The invasive rugose spiraling whitefly, *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae)

Introduction: Agricultural crops in India are vulnerable to the threat posed from the invasive pest species. Till date 118 exotic species have invaded, which include several economically important whiteflies. Currently, there are 442 species of whiteflies belonging to 63 genera known from India. Two invasive whiteflies, *viz.,* the spiraling whitefly *Aleurodicus dispersus* Russell and the solanum whitefly *Aleurothrixus trachoides* (Back) have invaded India in 1995 and 2014, respectively. Recently, yet another invasive species, *Aleurodicus rugioperculatus* Martin was recorded on coconut palm (*Cocos nucifera* L.) during September, 2016 for the first time from India as well as Oriental region. This species is commonly known as the rugose spiraling whitefly (RSW) or gumbo limbo whitefly. RSW has a wide range of host plants including palms, ornamentals and fruits.

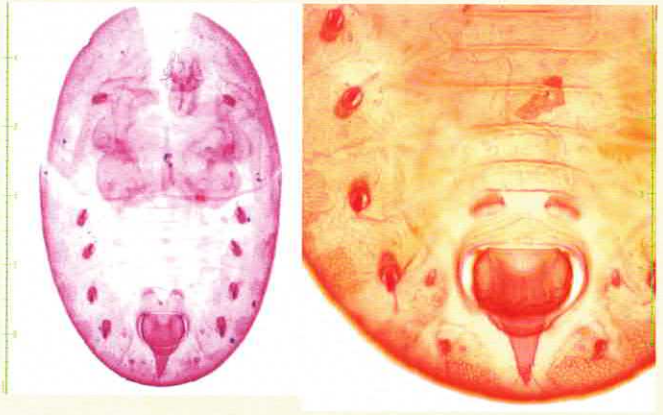
Origin: RSW was described by Martin in 2004 in Belize on coconut. Subsequently, it was reported as a pest on gumbo limbo (*Bursera simaruba* L.) in Miami-Dade county of South Florida in 2009. This whitefly is believed to have originated from Central America and its incidence is limited to Belize, Mexico, Guatemala and Florida in Central and North America. Mode of entry of RSW into India is unknown. However, it is likely that it has entered interception through the trade of plant materials.

Distribution: Initially, RSW infestation was observed in several coconut farms in Coimbatore district. Subsequently, its population increased greatly and spread across the coconut and banana growing regions in Southern India, probably due to the high dispersal potential of the pest and continuous availability of host plants in large areas. Invasion and infestation of RSW so far has been recorded from coconut growing southern states of the country except Karnataka. However, RSW is likely to spread to other states where coconut and banana are cultivated.

Identification characteristics: Colonies were in generally poor in condition with groups of woolly wax puparia untidily grouped under the leaves of the host. RSW is typically characterized by broadly cordate vasiform orifice, operculum ventro-basally spinulose and dorsally characteristically rugose, with a pair of ventro-median fine setae, lingual head protruding beyond vasiform orifice, finely spinulose, apically acute, its four setae situated close to apex.

The puparium of this species can be easily distinguished from *A. dispersus*, the other known con-generic species in India by the presence of a pair of small compound pores on each of abdominal segments VII and VIII, characteristically rugose operculum, atypically narrowly acute lingual apex and reticulated cuticle.

Biology: The pre-oviposition period is 2.7 days, life time fecundity 225.5±26 eggs on bird of paradise (*Strelitzia nicolai* Regel & Korn). Since it has an arrhenotokous parthenogenesis, unmated female produces only male progeny. Adult longevity is 27.5±2.7 and 36.8±3.5 days for females and males, respectively.



Puparium of RSW (National Acc. No. NBAIR-Aleuro /21/2017) showing operculum and characteristic triangular shape of the lingual with setae

Host plants: RSW is a highly polyphagous pest reported to feed on about 120 plant species including economically important cultivated plants and palms, fruit crops and ornamental plants. It is classified as a serious threat for coconut cultivation in Florida. In India, initial infestation observed in coconut in Tamil Nadu, subsequently the pest was found to feed on banana, custard apple, sapota, and several ornamental plants like bird of paradise, oleander, African tulip tree and butterfly palm in Tamil Nadu, Kerala and Andhra Pradesh. Few life stages of RSW were found on cocoa, citrus, jackfruit, *Hibiscus* and garden cordon.

Molecular characterization & DNA Barcode:
Molecular identification of RSW (A-GenBank Acc. No. KY209909) and its potential aphelinid parasitoid *Encarsia guadeloupae* (B-GenBank Acc. No. KY223606) was done based on cytochrome oxidase I gene (658bp) and barcodes were generated (BOLD Systems, Canada).

