

**HOST RANGE OF RUGOSE SPIRALING WHITEFLY,
(*Aleurodicus rugioperculatus*) MARTIN AND ITS INCIDENCE
AND DAMAGE ON COCONUT PLANT IN COASTAL
REGION OF BANGLADESH**

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ABSTRACT

Rugose spiraling whitefly, *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) is an invasive pest causing severe damage to several plant species. Surveys were conducted in the farmers' orchards of 11 coastal districts of Bangladesh namely Patuakhali, Barguna, Barishal, Khulna, Bagherhat, Pirojpur, Jhalokathi, Bhola, Laxmipur, Noakhali and Cox's Bazar to know the host range of rugose spiraling whitefly and its incidence and damage in coconut during July 2021 to June 2022. Results revealed that a total of 22 plant species from 16 families were recorded as hosts of *A. rugioperculatus*. Among the host plants 4 hosts were infested by *A. rugioperculatus* in which all the life stages such as egg spirals, nymphs and adults of whitefly were noticed whereas in other 18 host plants only the egg stages were observed. The highest incidence of whitefly egg spirals, nymphs and adults per leaflet of coconut was observed in September 2021 at Bagherhat followed by October, November and May 2022 while the lowest was in July 2021 at Cox's Bazar followed by June, January, February 2022 and December 2021. The highest percent (97%) infested tree was recorded in Bagherhat district while the lowest percent infested tree (68%) was in Cox's Bazar. The highest percent (96.23%) of infested fronds per tree were recorded in Bagherhat district and the lowest percent infested fronds per tree (67.23%) was in Cox's Bazar. The highest percent (84%) of leaflet area occupied by this insect was recorded in Bagherhat and the lowest percent was in Cox's Bazar (48%).

Keywords: Rugose spiraling whitefly, Damage, Host range, Incidence, Coconut plants, Coastal areas.

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INTRODUCTION

Coconut (*Cocos nucifera*) is one of the most important palm crop in tropical, subtropical and warm temperate climates. It is usually referred as ‘tree of heaven’ or ‘kalpavriksha’ because it provides more useful and diverse product to the people. Coconut is grown in more than 90 countries, mainly in Asia, Pacific Islands and South America of the world in an area of 12 million hectares, with an annual estimated production of 70 billion nuts (Hoe, 2018). Coconut oil and other products are also making a comeback commercially in both natural foods and cosmetic industries. Rugose spiraling whitefly (RSW), *Aleurodicus rugioperculatus* Martin 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) and spread to other coconut growing countries in the Oriental region. It was also a serious threat to coconut palm and several other Arecaceae plant species in Florida (Stocks and Hodges, 2012; Kumar et al., 2013). The dangerous invasive pest was first reported on coconut (*Cocos nucifera* L.) at Pollachi, Tamil Nadu in India during August 2016 (Sundararaj and Selvaraj, 2017). It is an invasive pest that attacks a wide range of host plants including palms, woody ornamentals and fruits. Coconut and banana are among the most preferred host plants which are reported by several authors (Sundararaj and Selvaraj, 2017; Selvaraj et al., 2019). The occurrence and infestation of this pest on coconut leaves is reported for the first time in Bangladesh at Regional Agricultural Research Station (RARS), BARI, Jashore during May, 2019. After that, up to November 2019, the infestation of this pest was also observed in six more districts viz., Magura, Jhenaidah, Kushtia, Pabna, Gopalganj and Faridpur, including seven more host plants (Dutta et al., 2019). The production of coconut is hampered due to infestation of several insects and mite pest since last four years in Bangladesh. Recently this invasive whitefly identified as rugose spiraling whitefly (RSW), *Aleurodicus rugioperculatus* Martin has become a serious threat to coconut production in Bangladesh (Ullah et al., 2021). The insect, which derives its name from its egg-laying pattern, is a tiny insect measuring up to 2 mm in length that sucks out sap from under the leaves, inducing stress on the host plant from the loss of water and nutrients. The honeydew excreted by the fly attracts ants and encourages the growth of fungus sooty mould. Although sooty mould is not a plant disease, its presence on the upper surface of the leaf can potentially reduce photosynthesis of the plant that results in heavy yield loss (Ullah et al., 2021). Occurrence and severe infestation of the invasive rugose spiraling whitefly on oil palm (*Elaeis guineensis* Jacq.) in India is also reported for the first time (Selvaraj et al., 2019). The RSW is highly polyphagous with 118 hosts belonging to 43 plant families including economically important crops in the United States (Francis et al., 2016). 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 worldwide (Selvaraj et al., 2016; 2017). Subsequently, the pest was reported to feed on different horticultural plants such as banana, sapota, mango, guava, custard apple, water apple and many more ornamental

