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Status of Rugose Spiraling Whitefly *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) in West Bengal with notes on host plants, natural enemies and management

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Abstract

After the invasive introduction of Spiraling whitefly (*Aleurodicus dispersus* Russell) and Silver leaf whitefly (*Bemisia argentifolii* Bellows) during 1993 and 1999, the Rugose Spiraling Whitefly, *Aleurodicus rugioperculatus* Martin appeared as a serious alien threat to Indian agriculture with its devastating infestation on coconut and banana in southern India during 2016. Recently in June, 2019 a severe infestation was recorded in coconut plantations of Teaching Farm, BCKV, and Mandouri which appears to be the first report of this invasive insect in Nadia district of West Bengal. Later RSW was also found to be associated with several other commercial crops as Banana, Mango, Guava and ornamental plants such as Majesty Palms, Powder puff and Indian Rubber Bush and Maize among the field crops. A substantial control was achieved by spraying with Flonicamid 50% WDG and Lancer Gold (Acephate 50% + Imidacloprid 1.8% SP) @5gm and 2gm/l respectively and root-feeding with Monocrotophos 36SL @4 ml/plant as immediate remedy measure. Evaluation of Neem based insecticide is under progress. In addition to this, an intensive survey for natural enemies revealed a high population of Neuropteran predators, few parasitoids and some Phytoseiid mites as natural enemies for the pest. The current study opens further opportunities for investigation on the management of RSW under West Bengal conditions.

Keywords: Rugose Spiraling Whitefly, status, coconut, host plant, first record

Introduction

India being a tropical country with a warm and humid climate and a centre for extensive international trade of agricultural commodities has always been vulnerable to threats of exotic pests. Global anthropogenic climate change for the last several decades, increase in annual temperature, scanty rainfall and widespread human migration worked as key factors for spread and establishment of the invasive species in our country. Rugose spiralling whitefly (RSW), *Aleurodicus rugioperculatus* Martin is a new invasive and highly polyphagous species in India which was first described from Belize, Florida during 2004 from Coconut, but believed to be originated from Central America (Martin, 2004) [2]. It spread very fast over in Mexico, Guatemala and United States. In the European countries, the species has not been reported yet. The import of agricultural materials from the new world and the tropical warm and humid climate of Indian subcontinent certainly contributed to the establishment and spread of this alien invasive species. subcontinent It is the third reported invasive whitefly in India after Spiralling whitefly, *Aleurodicus dispersus* Russel and silver leaf whitefly *Bemisia argentifolii* Bellows (Gupta *et al.*, 2018) [4]. RSW was first reported from Coimbatore District of Tamil Nadu on leaves of the coconut palm (Selvaraj *et al.*, 2017) [3] followed by Karnataka, Kerala, Andhra Pradesh and Assam on different plants including monocots and dicots (Rao *et al.*, 2018) [5]. Recently in June 2019, a severe infestation was recorded in coconut plantations of Teaching Farm, BCKV, and Mandouri. In September, 2019 the pest was recorded on Maize leaves which appears to be the first report of this invasive pest on any field crop from West Bengal. The objective of the present study was to ascertain the identity of pest and examine the pest's status and distribution throughout the study area. As it is a polyphagous pest, so it is very important to find the host range of the pest. Then for the management purpose, suitable natural enemies and chemical control tactics were also investigated during the study.

Materials and Methods

An extensive survey was carried out in Horticultural teaching farm (Mondouri), Bidhan Chandra Chandra Krishi Viswavidyalaya, Mohanpur campus and Kalyani Directorate of

Research campus from August to November of 2019. The specimens were slide-mounted following modified Wilkey's protocol (Hodges and Evans, 2005) and the identification was carried out using the keys provided by Martin, 2004 [2]. Identification of the whitefly is mainly based on 4th larval instar (puparium) which is almost distinct for each species. After detection of the symptoms, coconut plantations (10 plants) were monitored for a month to observe the nature of pest population by calculating the percentage of leaf infested/plant and percentage of the area infested/leaf. To find the host and natural enemies, an elaborative survey was carried out by the authors for identifying the infested host plants and possible natural enemies occupying the same habitat with the pest. For immediate remedy from the pest control measures were taken by spraying with Ulala (Fonicamid 50%WDG) and Lancer Gold (Acephate 50%+Imidacloprid 1.8%SP) @5gm and 2gm/l respectively and root-feeding with Monocrotophos 36SL@4ml/plant. Evaluation of HMO and Neem based insecticides is under progress.

