SHORT COMMUNICATION

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INVASIVE RUGOSE SPIRALLING WHITEFLY *Aleurodicus rugioperculatus* MARTIN, A SERIOUS PEST OF OIL PALM *Elaeis guineensis* IN INDIA

SELVARAJ, K*; VENKATESAN, T*; SUMALATHA, B V* and KIRAN, C M*

ABSTRACT

Occurrence and severe infestation of the invasive rugose spiralling whitefly (RSW), Aleurodicus rugioperculatus *Martin (Hemiptera: Aleyrodidae) on oil palm* (Elaeis guineensis *Jacq.*), *(Arecales: Arecaceae) in India is reported for the first time. The severity of its infestation, impact on oil palm cultivation, occurrence of natural enemies and non-chemical management strategies against RSW are discussed.*

Keywords: invasive, rugose spiralling whitefly, oil palm, *Aleurodicus rugioperculatus.*

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INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) is a native of West Africa and it is the crop of the present and future vegetable oil economy of the world as well as India. Palm oil contributes 70% of total vegetable oil import and is one of the cheapest oil due to high productivity per hectare (Kalidas *et al.,* 2014). In India, oil palm covers an area of about 0.3 million hectares with production of about 1.2 million tonnes. Out of this, Andhra Pradesh covers an area of about 0.15 million hectares and production of about 1.1 million tonnes. In India, Andhra Pradesh, Karnataka and Tamil Nadu are major oil palm growing states. Although oil palm is a new crop to India, the pest occurrence is found increasing over the period of cultivation. In India, about 60 insect species were reported to infest oil palm (Dhileepan, 1991; 1992; Kalidas, 2011) of which many pests were found to infest the crop causing yield loss.

Rhinoceros beetle, *Oryctes rhinoceros* (L.); leaf web worm, *Acria* sp.; psychid, *Mestia plana*; slug caterpillar, *Dama catenatus*; scales and mealybugs were reported as major pests which feed on oil palm and except the leaf web worm, the rests all are found to migrate from the local ecosystem. Most of these pest populations were found migrating to other palms such as coconut and arecanut which are commonly seen in the adjoining areas of oil palm plantations. The loss estimation on the yields of oil palm due to the above pests was in the range of 20%-30% extending to three years after attack (Kalidas, 2012). The pests which are common to both coconut and palmyrah were found migrating to oil palm. Psychid and slug caterpillars, which are reported to be minor pests of coconut, palmyrah and arecanut were found to cause heavy infestation on oil palm causing yield losses up to 50% (Kalidas, 2012; Kalidas and Saravanan, 2013).

Recently, severe incidence and infestation of invasive rugose spiralling whitefly (RSW) *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) was found on oil palm in its growing areas in Andhra Pradesh and Karnataka in India. The dangerous invasive pest was reported for the first time on coconut (*Cocos nucifera* L) at Pollachi, Tamil Nadu in India during August 2016 (Sundararaj and Selvaraj, 2017). Subsequently, the pest was reported to feed on many horticultural plants such as banana, sapota, mango, guava, custard apple, water apple and many more ornamental plants including false bird of paradise, rubber fig, butterfly palm, ruffled fan palm, *Calophyllum* in Tamil Nadu, Karnataka, Kerala and Andhra Pradesh (Selvaraj *et al.,* 2016; 2017). The RSW was reported to feed on more than 30 host plants in India and about 120 plant species including several economically important horticultural and ornamental crops globally. It was a serious threat

* ICAR-National Bureau of Agricultural Insect Resources, Post Bag No. 2491, H. A. Farm Post, Bellary Road, Hebbal, Bengaluru, 560 024, Karnataka, India.
E-mail: selvaentomo@gmail.com

to coconut palm and several other Arecaceae plant species in Florida (Stocks and Hodges, 2012; Kumar *et al.*, 2013). It is believed to have been originated from Central America and its incidence is limited to Belize, Mexico, Guatemala and Florida in Central and North America (Evans, 2008).

