Feeding behaviour of Apertochrysa astur on exotic rugose spiraling whitefly (RSW) under net-house conditions

P. Viswanadha Raghuteja *[1], N. B. V.Chalapathi Rao [2], E. Padma [3], A. Kireeti [4], N. Emmanuel [5] and K. Umakrishna [6]

[1, 3, 5& 6] Dr. YSR HU –College of Horticulture (COH), Venkataramannagudem, West Godavari district, Andhra Pradesh – 534 101. , [2&4] Dr. YSR HU - Horticultural Research Station (HRS), Ambajipeta, Dr. B. R. Ambedkar Konaseema district, Andhra Pradesh – 533214.

Introduction

Coconut palm, *Cocos nucifera L.*, commonly known as "Tree of Life" or "Kalpavriksha"grown in 2.19 million ha in India, with a production of 20,736.74 million nuts and a productivity of 9,430 nuts/ha (2020-21). An exotic and invasive RSW, *Aleurodicus rugioperculatus Martin*, has entered India and was first reported on coconut palm in August-September 2016 at Pollachi in Tamil Nadu and Palakad in Kerala (Sundararaj and Selvaraj, 2017 and Josephrajet al. 2017). Later in the year 2020, Chalapathi Rao *et al.* reported the initial occurrence of *A. rugioperculatusat* Kadiyapulanka nursery gardens of Andhra Pradesh during late December 2016. The nut dropping of *A. rugioperculatus* infested Godavari Ganga hybrid and East Coast Tall (ECT) variety coconut palms under high Infestation Grade Index (I.G.I) (> 20 spirals per leaflet) was reported to be 35.32 and 28.51 per cent at Dr. YSR HU - Horticultural Research Station (H.R.S), Ambajipeta for the first time by Raghuteja *et al.* 2023. However, natural enemies such asparasitoids and predators play amajor role in combating the population of invasive RSW pest infesting coconut based horticultural ecosystems.

Green lace wing, *Apertochrysa astur,* Banks (Neuroptera: Chrysopidae) is the most promising predator against RSW because of its cosmopolitan distribution, good searching ability and easy rearing in the laboratory (Chalapathi Rao et *al.* 2021). The chrysopids larvae predate on a broad range of pest species such as mealybugs, thrips, aphids, whiteflies, mites and eggs of insect pests while adults are free-living and feed only on pollen, nectar and honeydew secretion. In A.P, natural establishment of *A. astur* was documented against RSW in coconut palms and the technology on its mass-multiplication was standardized at H.R.S, Ambajipeta, Dr. YSR HU, Andhra Pradesh. Henceforth, an effort was made to study the feeding behaviour of *A. astur* against RSW under net house conditions so as to standardize the release rate frequencies of *A. astur.*

Feeding behaviour of *A. astur* instars against RSW eggs on hourly day basis

The feeding behaviour of *A. astur* grubs in the first, second and third instars against RSW eggs was observed on an hourly basis from 6: 00 AM to 19: 00 PM. Predator grubs fed more eggs in the early morning (11 eggs) and late evening (10 eggs), compared to passive, static and very little feeding behaviour (0.2 - 0.3 eggs) during hot midday periods. The grubs were active throughout the morning sunrise hours in quest of food, such as RSW spirals. Consumption began

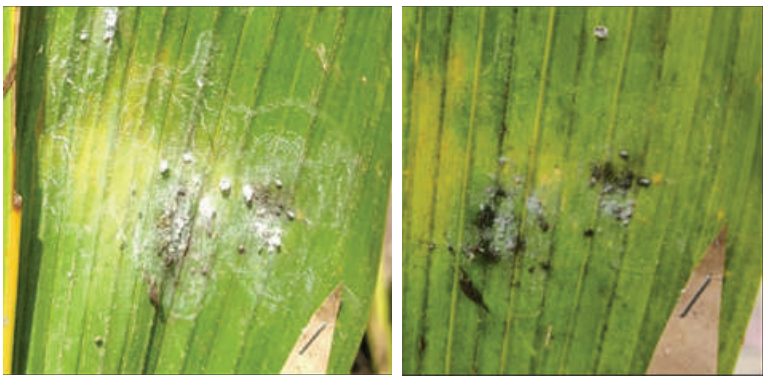

fig 1. RSW spiral on the same leaflet before and after feeding by A. astur grubs.