Results and Discussion

Adult Rugose Spiralling Whiteflies can be easily identified by their large habitus (almost 2.5mm) and irregular brown markings on white forewings. Adult males have large pincers at the end of the abdomen. Females lay yellowish eggs mostly the under surface of the leaves in a spiraling or concentric

manner and cover them with waxy substances. Among the five developmental stages in the life cycle of the Rugose Spiralling Whitefly, only the 1st instar is a mobile one and known as crawler. Immature with progressive instars produce a profuse quantity of wax filaments which appear as a tuft of fluffy and long crystal-like glass rods. The 4th instar *i.e.* the puparium is distinctly thick and larger than the commonly occurring species *Bemisia tabaci*. The puparium is characterized by dorsal reticulations, apically acute lingula, rugose (corrugated) operculum with a pair of ventromedial fine setae and hence the name Rugose Spiralling Whitefly. Different stages of RSW on coconut leaves are depicted in figure 1 a-d below.

As mentioned earlier, the Rugose Spiralling Whitefly was first recorded in India from Tamil Nadu in 2016 and within next two years, the pest was detected from coastal areas of Karnataka, Kerala and Andhra Pradesh (Karthik *et al.*, 2018) [1]. It was expected that the pest was spreading along the coastal areas of Indian subcontinent (Figure 2) but till now no record has been found from Orissa although in July 2018 it was observed from several districts of Assam (Pathak, 2019) [7]. Therefore, the origin of populations needs to be confirmed with molecular identification. The recent cyclone 'Bulbul' along the coast of Bay of Bengal may again influence the distribution and soon infestation in neighbouring states and Bangladesh may also be expected.

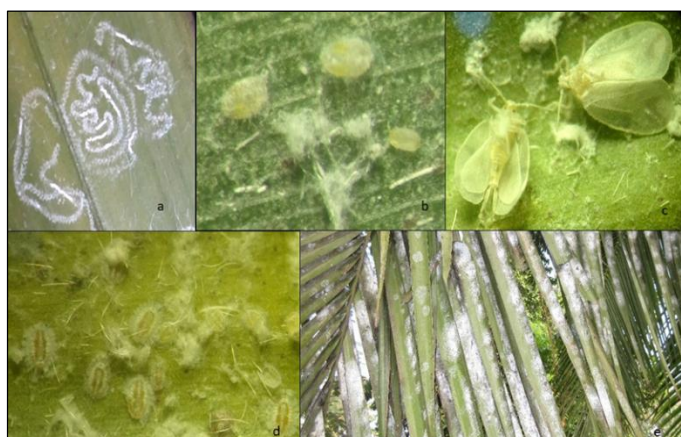


Fig 1: a) egg laying fashion b) eggs after removing wax flocculation c) adults d) puparia and e) infestation on coconut leaves by Rugose Spiralling Whitefly

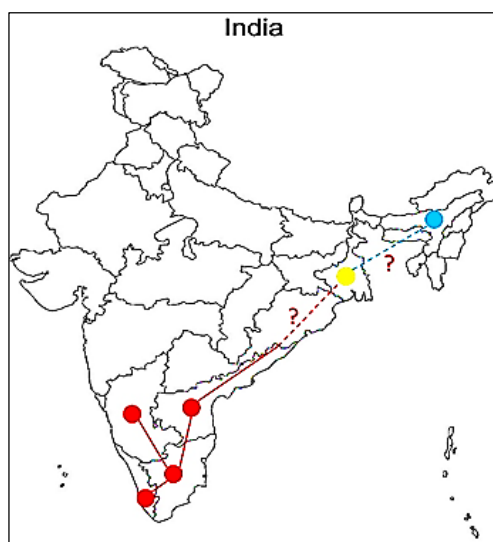


Fig 2: probable pathway of spread of RSW in Indian subcontinent

A survey through the locality of primary detection and the neighbouring areas revealed the pest's severe to medium infestation on Coconut, Arecanut, Banana, Rubber fig, potted palm, Mango, Guava, Bird of Paradise, Deodar and Acacia leaves (Figure 3). Among these Coconut plants, especially the dwarf varieties are severely infested with the most infestation

on the lower half of the canopy and the population reduces from 3rd leaf onwards from the bottom of the canopy (Fig. 3). The plants identified as hosts from West Bengal are depicted in Figure 4 and a list of important host plants of RSW so far reported from India is given in table 1.