Due to its polyphagous in nature, it extends its feeding ranges and spread the entire South Indian states especially on intensive coconut cultivation areas within a few months period mostly through transport of seedlings and farm produce from infested areas. Availability of a wide range of host plants in large areas and favourable weather conditions could be a reason for severe outbreak of RSW and establishment on many more host plants. Besides, direct damage by sucking sap, profuse honey dew excretion occurs which gets deposited on upper leaf surface attract sooty mould infestation which reduces the photosynthetic efficiency of plants. In addition to these host plants, maize, *Zea mays*; cashew, *Anacardium occidentale*; Indian shot, *Canna indica;* Rangoon creeper, *Combretum indicum* (unpublished) and oil palm are additional new host plants in India. In this communication, incidence on oil palm at different survey locations in India, severity, symptoms of damage and natural enemies are briefly highlighted.

MATERIALS AND METHODS

Survey on incidence and infestation, host plant range, geographical distribution, mode of dispersal and natural enemies of invasive RSW were continuously monitored on oil palm in West Godavari and East Godavari coastal districts of Andhra Pradesh and Mandya and Mysore districts of Karnataka in India from December 2017 to July 2018. We surveyed 2 ha in each location and assessed the extent of infestation of RSW. On an average 135-140 palms were planted in each hectare at each location (*Table 1*). Intensity of the RSW was assessed at lower three fronds per

TABLE 1. EXTENT OF INFESTATION OF RUGOSE SPIRALLING WHITEFLY ON OIL PALM AND ASSOCIATED NATURAL ENEMIES IN INDIA

Location	Areas surveyed in each location (ha)	Total number of palms surveyed	Palms infested (%)	Intensity/ severity (low/ medium/high)	Natural parasitism by *Encarsia guadeloupae* (%)	Predators
District: 1. Mandya, Karnataka, India						
Malavalli	2.0	270.0	20.4	Low	12-18	Nil
District: 2. Mysuru, Karnataka, India						
Lakshmipura	2.0	275.0	15.0	Low	05-08	Nil
District: 3. East Godavari, Andhra Pradesh, India						
Kadiyam	2.0	280.0	40.0	Low to medium	-	*Cybocephalus* sp. (Coleoptera: Nitidulidae)
Rajamundry	2.0	270.0	50.7	Low to medium	-	*Dichochrysa astur* (Neuroptera: Chrysopidae) *Cybocephalus* sp. (Coleoptera: Nitidulidae)
District: 4. West Godavari, Andhra Pradesh, India						
Eluru	2.0	280.0	88.2	Medium to high	10-26	*Dichochrysa astur* (Neuroptera: Chrysopidae) *Chrysoperla zastrowi sillemi* (Neuroptera: Chrysopidae) *Cybocephalus* sp. (Coleoptera: Nitidulidae)
Tadepalligudem	2.0	270.0	93.7	Medium to high	17-32	*Dichochrysa astur* (Neuroptera: Chrysopidae) *Chrysoperla zastrowi sillemi* (Neuroptera: Chrysopidae) *Cybocephalus* sp.
Kalavalapalli	2.0	274.0	96.3	Medium to high	24-41	*Dichochrysa astur* (Neuroptera: Chrysopidae) *Chrysoperla zastrowi sillemi* (Neuroptera: Chrysopidae)

Note: Low - <10 live egg spirals or adults/leaflet. Medium/moderate - 11-20 live egg spirals or adults/leaflet. High/severe - >20 live egg spirals or adults/leaflet.

palm based on the following criteria, *i.e.* low: 0-10 live egg spirals or adults/leaflet; moderate: 11-20 live egg spirals or adults/leaflet; severe: >20 live egg spirals or adults/leaflet.

Infested oil palm leaves with immature stages, puparium in the paper envelopes and adult whiteflies in 70% alcohol were collected for morphological and molecular identification (Dubey and David, 2012) along with relevant collection data. The infested leaves with immature stages were kept in the rearing cages in the laboratory and observed for percent parasitism. The identity of the pest and *E. gaudeloupae* was confirmed by morphology and molecular tools.

