



First record of four whiteflies (Hemiptera: Aleyrodidae) and their natural enemies in Lakshadweep Islands, India

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ABSTRACT: Four whitefly species including three invasive whitefly species viz., rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) on 10 host plants; Bondars nesting whitefly, *Paraleurodes bondari* Peracchi on seven host plants, woolly whitefly, *Aleurothrix floccosus* (Maskell) on guava and *Bemisia euphorbiae* (David & Subramaniam) on two plants were reported for the first time in Lakshadweep. Parasitoid, *Encarsia guadeloupae* Viggiani (Hymenoptera: Aphelinidae) and predators viz., *Pseudomallada* (= *Dichochrysa*) *astur* (Neuroptera: Chrysopidae) and *Cybocephalus indicus* (Coleoptera: Nitidulidae) were found associated with these whiteflies. Distribution of whiteflies along with their host plants and natural enemies in Lakshadweep Islands are given. © 2020 Association for Advancement of Entomology

KEYWORDS: Invasive, whiteflies, Lakshadweep, coconut, guava, natural enemies

INTRODUCTION

Lakshadweep is India's smallest Union Territory located in the Arabian sea comprises of 36 tiny coral islands, 12 atolls, three reefs, five submerged banks and ten inhabited islands (8° and 120-300' North latitude). Agriculture and fisheries are the most widely prevalent economic activity in the territory for their livelihood. Almost all the households have own small or marginal pieces of agricultural land. Although coconut is the main crop in all the islands, banana, guava, papaya, sapota, several vegetables cultivated as intercrop with coconut and ornamental plants are also widely cultivated and grown as landscape and sea erosion plants. Islands of Lakshadweep are rich in biodiversity including insects. Ghosh (1991) documented about 79 species of insects under order

of Coleoptera, Dermaptera, Dictyoptera, Diptera, Lepidoptera, Mantodea, and Orthoptera which feed on different crop plants. Rhinoceros beetle, *Oryctes rhinoceros* L, black headed caterpillar, *Opisina arenosella* Walker, mealybugs, *Pseudococcus* spp. coconut eriophid mite, *Aceria guerreronis* Keifer have been reported as pest of coconut whereas scales, whitefly, serpentine leaf minors, aphids, fruit borer and fruit flies which affect the intercrops (Anonymous, 2012).

Significant contribution on the whitefly fauna of Lakshadweep was made by Ramani (2000) who reported the occurrence of spiralling whitefly, *Aleurodicus dispersus* Russell in 27 islands. Dubey *et al.* (2004) documented the occurrence of 12 whitefly species belonging 11 genera in Lakshadweep. *Bemisia tabaci*, *Dialeuropora*

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decempuncta and *A. dispersus* were found on 4, 3 and 2 host plants, respectively, representing 9 families. Among host plants, *Thespesia populnea* harboured 4 whitefly species (*Aleuroclava complex*, *A. dispersus*, *Aleurolobus marlatti* and *B. tabaci*). The present survey is under taken on the whiteflies infesting coconut and other crop plants in the Island along with their natural enemy's complex.

A survey was conducted in various islands *viz.*, Kavaratti, Amini, Minicoy, Andrott and Keltan of Lakshadweep to investigate the occurrence, intensity of infestation, host plants, distribution and natural enemies of whiteflies during March, 2020. The intensity of damage was assessed randomly on five plants in each location on economically important host plants. Host plant leaves infested with immature stages and puparium in paper envelopes and adults whiteflies in 70% ethanol were collected as described by Dubey and David (2012) along with relevant collection data for further identification and documentation. Part of collected of host plant leaves/parts infested with immature stages and puparium were placed in rearing jar (21×10 cm) for the emergence of parasitoids. The emerging parasitoids were collected using aspirator and preserved in vials containing 70% ethanol for further identification.