plants in Tamil Nadu, Karnataka, Kerala and Andhra Pradesh (Sundararaj and Selvaraj, 2017).

The current incidence of RSW in Bangladesh is alarming due to its polyphagous nature and hence it has a great potential to extend its host range. Because of the rapid proliferation and easy dispersal of whitefly through wind, they spread to the neighbouring garden at faster rate causing serious threat to the economy of the coconut growers. The problem has become epidemic in south and south-western parts of Bangladesh and extensive damage to coconut has been noticed. However, so far, we know it has been reported as invasive pest of the coconut in Bangladesh. Hence studying on the host range, incidence and damage of invasive rugose spiralling whitefly on coconut in southern coastal regions of Bangladesh is essential.

MATERIALS AND METHODS

Survey on host plant range, incidence and damage of invasive rugose spiralling whitefly were conducted in the farmers' coconut orchards of 11 coastal districts namely Patuakhali, Barguna, Barishal, Khulna, Bagherhat, Pirojpur, Jhalokathi, Bhola, Laxmipur, Noakhali and Cox's Bazar districts of Bangladesh from July 2021 to June 2022. A total 22 upazila taking two from each district were selected as study sites for survey. Fifty (50) coconut trees from each upazila comprising 1100 trees were selected randomly for taking data and calculated the percentage of infested trees and percentage of frond infestation per tree. Data were recorded through observation of individual coconut tree in each location. The number of healthy and infested coconut trees were counted in each location. The number of healthy and infested fronds per tree of 10 randomly selected coconut trees was also recorded. To study the intensity of damage of *A. rugiperculatus* was formulated based on the percent intensity of damage as follows:

$$\text{Tree infestation (\%)} \text{ per location} = \frac{\text{No of plants infested}}{\text{Total no of plant observed}} \times 100$$

$$\text{Frond infestation (\%)} \text{ per tree} = \frac{\text{No of fronds in infested tree}}{\text{Total no of fronds observed in each tree}} \times 100$$

Five (5) trees out of 50 from each upazila were randomly selected for observations of whitefly incidence per 5 leaflets per frond of coconut tree were assessed through counts of egg spirals, nymphs and adults. The per cent leaflet area occupied by RSW populations (egg spirals, nymphs and adults) was measured by eye estimation. MS excel program was used to represent data graphically.

RESULTS AND DISCUSSION

Host range of rugose spiraling whitefly, *A. rugioferculatus*

In the present study, a total of 22 plant species from 16 families were recorded as hosts of *A. rugioferculatus*. Among the host plants 4 hosts were infested by *A. rugioferculatus* in which all the life stages such as egg spirals, nymphs and adults of whitefly were noticed whereas in other 18 host plants only the egg stages were observed and documented of which 2 host plants were not identified (Table 1 and Plate 1)). In host ranges, coconut and banana plant species were highly infested by *A. rugioferculatus*. The findings of the present study indicated that among all host plants, coconut was found to be the most preferable hosts followed by banana which is similar to the results of Elango et al. (2019) where they reported that, among all host plants coconut and banana were the most preferable hosts to RSW. Jethva et al. (2020) stated that this invasive pest is first time observed on Sapota, Mango, Banana, Custard Apple, Guava, Curry tree, Papaya, White wax jambu, Indian Almond, Sorghum and Groundnut in Gujarat state. A total of 17 plant species under 11 families were recorded as preferred hosts of *A. rugioferculatus* at Kerala (Shanas et al., 2016). Mayer et al. (2010) observed that it mainly infested coconut palms and other broad-leaved hosts in its native range. RSW is an invasive pest and being a recent introduction, is still on the process of adapting and establishing on various native plants/trees in Bangladesh. Hence, the species was observed on lesser number of host plants in Bangladesh compared to many other countries where this was established earlier. The host range is likely to expand as the species becomes more established and spread to newer areas in Bangladesh.