RESULTS AND DISCUSSION

Identity of the RSW was confirmed through morphological keys as described by Martin (2004) and Stocks and Hodges (2012). Molecular identification of the RSW and *E. guadeloupae* Viggiani (Hymenoptera: Aphelinidae) was done by amplifying CO1 gene (Dickey *et al*., 2015; Selvaraj *et al*., 2016). The extent of infestation of RSW ranged from 15.0 - 96.3 palms/2 ha in each location (*Table 1*). Furthermore, the extent of infestation was higher in oil palms planted adjacent to coconut gardens. This could be a reason for higher infestation in oil palms cultivated in Andhra Pradesh as compared to Karnataka. Moderate to severe infestation of RSW on oil palm was confirmed in two coastal districts of Andhra Pradesh (East Godavari, West Godavari) and low to moderate infestation in Mandya, Mysore districts in Karnataka (*Table 1*). Almost all the palms, in oil palm plantation were infested with RSW. The infestation was also higher in younger palms which were about 5 years old as compared to above 8 years old. The infestation was very severe and mostly observed on lower leaves of oil palm (*Figure 1*). Pest populations and live egg spirals completely covered most of the leaflets which ranged between 11-20 live egg spirals or adults/leaflet in most of the surveyed locations in Andhra Pradesh whereas the population of the pest was less than 10 live egg spirals or adults/leaflet in Karnataka. In Andhra Pradesh, the severely infested palms were completely covered with black sooty mold fungal growth on upper surface of the leaves (*Figure 1*). The adult whiteflies and immatures were found to suck the sap on the under surface of the leaves/leaflets of the oil palm. Extensive feeding of the pest leads to excretion of large quantity of honey dew which subsequently gets deposited on the upper surface of the leaves positioned down beneath or even on any other plant under oil palm. Waxy flocculent material produced by the adult whiteflies causes nuisance to human beings, as they get dispensed with a fluff of white dust during the movement of insects. The infestation may result in the premature drying of leaflets and leaves (*Figure 1*). Reduction in bunch yield of about 20%-25% was reported by growers; however, scientific assessment of yield loss needs to be determined. Earlier researchers and studies have reported that coconut was the preferred host for the RSW. The severe infestation of RSW on oil palm might be due to coconut and oil palm being cultivated as intercrop or border crop.

Figure 1. Damage symptoms on oil palm due to rugose spiralling.

Eggs are elliptical and yellowish in colour and are laid singly and associated with irregularly spiralling deposits of white flocculent wax. Immature stages of RSW produce profuse quantity of wax filaments both tufts of fluffy and long crystal like glassy rods. RSW adults are little larger than the commonly found whiteflies and adults can be distinguished by their large size and the presence of a pair of irregular light brown bands across the wings (*Figure 2*).

The natural enemies such as parasitoid, *E. guadeloupae* and chrysopid, *D. astur* Banks (Neuroptera: Chrysopidae) were found to be associated with RSW (*Figure 3*). However, *E. guadeloupae* was dominant and potential to provide about 41% natural parasitism in Andhra Pradesh and it was less than 20% in Karnataka. The natural parasitism in oil palm was significantly less (10%-41%) as compared to coconut, banana, custard apple, sapota and false bird of paradise in Tamil Nadu, Kerala and coastal Karnataka where it was recorded up to 80%-90%. This might be due to various conservation and augmentation strategies which were advocated to farmers through awareness programmes by several stakeholders in the last two years since the pest invasion in August 2016 (Sundararaj and Selvaraj, 2017). Besides biological control, under severe infestation of this pest, it was recommended to apply neem oil at 1% as foliar application and starch solution at 2% was also suggested for the control of sooty mold on upper surface of the leaves. So far, no chemical insecticides have been recommended against RSW as none of the insecticides have been labelled specifically for the control of this pest. Efforts may also be made to standardise mass rearing protocols for *E. guadeloupae* and *D. astur* for large scale release against RSW.

The invasion and establishment of RSW will further jeopardise the oil palm industry in India in terms of reduction in oil palm production and increased production cost due to more insecticides application. RSW is already established on many other host plants in the entire South India including coconut, banana and several palm plants. The current incidence of RSW in India is alarming due to its polyphagous nature and spread to other oil palm growing regions in the country. RSW was believed to be introduced into Andhra Pradesh through transportation of coconut seedlings from infested areas which could have paved the way for infestation of oil palm. During this movement, the potential natural enemies might have detached from its host, thereby, pest multiplied alarmingly in newer areas. Therefore, a holistic approach is needed for adaptation of rapid response strategies against its invasion by educating farmers and creating awareness among farmers and extension entomologists. Further, the parasitoid population should be augmented by the re-distribution of