Permanent mounts of the puparium were prepared as suggested by Martin (1987) and best mounts were obtained from puparial cases from which adults have emerged. Total of about 49 specimens were mounted representing four species and voucher specimens were deposited in ICAR-NBAIR museum. Identification of the whitefly species and their natural enemies were confirmed by morphological means. Assessment of natural parasitism (%) was determined based on the number of puparium parasitized as against unparasitized pupae in the host leaves. The host plants were identified with the help of plant taxonomists.

Four species of whiteflies, two species each representing the subfamily Aleurodicinae and Aleyrodidae were recorded from Lakshadweep Islands. This include three invasive *viz.*, rugose

spiralling whitefly, *Aleurodicus rugioperculatus* Martin; Bondar nesting whitefly, *Paraleurodes bondari* Peracchi and woolly whitefly, *Aleurothrixus floccosus* (Maskell) and one native species *Bemisia euphorbiae* on two host plants. All the four species were reported for the first time in Lakshadweep islands.

1. Rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin, 2004

Distribution: It is believed to have originated from Central America and its incidence is limited to Belize, Mexico, Guatemala and Florida in Central and North America. In India, it was recorded on coconut and on many other crop plants during 2016 at Pollachi, Tamil Nadu (Sundararaj and Selvaraj, 2017). The pest further rapidly spreads to Karnataka, Kerala, Andhra Pradesh, Telangana, Goa, Assam, West Bengal, Maharashtra, Gujarat and Meghalaya (Sumalatha *et al.*, 2020). The infestation of this whitefly is noticed in Lakshadweep Islands, Amini, Kavaratti, Minicoy, Andrott and Keltan island.

Host plants: Coconut, *Cocos nucifera* (Arecaceae), Indian almond, *Terminalia catappa* (Combretaceae), guava, *Psidium guajava* (Myrtaceae), banana, *Musa* spp. (Musaceae), rose apple, *Syzygium jambos* (Myrtaceae), noni, *Morinda citrifolia*, all spices, *Pimenta dioica* (Myrtaceae), ficus, *Ficus* spp. (Moraceae), sapota, *Manilkara zapota* (Sapotaceae) and portia tree, *Thespesia populnea* (Malvaceae). A total of 20 pupal cases on 10 slides were prepared to determined occurrence of this pest on these host plants.

Rugose spiralling whitefly is a highly polyphagous pest reported to feeds on about 120 plant species including economically important cultivated crops and palms. In India, it was found to feed on about 40 host plants especially coconut, banana, mango, sapota, guava, cashew, ramphal, oil palm, maize, Indian almond, water apple, jack fruit and many other ornamental plants like bottle palm, Indian shot, false bird of paradise and butterfly palm (Selvaraj *et al.*, 2017; Selvaraj *et al.*, 2019).

2. Bondar's nesting whitefly, *Paraleyrodes bondari* Peracchi, 1971

Distribution: *P. bondari* is a native of Neotropical region and it was first described on citrus from Brazil in 1971 (Peracchi, 1971). It was also been reported from Belize, Puerto Rico, Madeira, Comoros, Mauritius, Taiwan, Hawaii and Florida in the USA (Stocks, 2012). In India, its first incidence was reported on coconut palms from Kerala during 2018 (Josephraj Kumar *et al.*, 2019), Karnataka and the Andaman and Nicobar Islands (Vidya *et al.*, 2019). Present study confirms the occurrence of this pest in Lakshadweep islands.

Host plants: Coconut, guava, banana, noni, ficus, portia tree and unidentified plant. A total of 14 pupal cases on slides were prepared to determine occurrence of this pest on these host plants. *P. bondari* is polyphagous in nature and has more than 25 susceptible host plants. In India, it is found to feed on coconut, banana, guava, citrus sp. avocado, cassava, custard apple and ornamental ficus (Vidya *et al.*, 2019).