Table 1. Host ranges of rugose spiraling whitefly

A. Hosts in which all life stages of rugose spiraling whitefly observed			
Sl. No.	Common Name	Botanical Name	Family
1	Coconut	<i>Cocos nucifera</i> L.	Arecaceae
2	Banana	<i>Musa paradisiaca</i> L.	Musaceae
3	Areca nut	<i>Areca catechu</i>	Arecaceae
4	Guava	<i>Psidium guajava</i> L.	Myrtaceae
B. Hosts subjected to oviposition by rugose spiraling whitefly			
Sl. No.	Common Name	Botanical Name	Family
1	Hog plum	<i>Spondias mombin</i>	Anacardiaceae
2	Custard apple	<i>Annona reticulata</i>	Annonaceae
3	Jackfruit	<i>Artocarpus heterophyllus</i> L.	Moraceae
4	Balckberry	<i>Rubus fruticosus</i>	Rosaceae
5	Mahogany	<i>Swietenia macrophylla</i>	Meliaceae

6	Rangan/Ixora	<i>Ixora coccinea</i>	Rubiaceae
7	Orange jessamine	<i>Murraya paniculata</i>	Rutaceae
8	Mango	<i>Mangifera indica</i> L.	Anacardiaceae
9	Water apple	<i>Syzygium samarangense</i>	Myrtaceae
10	Hedge bamboo	<i>Phyllostachys glauca</i>	Poaceae
11	Keya plant	<i>Pandanus tectorius</i>	Pandanaceae
12	China rose	<i>Hibiscus rosasinensis</i> L.	Malvaceae
13	Brinjal	<i>Solanum melongena</i>	Solanaceae
14	Garden croton	<i>Codiaeum variegatum</i> (L.)	Euphorbiaceae
15	Croton	<i>Codiaeum variegatum</i> (L.)	Euphorbiaceae
16	Bakul/Spanish cherry	<i>Mimusops elengi</i> L.	Sapotaceae
17	Unknown		
18	Unknown		

**Coconut****Banana****Betel nut****Guava**



Hogplum



Custard apple



Jackfruit



Black berry



Mahogany



Rangan



Orange jessamine



Mango



Water apple



Bamboo



Keya plant



Different kinds of Croton

**Bakul****China rose/Hibiscus****Unknown host****Unknown**

Plate 1. Photographs of different host plants infested by rugose spiraling whitefly

Incidence of rugose spiraling whitefly on coconut tree

The incidence of rugose spiraling whitefly population per leaflet of coconut tree on different months of observations is shown in Fig. 1 and Plate 2 (A-C). The incidence of rugose spiraling whitefly egg spirals per leaflet was high in September 2021 followed by October, November and May 2022, while the low in July 2021 followed by June, January, February 2022 and December 2021. The number egg spiral/leaflet gradually decrease from December 2021 to February 2022. Similar trends were also

observed in case of nymph and adult per leaflet of coconut tree during July 2021 to June 2022. The incidence of whiteflies gradually increased with increasing temperature and time, but decreasing with increasing of rainfall during June, July and August and cooler weather during December, January and February.