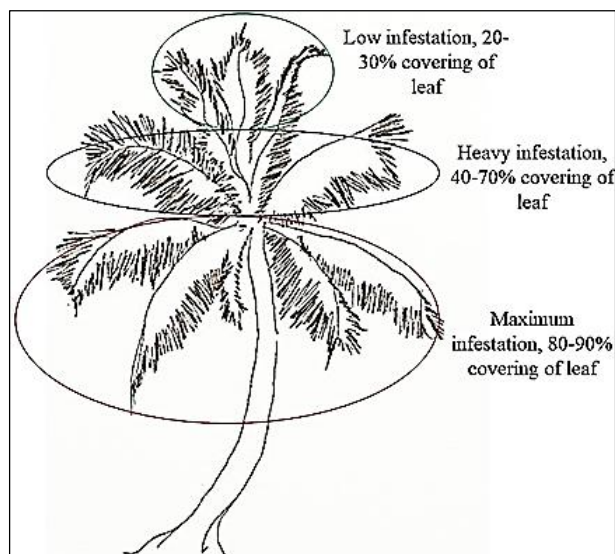


Fig 3: Nature and extent of infestation in coconut plant



Fig 4: Some of the host plants of RSW found in West Bengal: a) Coconut b) Arecanut c) Rubber Fig d) Guava e) Banana f) Mango g) Potted palm h) Acacia i) Maize j) Powder puff k) Kadam

Table 1: List of Host Plants of Rugose Spirling Whitefly from India

Host Plants	Scientific Name	Family	States
Acacia	<i>Acacia auriculiformis</i>	Fabaceae	West Bengal
Arecanut	<i>Areca catechu</i>	Arecaceae	Assam, West Bengal
Banana	<i>Musa sp</i>	Musaceae	Andhra Pradesh, Tamil Nadu, Karnataka, West Bengal, Assam
BER	<i>Ziziphus mauritiana</i>	Rhamnaceae	Assam
Betelvine	<i>Piper betle</i>	Piperaceae	Assam, Karnataka
BHINDI	<i>Abelmoschus esculentus</i>	Malvaceae	Tamil Nadu
Bird of paradise	<i>Strelitzia reginae</i>	Strelitziaceae	Karnataka
Black pepper	<i>Piper nigrum</i>	Piperaceae	Assam
Brown salwood	<i>Acacia mangium</i>	Fabaceae	Andhra Pradesh
Butterfly palm	<i>Dypsis lutescens</i>	Arecaceae	Karnataka
Citrus	<i>Citrus sinensis</i>	Rutaceae	Tamil Nadu, Assam
Coconut	<i>Cocos nucifera</i>	Arecaceae	Andhra Pradesh, Tamil Nadu, Karnataka, West Bengal, Assam
Crown of thorns	<i>Euphorbia milii</i>	Euphorbiaceae	Andhra Pradesh
Curry tree	<i>Murraya koenigii</i>	Rutaceae	Kerala
Custard apple	<i>Annona squamosa</i>	Annonaceae	Tamil Nadu
Deodar	<i>Cedrus deodara</i>	Pinaceae	West Bengal
Garden croton	<i>Codiaeum variegatum</i>	Euphorbiaceae	Andhra Pradesh