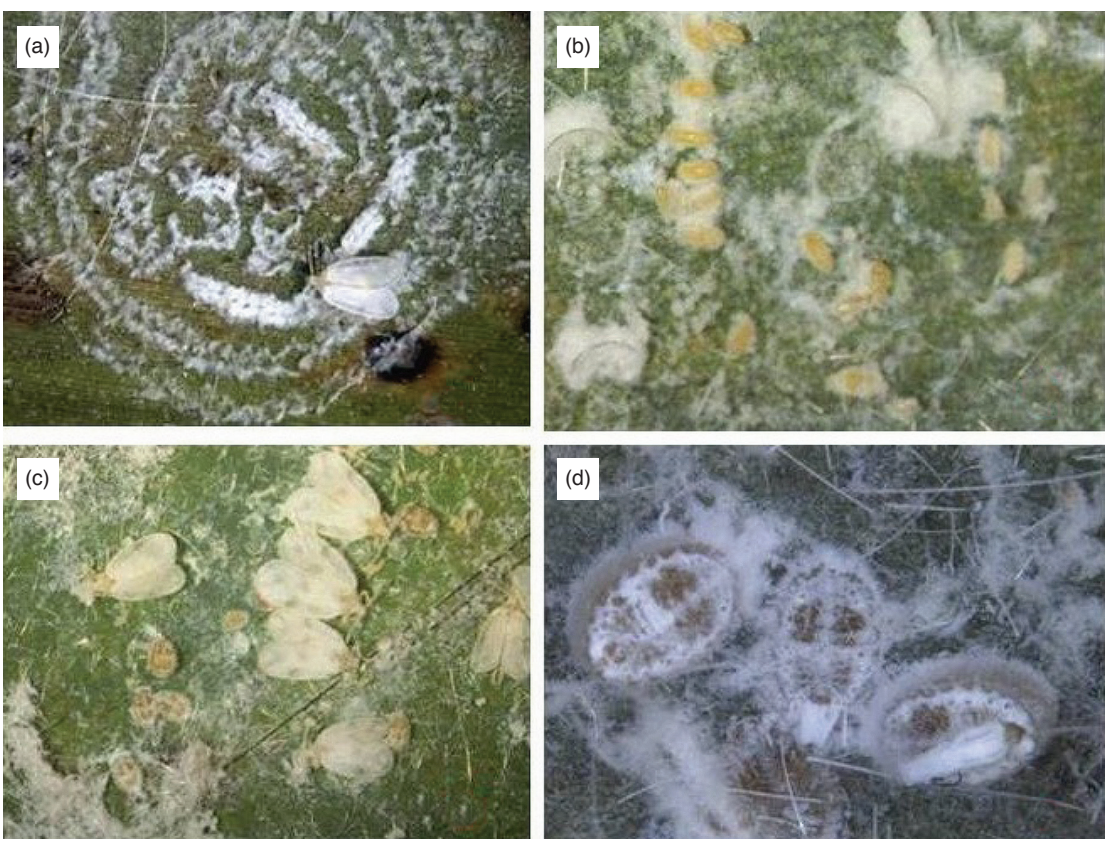

Figure 2. Different life stages: a) egg spiral, b) eggs, c) pupae, d) adults of rugose spiralling whitefly.

Figure 3. Natural enemies of rugose sprilling whitefly. a-b) Encarsia guadeloupae, *c)* Dichocharysa astur, *d)* Cybocephalus *sp.*

E. guadeloupae to the affected areas through field insectary technique, *i.e.* field collected parasitised material may be strategically placed in, on, or next to infested vegetation. Strategies for the conservation and natural build-up of *E. guadeloupae* through providing reservoir plants/banker plants may be developed which protect them from pesticides, shelter and unfavourable weather conditions.

CONCLUSION

The invasive RSW is now well established on oil palm and coconut in India. Frequent monitoring of the pest occurrence should be done for its early detection and management. Re-distribution of natural enemies especially *E. guadeloupae* was suggested wherever they are absent or inadequate to bring down the pest population for early suppression. Two plant species, *i.e. Canna indica* and banana were found to harbour maximum *E. guadeloupae* population in the field as well as in the net house condition. It is advised to grow these plants as Banker plants (refugia for parasitoids) in oil palm plantations for conservation and augmentation of the parasitoid.

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