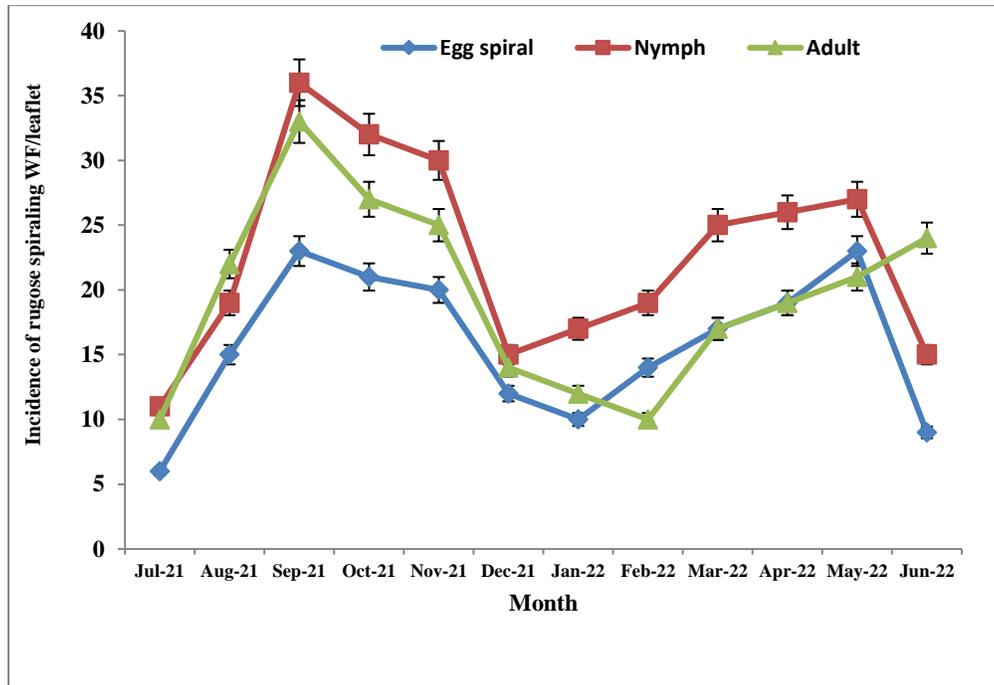


Figure 1. Incidence of rugose spiraling whiteflies (*Aleurodicus rugioperculatus*) per leaflet of Coconut tree during July 2021 to June 2022

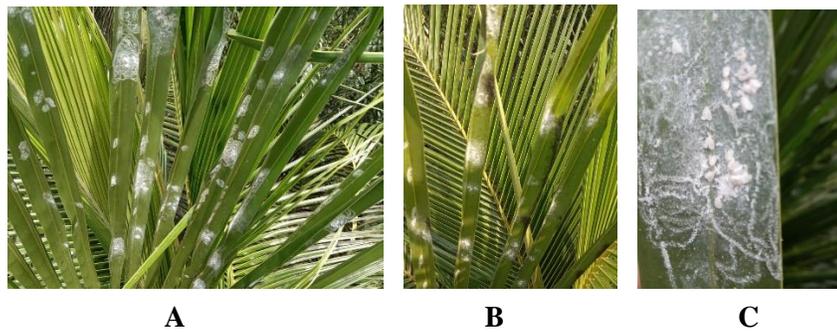


Plate 2. Photograph of incidence showing egg spirals (A), nymphs (B) and adult stage (C) of rugose spiraling whitefly

Damage severity of rugose spiraling whiteflies

Percentage of coconut tree infestation by rugose spiraling whitefly: The percentage of tree infestation by rugose spiraling whiteflies in 11 coastal districts of Bangladesh is presented in Fig. 2 and Plate 3 C, E. The percentage of tree infestation in different locations ranged from 68% to 97%. The highest percent (97%) of infested plants was recorded in Bagherhat district followed by Noakhali (96%), Khulna (94%), Bhola (93%) and Barguna (92%) while the lowest percent was recorded in Cox's Bazar (68%) followed by Jhalokathi (77%), Pirojpur (78%), Patuakhali (84%) Laxmipur (86%) and Barishal (89%).