to decline progressively from 8:00 AM onwards, becoming very low throughout the afternoon hours and then gradually retaining from 16:00 PM onwards. *A. astur* grubs consumed 71 eggs throughout the course of 13 hours, with an average consumption of 5.46 eggs per hour. The number of RSW eggs were reduced from 440 to 369 eggs after the predator consumed 71 eggs during the day and a leftover of 302 eggs was recorded on the next morning, implying that the grubs consumed a total of 67 eggs during the night (19:00 PM to 6:00 AM) time (Table 1 and Figure 1).

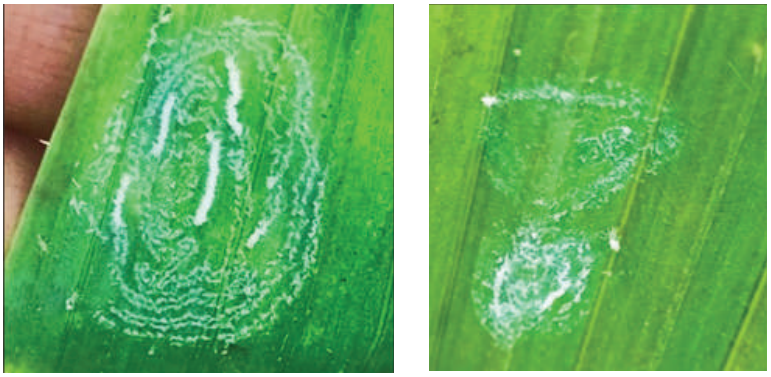

Fig 2. Feeding of RSW eggs by 1st instar A. asturgrubs

Preference of feeding by *A. astur* grubs and migration

The fresh instars of *A. astur* prefer RSW eggs, whereas the 2nd instars prefer nymphs, 3rd instars prefer both eggs and nymphs. The late *A. astur* instars were highly voracious and consumed more RSW eggs due to small prey size coupled with static behaviour. Foraging behaviour of many predators depends on the body size of the predator as well as that of the prey.

The movement of *A.astur grubs* from one seedling to another was also observed on soil after completing consumption of RSW spirals in a plant, whereas in case of adults being winged forms flying behaviour was observed during their movement from one plant to another.

Time Period for the predation on RSW spirals

It took a time period of 7-10 days for *A. astur* grubs to completely devour the *A. rugioperculatus* spirals (eggs, nymphs, pupae and adult) in low incidence coconut seedlings, whereas 15-20 and 25-30 days to fully consume medium and high RSW incidence seedlings. The extension of *A.astur* grub period was

Indian Standard Time (IST)	First Instar (1st)	Second Instar (2nd)	Third Instar (3rd)	Total Number of eggs fed (N)
6:00–7:00 AM	4.0	2.0	5.0	11.0
7:00–8:00 AM	3.0	2.5	4.0	9.5
8:00–9:00 AM	2.5	2.0	4.0	8.5
9:00–10:00 AM	2.5	1.5	3.0	7.0
10:00–11:00 AM	2.0	1.0	2.5	5.5
11:00–12:00 PM	1.0	0.5	2.0	3.5
12:00–13:00 PM	0.5	0.0	1.0	1.5
13:00–14:00 PM	0.2	0.0	0.0	0.2
14:00–15:00 PM	0.1	0.0	0.2	0.3
15:00–16:00 PM	0.5	0.0	1.5	2.0
16:00-17:00 PM	1.0	0.5	2.5	4.0
17:00-18:00 PM	2.5	2.0	3.5	8.0
18:00-19:00 PM	3.0	2.5	4.5	10.0
Total number of eggs consumed during day time				**71.0**