Host plants of rugose spiraling whitefly

Symptoms of damage: Nymphs and adults suck the sap by direct feeding especially on underside of the leaves / leaflets. Adults produce prodigious quantities of honey dew excretion which in turn completely darken the leaves through by sooty mold development. The typical concentric waxy spiraling symptoms were noticed on various parts of host plants in heavily infested areas. Waxy flocculent material produced by adults cause nuisance to human being. In coconut, RSW prefers to colonize on hybrid and dwarf varieties, especially Chowghat orange, Malaysian orange and Ganga Bondam.

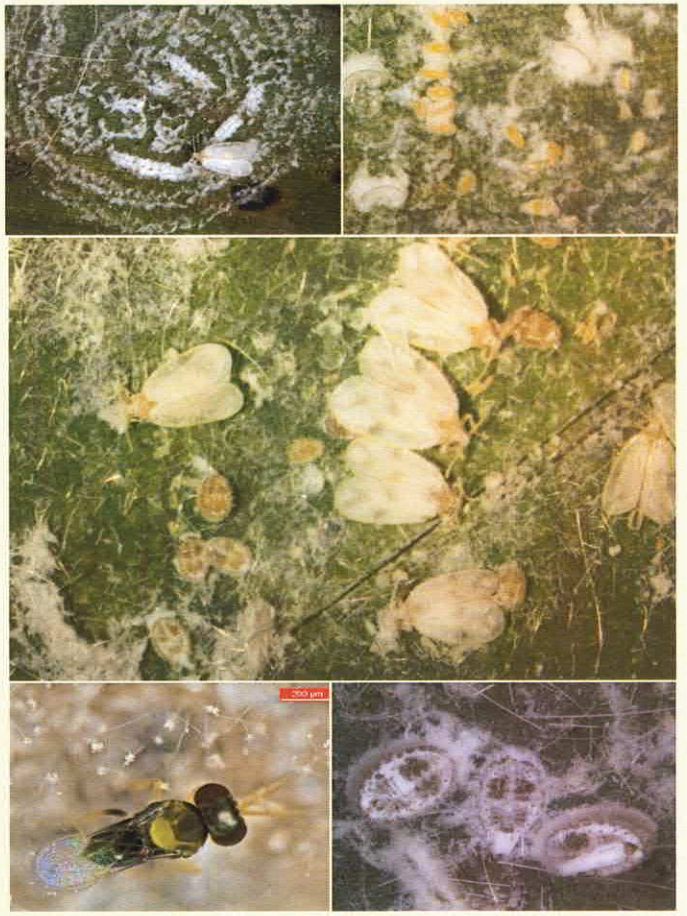
Symptoms of damage in coconut palm

Life stages: RSW undergo six stages which include egg, three immature nymphal instars, the fourth nymphal stage known as "puparium" (sedentary) and the adult. RSW adults are about three times larger than the commonly found whiteflies and are lethargic by nature. It is closely related to giant whitefly *A. dugesii* and spiraling whitefly *A. dispersus*. The female of RSW lays eggs on the underside of leaves in a circular pattern or concentric waxy spirals and covers them with white flocculent wax. Eggs are elliptical and creamy white to dark yellow in colour and immature stages are creamy brownish yellow in colour and lightly dark before adult emergence. Immature stages produce profuse quantity of wax filaments both tufts of fluffy and long crystal like glassy rods. Adults can be distinguished by their large size and the presence of a pair of irregular light brown bands across the wings. Males have long pincer like structures at the tip of their abdomen.

Natural enemies: The most commonly recorded were green lacewing (*Mallada* sp.), Coccinellids (*Cybocephalus* sp.; *Jauravia pallidula; Cheilomenes sexmaculata*) and aphelinid parasitoid *Encarsia guadeloupae* with 20 to 60% parasitism. Parasitized nymphs turn dark brown in colour and the adults emerge by cutting a circular lid at the thoracic region. Adults are very tiny, solitary wasps and can be identified by their yellow scutellum against their brownish body. This parasitoid was fortuitously introduced with *A. dispersus* into India.

Management strategies: Due to the presence of *E. guadeloupae* in coconut and banana ecosystems in India, there is a significant reduction in RSW. Further, population of the parasitoid has increased phenomenally over a period of time through breeding, favourable weather conditions and perennial nature of palms. Therefore, it is recommended that application of unwarranted insecticides may be avoided to enhance the parasitism. Efforts may be made to sensitize growers about the pest, host range, conservation of biocontrol agents and other nonchemical methods for suppression of the pest.

The Invasive Rugose Spiraling Whitefly *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) in India



K. Selvaraj
T. Venkatesan
Ankita Gupta
Chandish R. Ballal
S. K. Jalali

ICAR- National Bureau of Agricultural Insect Resources
Post Bag No. 2491, H.A. Farm Post, Bellary Road
Bengaluru-560024, Karnataka, India
Tel: 080-23511982/998; Fax: 080-23411961
Website: www.nbair.res.in; Email: directornbaii@gmail.com