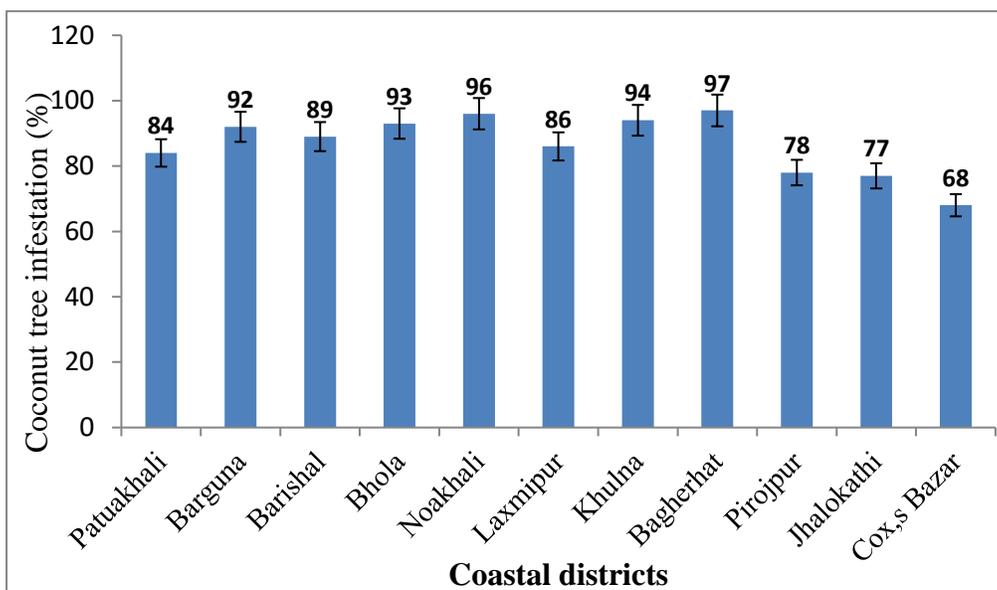


Figure 2. Mean percentage of plant infestation by rugose spiraling whitefly in seven coastal districts

Percentage of infested fronds per coconut tree

Fig. 3 showed the percentage of infested fronds per coconut tree by rugose spiraling whiteflies among 11 coastal districts. The highest percent (96.23%) infested fronds per tree was recorded in Bagherhat district followed by Noakhali (95.83%), Barguna (94.55%), Khulna (94.44%) and Bhola (94.30%) while the lowest percent was recorded in Cox's Bazar (67.23%) followed by Jhalokathi (75.45%), Barishal (85.50%), Pirojpur (86.12%), Patuakhali (88.81%) and Laxmipur (90.91%) (Plate 3, C-E).

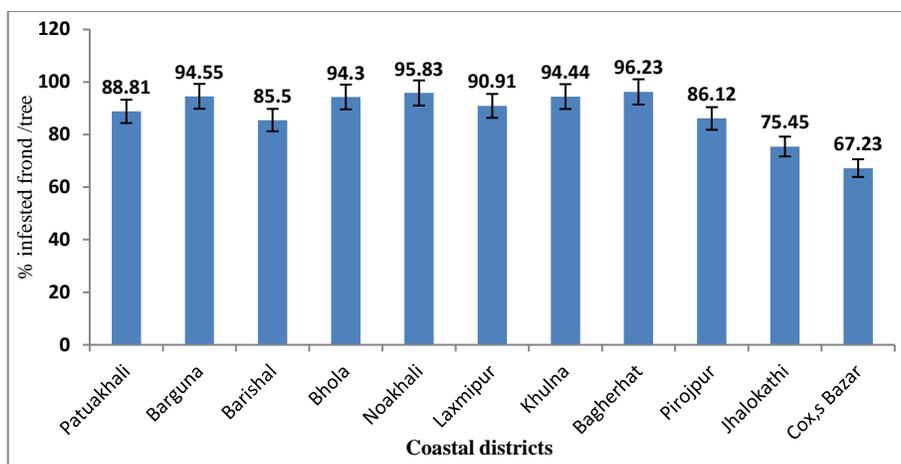


Figure 3. Mean percentage of infested fronds per coconut tree by rugose spiraling whitefly in seven coastal districts

Percentage of leaflet area covered by rugose spiraling whitefly colonies: The most noticeable symptoms of an infestation of the rugose spiraling whitefly is the abundance of the white, waxy materials and also excessive sooty mould covering the leaves or leaflet. The highest percent (84%) leaflet area covered by this insect was recorded in Bagherhat district followed by Khulna (78%), Noakhali (75%), Bhola (72%) and Barguna (70%) while the lowest percent was recorded in Cox's Bazar (48%) followed by Jhalokathi (50%), Patuakhali (55%), Laxmipur (62%), Pirojpur (65%) and Barishal (67%) (Fig. 4 and Plate 3 A,B,C,D,E,F).