Table 1. Number of *A. rugioperculatus* eggs fed by different instars of *A. astur* predator at different time intervals


Fig 3. Devouring of RSW colony by 2nd instar *A. astur* grubs


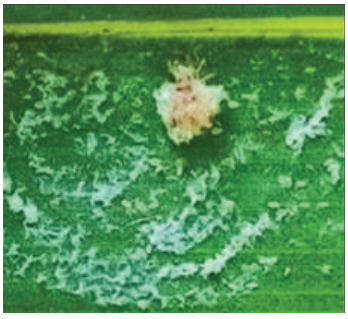

Fig 4. Feeding of bondar's nesting whitefly (BNW) eggs by *A. astur* grubs

observed in high and medium RSW incidence plants whereas; the period was short in low RSW incidence. It might be due to the more availability of food content in the form of number of RSW spirals (eggs, nymphs, pupae and adults) in medium and high incidence plants respectively. Henceforth, the grub period was prolonged in case of medium and high RSW incidence plants.

In addition to RSW, *A. astur* grubs also consumed the eggs of neo-tropical invasive Bondar's Nesting Whitefly (BNW), *Paraleyrodes bondari.* The feeding of *A. astur* was identified against RSW, *A. rugioperculatus* and BNW, *P. bondari* life stages. Unlike *A. rugioperculatus*, nonatural parasitisation by *Encarsia guade loupae Viggiani* (Hymenoptera: Aphelinidae) was reported on *P. bondari* till to date. No specific predators for this species recorded in the literature yet. Henceforth, *A. astur* acts as dual purpose for successful classical biological control of both *A. rugioperculatus* and BNW, *P. bondari* infesting coconut based horticultural ecosystems.

Acknowledgements

The author is thankful to the staff of Dr. YSR HU-Horticultural Research Station (HRS), Ambajipeta.


Fig 5. Migration of *A. astur* grubs through soil

References:

Bhagavan, B. V. K., Kireeti, A. and Chalapathi, N. B. V. R., (2021) Promising new hybrids for improving productivity of coconut. Indian Coconut Journal, 64 (6): 19-22.

Chalapathi, N. B. V. R., Ramani, B. S. L., Rakshith, R. D. and Bhagavan, B. V. K., (2020) Biocontrol management options for invasive white flies on Coconut. Indian Coconut Journal, 63 (4): 19-24.

Chalapathi, N. B. V. R., Ramani, B. S. L., Rakshith, R. D. and Bhagavan, B. V. K., (2021) Diet standardization for *Pseudomallada astur Banks* (Neuroptera: Chrysopidae) and assessment of its predatory potential against the rugose spiraling whitefly *Aleurodicus rugioperculatus Martin* (Hemiptera:Aleyrodidae). International journal of tropical insect sciences https://doi.org/10.1007/s42690-021-00601-9.

Josephraj, K. A., Chandrika, M., Poorani, J., Merin, B., Daliyamol, V., Krishna, K., Vinayaka, H. and Chowdappa, P., (2017) Discovery of a sooty mold scavenging beetle, *Leiochrinus nilgirianus Kaszab* (Coleoptera: Tenebrionidae) on coconut palms infested by the invasive rugose spiralling whitefly, *Aleurodicus rugioperculatus Martin* (Hemiptera: Aleyrodidae). Phytoparasitica, 46: 57-61.

Raghuteja, P. V., Chalapathi, N. B. V. R., Padma, E. and Kireeti, A., (2023) Immature nut fall of coconut and incidence of Rugose Spiraling Whitefly, *Aleurodicus rugioperculatus Martin*. Indian Journal of Entomology Ref. No. e23993.1-4. DoI. No.: 10.55446/IJE.2023.993.

Sundararaj, R. and Selvaraj, K., (2017) Invasion of rugoses piralling whitefly, *Aleurodicus rugioperculatus Martin* (Hemiptera: Aleyrodidae): a potential threat to coconut in India. Phytoparasitica DOI: 10.1007/s12600-017-0567-0.