clusters with short stalks that turn slight pinkish upon eclosion and flat creamy-yellow nymphs with prominent fibre glass strands from the dorsum are some characteristic features (Iaccarino *et al*.) [3]. (Fig 3)

Fig 1: Rugosespiralling whitefly, *Aleurodicus rugioperculatus* Martin

Fig 2: Bondar's nesting whitefly, *Paraleyrodesbondari* Peracchi

Fig 3: Nesting whitefly, *Paraleyrodes minei* Iaccarino

Nature of Damage

The rugose spiraling whitefly starts attacking from the lower leaves of the coconut palm. It drains the sap from the underside of the palm leaves (Dickey *et al*.) [2], producing a significant amount of honeydew which settles on the upper surface of the next lower leaf leading to the growth of black sooty mould. *P. minei* constructs 3 to 30 nest colonies on coconut leaflets and leads to sooty mold production in leaves (Josephrajkumar) [5]. The simultaneous coexistence of *P. bondari* and *P. minei* were also observed in coconut leaflets (Iaccarino *et al*.) [3].

Weather factors

The shift in weather pattern such as deficit monsoon is one of the primary reasons of immediate upsurge of whiteflies. (Chandrika *et al*.) [1]. They are so sensitive to wet season and

heavy rains. Increase in temperature over 2 ºC during summer is another pre-disposing factor for the increase in pest population (Dickey *et al*.) [2]. Longevity of *A. rugioperculatus* is comparatively higher than the longevity of *P. minei* and longevity of *P. minei* over the seasons (Table 1).

Table 1: Longevity of whitefly in correlation with temperature during summer season

Date of observation	Average temperature	Longevity of *P. minei*	Longevity of *P. minei*	Longevity of *A. rugioperculatus*
January 2019	35.3 ^{0}C	13.00(3.67) ^{c}	15.00(3.94)^c	18.00(4.30)^d
February2019	35.6 ^{0}C	12.00(3.54) ^{c}	16.00(4.06)^c	19.00(4.42)^d
March 2019	37.9 ^{0}C	18.00(4.30)^b	22.00(4.74)^{ab}	26.00(5.15)^c
April 2019	38.4 ^{0}C	12.00(3.54)^c	17.00(4.18)^b	20.00(5.34)^b
May 2019	38.9 ^{0}C	28.00(5.34)^a	25.00(5.05)^a	30.00(5.52)^a
June 2019	33.9 ^{0}C	10.00 (3.24)^d	10.00 (3.24)^d	15.00 (3.94)^e
SEd		1.26	1.01	1.03
CD(0.05)		2.81	2.05	2.30

Natural Enemies

Fifty percent of the Rugose Spiraling Whitefly were parasitized by a tiny hymenopteran parasitoid, (*Encarsia* sp. F: Aphelinidae) has body size of <1 mm size (Martin *et al*.) [7].Lady bird beetles belonging to *Jauravia* sp. (Joseph rajkumar) [5] and a wide array of spiders were also effective in controlling the RSW. The parasitoid and predator recorded in rugose spiralling whitefly was not able to control *P. minei* and *P. bondari.* (Iaccarino, *et al*.) [4] Instead, scavenger beetle, coccinellid beetle and lacewings are able to check the spread of the two nesting whitefly species *viz.,* sooty mould scavenger beetle, *Leiochrinus nilgirianus* (Joseph Rajkumar) [5] and some lady beetle grubs (Martin *et al*.) [7] and lacewings are the natural enemies of *P. Minei* and *P. bondari* nesting whiteflies (Dickey, *et al*.) [2].

Conclusion

The further increase in whitefly population and sooty mould deposits could lead to economic setbacks. The emergence of nesting whiteflies at the receding phase of rugose spiraling whitefly suggests that the nesting whitefly group emerged into after the natural parasitism of *A. rugioperculatus*. Continuous rainfall dislodged the whitefly from underneath the coconut palm fronds.

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