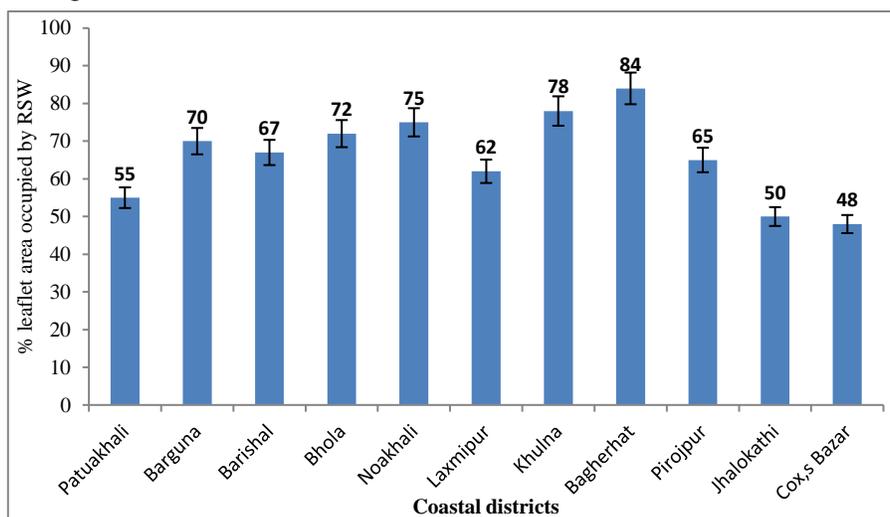


Figure 4. Percentage of leaflet area covered by rugose spiraling whitefly in seven coastal districts

**A****B****C****D****E****F**

Plate 3 (A-F): Damage symptoms on coconut plants caused by rugose spiraling whitefly

In present study, the percentage of tree infestation in different locations ranged from 84% to 97% which is supported by Kityo et al. (2017) who reported up to 100% coconut tree infestation in different districts of Mozambique. Elango et al. (2019)

studied the intensity of damage by *A. rugioeperculatus* on coconut in several districts of Tamil Nadu, India. The rugose spiraling whitefly incidence was high in Coimbatore (62.86%) district followed by Tiruppur (56.06%) and Erode (54.43%). Dutta et al. (2019) reported that the percent coconut tree infestation by RSW in different locations which ranged from 46.66-68.33%. The highest infestation (68.33%) was recorded from Magura Sadar (68.33%) followed by Jashore Sadar (63.33%), while the lowest was recorded in Isurdi, Pabna (46.66%). The severity of infestation ranged between 40-60% on coconut in India (Rao et al. 2018). Kumar et al. (2013) reported that this pest caused a great deal of concern in southern coastal counties in previous years. Rugose spiraling whitefly is a phloem feeder and excretes large quantities of honeydew, which covers anything under the infested plant. Thick layers of sooty mould rapidly develop which is unsightly, disrupts normal leaf physiology, and exacerbates the nuisance condition. The type and level of damage vary by plant species and plant condition, and although this whitefly does not kill large or healthy trees, smaller or unhealthy plants might succumb to very high infestation levels (Mayer et al., 2010; Ullah et al., 2021). Heavy infestation of rugose spiraling whitefly and secondary infection of sooty mould were observed in coconut trees as well as other horticultural crops and ornamental plants nearby coconut trees. Almost all the leaves of coconut, banana and other host plants nearby were brownish-black in appearance due to severe growth of sooty mould (Pathak, 2019).

CONCLUSION

A total of 22 host plants were infested by rugose spiraling whitefly in coastal districts of Bangladesh where coconut and banana were the most preferred hosts. The highest incidence was observed in September and lowest in July. The highest percentage of tree, fronds and leaflet area damage was recorded in Bagherhat and the lowest in Cox's Bazar.

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