3. Woolly whitefly, *Aleurothrixus floccosus* (Maskell), 1896

Distribution: *A. floccosus* was first described from Jamaica in 1896 (Martin and Mound, 2007) and native to the Neotropical region wherever citrus is grown (Malumphy *et al.*, 2015). In India, its occurrence was first reported on guava (*Psidium guajava*) in Kozhikode, Kerala (Sundararaj *et al.*, 2020). Subsequently, it was found in Ramanagara, Bengaluru Rural, Bengaluru Urban Mysore and Mandya districts of Karnataka and Coimbatore, Salem and Dharmapuri districts of Tamil Nadu on guava (Unpublished data). The infestation of this whitefly was noticed on guava in three islands of Lakshadweep viz., Kavaratti, Keltan and Amini.

Host plants: It was found infesting guava, *A. floccosus* is polyphagous, reported to feed on 20 plant families, and exhibits a strong preference for citrus (Malumphy *et al.*, 2015) but so far in India, it was found to feed only on guava. A total of 5 pupal cases on slides were examined to confirm the occurrence of this pest on guava.

4. *Bemisia euphorbiae* David & Subramaniam, 1976

Distribution: David and Subramaniam (1976) described this whitefly on *Euphorbia prostrata* from Madurai, Tamil Nadu. Jeritta and David (1986) reported it on *Phyllanthus fratemus* and *P. maderaspatensis* in Tamil Nadu. Mani and Krishnamoorthy (1995) recorded this whitefly on *P. acidus* in Bangalore, Karnataka. The occurrence of *B. euphorbiae* was also reported on Chekurmanis, *Sauropus androgynus* (George and David, 2010),

Host plants: In Lakshadweep it was found infesting Indian gooseberry *P. acidus* and *P. niruri* (Phyllanthaceae). Ten pupal cases on slides were examined to confirm the occurrence of this pest on these plants.

Co-existence: All three invasive species recorded in the survey are believed Neotropical origin and have host preference towards many economically important crop plants including coconut, banana and guava. The co-occurring of these whiteflies was commonly observed in the same palms and even in the same colony indicates probably the pests would have invaded simultaneously into India. *A. rugio-perculatus* co-exists with *A. dispersus* and *P. bondari* on coconut palms whereas *A. floccosus* co-occurred with *P. bondari*, *A. dispersus* and *A. rugio-perculatus* on guava. Similarly, *P. bondari* was coexist with *A. rugio-perculatus* on other host plants. This co-existence and mutual survival of these species is could be due to the marked time partitioning of the resources in their niche for their growth and survival.

Natural enemies: The surveys also revealed the presence of several natural enemies associated with these whiteflies in Lakshadweep. Aphelinid parasitoid, *Encarsia guadeloupae* on *A. rugio-perculatus* and predators viz., *Pseudomallada (=Dichochrysa) astur* and *Cybocephalus indicus* were observed to be feeding on *A. rugio-perculatus*, *A. floccosus* and *Bemisia euphorbiae*. The natural parasitism of *E. guadeloupae* was observed to the extent of 24-46% on *A. rugio-perculatus*.

Exotic non-native invasive whiteflies in India cause direct and indirect yield losses in agriculture, horticulture and forestry crop plants. In the present study, it was found breeding of four more whitefly species in the Lakshadweep islands in addition to earlier report 12 species. Considering the small but unexplored area of Lakshadweep, the present contribution is emphasis the need for further extensive and intensive study of whitefly species occurring in the Lakshadweep. It is believed, these invasive whitefly species might be moved from main land of India through the transportation of crop plants/seedling. Domestic quarantine may be strengthened to prevent the un-deliberate introduction of invasive species into islands. Further, awareness may be created among the island resident and tourist to stop the unwanted introduction of pest from mainland. Prevention is the most economic option and they can be managed strategically through timely implementation of classical biocontrol programme. Further, augmentation and conservation of potential natural enemies is necessary to reduce below the damaging level. Hence it is of utmost importance that effective measures for the prevention of this alien species are to be taken on a long-term basis.