Golden trumpet	<i>Allamanda cathartica</i>	Apocynaceae	Andhra Pradesh
Guaava	<i>Psidium guajava</i>	Myrtaceae	Andhra Pradesh, Tamil Nadu, Karnataka, West Bengal, Assam
China rose	<i>Hibiscus sp.</i>	Malvaceae	Tamil Nadu
Hog plum	<i>Spondias mombin</i>	Anacardiaceae	Kerala
Indian almond	<i>Terminalia catappa</i>	Combretaceae	Andhra Pradesh, Karnataka
Jackfruit	<i>Artocarpus heterophyllus</i>	Moraceae	Kerala, Andhra Pradesh
Jatropha	<i>Jatropha curcas</i>	Euphorbiaceae	Tamil Nadu
Kadam	<i>Neolamarckia cadamba</i>	Rubiaceae	West B
Laurel ball tree/punnai	<i>Calophyllum inophyllum</i>	Calophyllaceae	Karnataka
Litchi	<i>Litchi chinensis</i>	Sapindaceae	Assam
Malabar tamarind	<i>Garcinia gummi-gutta</i>	Clusiaceae	Kerala, Andhra Pradesh
Mango	<i>Mangifera indica</i>	Anacardiaceae	Andhra Pradesh, Tamil Nadu, Karnataka, West Bengal, Assam
Maize	<i>Zea mays</i>	Poaceae	West Bengal
Nutmeg	<i>Myristica fragrans</i>	Myristicaceae	Kerala
Oleander	<i>Nerium oleander</i>	Apocynaceae	Andhra Pradesh, Karnataka
Papaya	<i>Carica papaya</i>	Caricaceae	Assam
Portia tree	<i>Thespesia populnia</i>	Malvaceae	Andhra Pradesh
Potted palm	<i>Chamaedorea elegans</i>	Arecaceae	West Bengal
Powder puff	<i>Calliandra hematocephala</i>	Fabaceae	West Bengal
Rangoon creeper	<i>Combretum indicum</i>	Combretaceae	Andhra Pradesh
Rubber fig	<i>Ficus elastic</i>	Moraceae	West Bengal, Karnataka
Ruffled fan palm	<i>Licuala grandis</i>	Arecaceae	Karnataka
Sapota	<i>Manilkara zapota</i>	Sapotaceae	Tamil Nadu, Karnataka
Soursop	<i>Annona muricata</i>	Annonaceae	Kerala
Taro	<i>Colocasia esculenta</i>	Araceae	Kerala
Water apple	<i>Syzygium samarangense</i>	Myrtaceae	Karnataka
Wild jackfruit	<i>Artocarpus hirsutus</i>	Moraceae	Andhra Pradesh
Wire weed	<i>Polygonum erectum</i>	Polygonaceae	Andhra Pradesh

The progress of infestation was very rapid on coconut palms. In the present experiment, we observed from 40% to 100% leaf infestation (fully and partially opened leaves excluding the unopened frond in middle) after a month. Within the same time period, the per cent area infested per leaf exceeded 60% with a copious amount of sooty mould development on leaves (Fig. 5). Two *Tarsonemus* spp. were found to be associated with the whitefly feeding on fungal spores of the sooty mould developed on the leaves.

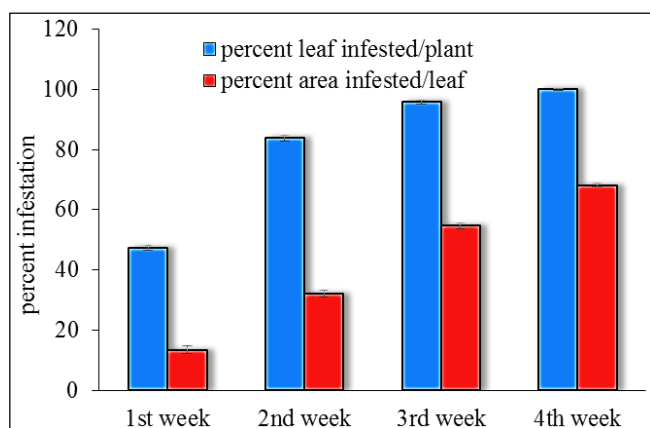


Fig 5: Progress of infestation on dwarf varieties of coconut palms

During the survey, we observed high population of Neuropteran grubs and small and scanty populations of Coccinellid predators, Aphelinid parasitoids (*Encarsia sp.*) and Phytoseiid mites (*Amblyseius largoensis*, *Euseius sp.*) occupying the same habitat on coconut leaves but direct feeding or parasitization was not observed. That is why the association of these predators and parasitoids need to be further assessed in field and laboratory to identify effective natural enemy of the pest. Foliar spray and root-feeding with aforesaid insecticides gave substantial control over the initial population (not quantified due to short period) but the activity

of Natural Enemies was drastically reduced. That is why trials with Neem-based formulations and Horticultural Mineral Oil are under progress as an eco-friendly approach.

Conclusion

Rugose spiralling whitefly is indeed an alarming threat to the agriculture of West Bengal because of its wide host range and high adaptation. Till now the severity of infestation is pronounced on Coconut and banana plants but it may cause economic loss to other cultivated crops as well within its host range, if not managed properly. Conventional chemicals against sucking pest is not efficient to tackle the population below ETL and conserve its natural enemies. The severity of infestation is indeed alarming and needs immediate measures against them using neem-based pesticides, HMO and exploiting natural enemies in a compatible way. Regular monitoring is necessary at block and district level to keep an eye on the distribution and radiation of host species along with awareness programmes for farmers.

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