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REFERENCES

- Anonymous (2012) Lakshadweep development Report on Agriculture. file:///C:/Users/ADMIN/Desktop/WFs/in/Lakshadweep/_india_lakshadweep3a.pdf (accessed on 29.08.20).
- Dubey A.K. and David B.V. (2012) Collection, preservation and preparation of specimens for taxonomic study of whiteflies (Hemiptera: Aleyrodidae). In: The whiteflies or mealy winged bugs: biology, host specificity and management (Ed. B.V. David), Germany, Lambert Academic Publishing. pp. 1–19.
- Dubey A.K., Regu K and Sundararaj R. (2004) Aleyrodid (Hemiptera: Aleyrodidae) fauna of the Lakshadweep, India. *Entomon* 29(3): 279-286.
- George P and David B.V. (2010) Two whitefly pests of Chekurmanis, *Sauropus androgynus* Merr in Coimbatore, Tamil Nadu, India. *Entomon* 35 (1): 59-60.
- Ghosh A.K. (1991) Fauna of Lakshadweep. Published by Zoological Survey of India, Kolkata. 441pp.
- Jeritta A.L.R. and David B.V. (1986) Some insects associated with euphorbiaceous weeds. *Pest Management* 1:21-26.
- Josephraj Kumar A., Mohan C., Babu M., Krishna A., Krishnakumar V., Hegde V and Chowdappa P. (2019) First record of the invasive Bondar's nesting whitefly, *Paraleyrodes bondari* Peracchi on coconut from India. *Phytoparasitica* 47: 333–339. DOI.org/10.1007/s12600-019-00741-2
- Malumphy C., Radonjic S., Hrcncic S. and Raicevic M. (2015) New data on the whiteflies (Insecta: Hemiptera: Aleyrodidae) of Montenegro including three species new for the country. *Acta entomologica serbica* 20: 29-41.
- Mani M and Krishnamoorthy A. (1995) Natural enemies of the whitefly, *Lipaleyrodes euphorbiae* David and Subramaniam (Homoptera : Aleyrodidae). *Journal of Biological Control* 9(2): 102-104.
- Martin J.H. (1987) An identification guide to common whitefly pest species of the world (Homoptera: Aleyrodidae). *Tropical Pest Management* 33: 298-322.
- Ramani S. (2000) Fortuitous Introduction of an aphelinid parasitoid of the spiralling whitefly, *Aleurodicus dispersus* Russell (Homoptera: Aleyrodidae) into the Lakshadweep Islands with notes on host plants and other natural enemies. *Journal of Biological Control* 14(1): 55-60.
- Selvaraj K., Venkatesan T., Sumalatha B.V. and Kiran C.M (2019) Invasive rugose spiralling whitefly *Aleurodicus rugioperculatus* Martin, a serious pest of oil palm *Elaeis guineensis* in India. *Journal of Oil Palm Research* 31(4): 651-656.
- Selvaraj K., Sundararaj R., Venkatesan T., Ballal C.R., Jalali S.K., Gupta A. and Mrudula H.K. (2016) Potential natural enemies of the invasive rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin in India. *Journal of Biological Control* 30(4): 236-239.
- Sumalatha B.V., Selvaraj K., Poornesha B. and Ramanujam B. (2020) Pathogenicity of entomopathogenic fungus *Isaria fumosorosea* on invasive rugose spiralling whitefly

- Aleurodicus rugioperculatus* and its effect on parasitoid *Encarsia guadeloupa*. *Biocontrol Science and Technology* 30(10): 1150-1161. DOI.org/10.1080/09583157.2020
- Sundararaj R. and Selvaraj K. (2017) Invasion of rugose spiraling whitefly, *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae): a potential threat to coconut in India. *Phytoparasitica* 45: 71-74.
- Sundararaj R., Selvaraj K., Kalleshwaraswamy C.M., Ranjith M and Sumalatha B.V. (2020) First record of the invasive woolly whitefly *Aleurothrixus floccosus* (Maskell) from India. *Indian Journal of Entomology* 82(1): 88-91.

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